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ASSESSMENT OF NURSES' KNOWLEDGE AND PRACTICE REGARDING PREVENTION OF SURGICAL SITE INFECTION AT OROTTA AND HALIBET NATIONAL REFERRAL HOSPITALS

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ABSTRACT

Introduction: Surgical site infection (SSI) is a common health care associated infection that significantly impacts patient safety and financial losses for health system. Patient safety is an important concern for all health care professionals, specifically for nurses. They provide health care services 24 hours a day to their clients in the hospitals and other health care settings. Nurses are considered as the “heart and soul” of every hospital. Nurses' knowledge and practices play a significant role to control of infections which ultimately enhances quality care of patients. **Objective:** The objective of the study is to assess the knowledge and practice of nurses on the prevention of surgical site infection. **Method:** Cross sectional analytical study design was used to conduct the knowledge and practice of nurses regarding prevention of surgical site infection at the two National Referral Hospitals (Orotta and Halibet) in Asmara, Eritrea. Quantitative study approach was employed to assess the knowledge and practice of the nurses. All staff nurses (n=142) who work in surgical wards were included in the study. A structured pre-developed tool was adopted to conduct the study. Data was analyzed with Statistical Package for Social Science (SPSS, Version 25) using ANOVA and t-Test. **Result:** The result revealed that the overall knowledge on prevention of SSI were high, moderate, low and very low in 5.63%, 14.79%, 42.96% and 36.62% of the nurses, respectively. The average knowledge on prevention of SSI was 15.08 out of 25. Nurses were found to have significantly higher knowledge on prevention of SSI at pre-operative stage (M=63.30%, SD=14.81) as compared to the post-operative (Mean=51.85%, SD=17.81). The majority (40.85%) of the nurses had high practice and 7.75% had very high practice. The average practice score was 76.72% out of 100%. Practice score of the nurses was significantly higher for the items assessing post-operative (Mean=84.44, SD=10.99) as compared to pre-operative period (Mean=69.41, SD=15.47). Knowledge score was not significantly different across the categories of demographic characteristics, however, practice score was different across the categories of years of experience (p=0.026). Moreover, practice score was significantly related with knowledge score (r=0.201, p=0.016). **Conclusion:-**Nursing practice related to prevention of SSIs is not satisfactory. Therefore, efforts to transform nurses' knowledge into practice is an important concern for educational and awareness programs to improve knowledge and practice changes in regard to prevention of SSI are also needed.

KEYWORDS

Knowledge, Practice, Nurse and Surgical site infection.

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INTRODUCTION

Surgical site infection (SSI) is a common health care associated infection that significantly impacts patient safety and financial losses for health system¹. Patient safety is an important concern for all health care

professionals, specifically for nurses². They provide health care services 24 hours a day to their clients in the hospitals and other health care settings. Nurses are considered as the “heart and soul” of every hospital. Nurses’ knowledge and practices play a significant role to control infections which ultimately enhances quality care of patients³. An American journalist and nursing advocate, Suzanne Gordon says that; by using extensive knowledge, nurses work as a rescuer who secures patients from the risks and consequence of disease, disability as well as from the risks and consequences of the treatment of diseases. Consequently, they make a real difference in outcomes⁴. Nurses have a distinctive chance to lessen the probability of hospital-acquired infections. They can assist patients in their recovery and reduce the complications associated with infections by the utilization of adequate knowledge and practices⁵.

One of the most common types of Healthcare Associated infection is Surgical Site Infection (SSI) which is accountable 20% to 25% of all Healthcare Associated infections. It is an infection which occurs after a surgical procedure that happens within 30 days after the operation or up to one year in those surgical patients in which an implant has been placed in an organ⁶. It leads to morbidity, extended hospital stay and increased financial expenditure⁷. This places a major economic burden on the healthcare system². Its prevention is known as a key component of care quality and patient safety⁸.

Nurses are the ones who provide constant care of in-patients and thus, they can be the most reliable persons to spread their knowledge and practices for the health and wellbeing of the people, human kind or nation. From the beginning, nursing is a profession which has been working to promote people’s health, relieve their pain and misery, advocate for the weak and the susceptible and educate the people to attain a better quality of life⁹.

Florence Nightingale was the first infection control nurse. She established the relationship between nursing and infection control in 1854 in the period of the Crimean war where she provided her services to the victims of the war in a military hospital of Scutari. The hospital’s condition was very poor, where she claimed that if we will improve the

hygienic conditions of the hospital we can reduce the number of deaths¹⁰. Healthcare associated infections are major healthcare problems for the people worldwide. Millions of people are affected by them each year¹¹.

Frequency of surgical site infection is high in developing countries than developed countries. In developing countries, the risk of infection is 2 to 20 times higher¹². Incidence rate of surgical site infection in Pakistan is documented as high which is 38.1%¹³.

A quantitative descriptive cross sectional study was done in Asmara on 60 nurses working in HNRH selected with total enumerative technique to assess the level of knowledge and practice on prevention of SSI. The result of their level of knowledge 36(60%) had good knowledge and the rest 24(40%) had moderate knowledge. Regarding to practice there were 10 nurses who had never been practiced in postoperative wound care so out of the 50, 48(96%) found to have good practice and the rest 2(4%) have moderate knowledge¹⁴.

Surgical site infection incidence rate is high in developing countries like Eritrea. There are not many studies documented that these infections can be caused by health care workers. The majority of healthcare professionals are nurses; they have a greater risk for both self-acquiring and transmitting infections to others. Breakdown in the knowledge and low standard practice of nurses can cause the transmission of infection especially among open wound/site surgeries. Therefore, this study tried to assess the knowledge and practice level of nurses related to surgical site infection prevention to promote patient’s safety as well as to increase the quality of patient care.

METHODS

Study design and period

A Cross sectional analytical study design was used to conduct the knowledge and practice of nurses regarding prevention of surgical site infection at the two National Referral Hospitals (Orotta and Halibet) in Asmara, Eritrea. Quantitative study approach was employed to assess the knowledge and practice of

the nurses on prevention of SSI. The study was conducted from February 2022 to April 2022.

Study setting

Hospital based study was conducted in the capital city of Eritrea, Asmara. Asmara is located in the latitude and longitude 15°20', 38°56'E respectively, and sits at an elevation of 2325meters (7628ft) above sea level. Its total population in 2018 was estimated to be 896,000. It has two main national referral surgical hospitals. The two hospitals are Orotta and Halibet National Referral Hospitals. ONRH has 110 beds in surgical wards while, Halibet referral hospital has the total number of 86 beds was selected from these surgical wards.

Study population

All staff nurses who work in surgical wards were constitute the target population for the study with a total number of 142. The surgical wards in Orotta are generally classified as Surgical Ward A and Surgical Ward B. Moreover, there occurs a gynecological, maternity postoperative ward and ENT surgical ward. On the other hand, nurses in surgical wards of Halibet included from orthopedic surgical ward, general surgery ward and burn surgery. All volunteer staff nurses currently working at the surgical wards of the two referral hospitals was included in the study. The distribution of the nurses by hospital and category of surgical wards is displayed in Table No.2.

Sample size and Sampling technique

Complete enumeration of the nurses at the two referral hospitals was performed. Hence, sample size computation and sampling technique had no relevance in this study.

Data collection tool

A structured pre-developed tool was adopted to conduct the study. The questionnaire/tool was adopted in a way to fit the setting of the country and hospitals. The questionnaire was developed by Sickder, *et al*, (2014)³. The tool was mainly included,

Demographic characteristics: age, gender, marital status, Educational level, Total year of experience, Experience in surgical ward and ever been training.

Knowledge assessing items: 25 multiple choice questions

According to (McDonald 2002) scores into five levels (refer to Table No.3)

Practice assessing items: 25 questions responded in five point Likert Scale (Refer to Table No.3).

Variables

Dependent variable: Knowledge and practice of nurses regarding prevention of SSI was the outcome variable.

The independent variables include: Patients socio demographic characteristics (age, gender, Total Year of experience, marital status, Educational level, Experience in surgical ward and Ever been trained).

Data Analysis Procedure

Data was entered directly to Statistical Package for Social Science (SPSS, Version 25). Then cleaning of the data was undergone before the preliminary analysis. Preliminary analysis on normality of the knowledge and practice was performed. Summary of the variables had been done using mean (SD), median (IQR) for continuous variables and frequency (percentage) for categorical variables. Parametric tests (t-test, ANOVA, LSD post hoc and Error bar plot) were used. Tables and graphs were used to present the results. P-values less than 0.005 have been considered as significant throughout the analysis.

Pre Test

The pilot study was done in Berhan Ayni National Referral Hospital in Asmara. This study was aimed at assessing the feasibility of the study, validity, sensitivity and understandability of the data collection instrument. The sample for pilot study was 14 nurses.

VALIDITY

The validity of the tool is already done by the primary author and accepted as an international tool.

Reliability

In order to assess the internal consistency of the questionnaire regarding the knowledge and practice Cronbach's alpha value was computed. The results showed acceptable internal consistency estimates by revealing the Cronbach's alpha for practice and knowledge as 0.756 and 0.723 respectively.

Ethical Consideration

Permission for the study has been taken from the Research and Ethics Committee of Orotta College of Medicine and Health Sciences and subsequently by the Committee in Ministry of Health. Then, approval from the head of departments of the surgical wards had been sought. Staff members were asked to participate voluntarily through written formal consent. All nurses were informed that they have the right to leave, if inconveniences exist. Furthermore, there was a confirmation on confidentiality of the collected data.

RESULTS AND DISCUSSION

Demographic characteristics

The average age of the participants was 30.86 years (SD=9.37) and majority (42.3%) of them were in the age group 26 to 35 followed by 20 to 25(36.6%). Two third (66.2%) of them were females and more than half (55.6%) were single with regards to marital status. Around half (51.4%) of the participants were health assistants with 1 to 5 years of experience (47.9%). The average life time years of experience and in surgical ward were 6.00 (IQR=9) and 3.00 (IQR=3.75) years respectively. Almost half (47.9%) of the health workers had 1 to 5 years of experience in surgical ward. More than sixty percent (62.7%) of the health workers also took training before. The percentage distribution of the socio-demographic characteristics of the study subjects is displayed in Table No.4.

Knowledge regarding prevention of SSI

Knowledge regarding prevention of SSI was assessed using relevant questions at pre-operative and post-operative stages. At pre-operative stage, four components namely, hygiene and skin preparation, controlling underlying medical condition, maintaining nutritional status, prophylactic antibiotics were used to assess their knowledge.

In order to have a preliminary categorical classification of the knowledge on prevention of SSI, categories were made as per the McDonald's guide. The result revealed that majority had very low (36.62%) and low (42.96%) levels of knowledge. The percentage of nurses with moderate and high

level of knowledge was 14.79% and 5.63% respectively.

Pre-operative knowledge on prevention of SSI

The majority of the nurses had correct knowledge on purpose for pre-operative skin preparation (88.73%), purpose for surgical hand washing (85.925), best skin agent for pre-operative showering to prevent SSI (80.99%), best agent for pre-operative skin preparation (71.83%). On the other hand, less than a quarter of the nurses knew the best method of pre-operative shaving (23.24%), and best time for pre-operative hair removal (19.01%).

Regarding the controlling underlying medical condition component, almost two third (64.79%) of the nurses correctly answered the right level of blood sugar which enhances WBC to prevent SSI.

On maintaining nutritional status, most of the nurses had a correct knowledge on purpose of maintenance of normal nutritional status for surgical patients (80.28%), assessment of patient's nutritional status laboratories (74.65%) and regarding surgical patients with compromised immune system (74.65%). However poor knowledge was observed among the nurses on prevention of infection of patient with immune deficiency disorder (34.51%).

More than eighty percent (83.10%) of the nurses had a correct knowledge on prophylaxis antibiotic. More than half (58.45%) had a correct knowledge on time of administration for prophylaxis antibiotic to surgical patients.

Post-operative Knowledge on Prevention of SSI

Post-operative knowledge on prevention of SSI was assessed using another three components, namely, surgical wound care with aseptic precaution, wound assessment and monitoring of SSI, and nutritional support.

The results regarding surgical wound care with aseptic precaution showed most of the nurses had a correct knowledge on best agent for pre-operative skin preparation (71.83%), benefit of wound dressing (71.13%), and selection of dressing solution (62.68%). However, very few (16.20%) of them had a correct knowledge on time of change for surgical wound dressing.

Regarding wound assessment and monitoring of SSI, almost two third (65.49%) of the nurses had a correct

knowledge on sign of SSI, however, less than half of them had a correct knowledge on laboratory used to ensure SSI (43.66%) and diagnosis of SSI (28.17%).

Nutritional support at post-operative stage, assessed by the kind of diet provided for post-operative patients was known by more than three fourth (79.58%) of the nurses.

Comparison of Knowledge score at the pre-operative and post-operative time periods

The results from the paired t-test revealed that, there is significantly greater knowledge ($p < 0.001$) score of the nurses on the questions that assess their knowledge at pre-operative time period (Mean=63.30, SD=14.81) as compared to that of the post-operative period (Mean=51.85, SD=17.80). The mean difference (95% CI) obtained was 11.45 (95% CI: 8.02, 14.88).

Demographic factors affecting knowledge on prevention of SSI

The knowledge was computed from the 25 items that assessed the nurses' knowledge on prevention of SSI. The average knowledge score was found to be 15.08 out of 25 (SD=3.10) with a maximum and minimum values of 8 and 22 respectively.

The knowledge score computed was assessed on whether difference existed across the categories of demographic variables. The result revealed that categories of age ($p=0.370$), sex ($p=0.139$), marital status ($p=0.431$), educational level ($p=0.219$), total years of experience ($p=0.811$), experience in surgical ward ($p=0.766$), and ever been given training ($p=0.678$) did not have significant difference in knowledge score. Hence, the knowledge score does not depend on either of the background characteristics. The summary results of the t-test and ANOVA are shown in Table No.7.

Self-reported practice regarding prevention of SSI

Similar to the knowledge, self-reported practice on prevention of SSI was assessed using four components at pre-operative stage and another three components at post-operative stage.

Similar classification with that of knowledge was made on the practice on prevention of SSI as per the McDonald's guide. The result revealed that less than

twenty percent of the nurses had very low (9.15%) and low (13.38%) level of practice. Around a quarter (28.87%) had moderate level of practice. However, the majority were found to have high practice (40.85%) and very high practice (7.75%).

Pre-operative practice on prevention of SSI

On hygiene and skin preparation component, the majority of the nurses reported that they *often/always* use alcohol and chlorhexidine gluconate as common antimicrobial in the ward (88.0%), advice immunodeficiency disorder patient to maintain personal hygiene (78.2%). Almost a quarter (26.1%) of the nurses reported that they *never* perform pre-operative shaving right before surgery.

Regarding controlling underlying medical condition, more than three fourth of the nurses reported that they *often/always* perform prescribed glucose test before and after surgery in a diabetic patient (79.6%), they administer injection insulin or give oral medication as ordered in diabetic patient (78.7%). On the other hand, almost a quarter (26.1%) reported that they *never* assess their patient BMI before and after surgery.

On maintaining nutritional status, more than seventy percent of the nurses reported that they *often/always* advise malnourished patient to take vegetables and fruits before and after surgery (71.8%) and they also advise obese patients to intake less carbohydrate (73.9%).

Regarding prophylactic antibiotics, 55.6% and 20.4% of the nurses reported that they administer pre-operative prophylactic antibiotic within one hour before surgery, *often/always* and *never*, respectively.

Post-operative practice on prevention of SSI

Regarding the practice on surgical wound care with aseptic precaution, the majority of the nurses reported that they *often/always* use sterilized dressing materials for cleansing surgical wound dressing (96.5%), they use povidone-iodine and normal saline for cleansing surgical wound dressing (94.4%) and they discard the soiled material in the proper place after performing wound dressing (93.7%). On the other hand, only 9.9% reported that they *never* use face mask during cleansing surgical sound dressing.

On wound assessment and monitoring of SSI, most of the nurses reported that they often/always assess and monitor surgical site infection (87.3%), they separate infected from non-infected cases during dressing (83.8%), and use an aseptic technique during obtaining swab culture (73.9%).

More than three fourth (76.1%) of the nurses reported that they often/always advise a malnourished patient to intake nutritious diet.

Comparison of practice score at the pre-operative and post-operative time periods

The results from the paired t-test revealed that, there is significantly greater practice ($p < 0.001$) score of the nurses on the questions that assess their practice at post-operative time period (Mean=84.44, SD=10.99) as compared to that of the pre-operative period (Mean=69.41, SD=15.47). The mean difference (95% CI) obtained was 15.03 (95% CI: 12.55, 17.52).

Factors affecting Practice on prevention of SSI – Demographic and knowledge on prevention of SSI

The practice on prevention of SSI score was computed from the 25 relevant questions. The average practice score was found to be 76.72 out of 100 (SD=11.28) with a minimum and maximum values of 37 and 100 respectively.

Assessment of the potential difference in the self-reported practice across the categories of background characteristics was performed using t-test and ANOVA. The result revealed that categories of age ($p = 0.858$), sex ($p = 0.578$), marital status ($p = 0.718$), educational level ($p = 0.484$), experience in surgical ward ($p = 0.882$), and ever been given training ($p = 0.461$) did not have significant difference in practice score. However, total years of experience ($p = 0.026$) had significant association. The summarized results are shown in Table No.10.

Further comparison of the categories of total years of experience was performed using Least Significant Difference (LSD) post hoc method. The result is shown in Table No.5.

The result revealed that participants having 6 to 10 years of total experience have significantly higher (MD=6.61, 95% CI: 1.75, 11.46) practice score as compared to those who have 1 to 5 years of

experience. Similarly, those with 6 to 10 years of experience have significantly higher (MD=5.66, 95% CI: 0.40, 10.91) practice score compared to those having 11 or above years of experience.

In addition, practice on prevention of SSI was positively significantly associated with knowledge on prevention of SSI (Spearman's $r = 0.210$, $p = 0.016$).

DISCUSSION

Knowledge of nurses on prevention of SSI

This study revealed, the nurses had a poor knowledge on pre and post-operative period was (60.32%). Similar study conducted in Bangladesh revealed that 69.6% had poor knowledge on prevention of SSI³. The reason for the poor knowledge in this current study could be related to low educational level. The second factor which may cause the low level of nurse knowledge regarding SSI was job experience, majority of nurse has less than three years which can affect nurses knowledge. Third factor might be due to lack of special courses regarding basic guidelines for preventing SSI and misconception stemming from the improper assessment of nurses educational and learning needs.

Comparison of Preoperative and postoperative Knowledge of nurse on prevention of SSI

The knowledge of the nurses on the prevention of SSI infection through preoperative care was found to be 63.3%. This is in line with Famakiwa in Nigeria in which they found out that such a knowledge was 66%¹⁵, in contrast to Teshager in Ethiopia described the knowledge to be 40.7%¹¹. While in the postoperative period the nurses had poor knowledge (51.85%), this is congruent with study conducted by Famakinwa (2014) in Nigeria, Teshager (2015) in Ethiopia. But in the current study it was significantly different. The differences in the knowledge score between the preoperative and postoperative periods could be associated to the level of the questions which indicate the indication on the prevention of SSI during these periods.

Demographic factors affecting knowledge on prevention of SSI

The demographic factors of the nurses were compared with their level of knowledge. However,

no significant difference was observed with these entire factors except in the work experience. Those who worked for six up to ten years were having a significantly higher level of knowledge as compared to their counterparts in line with a study conducted by Fatimah *et al*, (2020) in Malaysia¹.

Self-reported practice regarding prevention of SSI

In this study the practice score was (76.72). This study revealed that overall practice of staff nurses regarding preventing and managing of surgical site infection was at good level. The reason for this result might be because of the method selected for the data gathering was not observational. The second factor might be the procedures done in the wards are routine activities based upon ward practice and not necessarily on their knowledge. The finding on this study was similar with studies by Oluwakeami *et al*, 2017 and by Joshi in Japan 2014^{16,17}. Lower scores were observed in the study conducted in Amhara region Ethiopia by Frehiwot *et al*, 2015 (48.7%)¹⁸.

Comparison of Practice score at the Preoperative and postoperative time period

The practice of this study was compared during the pre and postoperative time period. The study revealed that about preoperative was (69.4%) were poor. The reason might be nurses in preoperative had lack of proper guidelines and give less credit for the policy of the hospital. Negligence of the nurses on the following precautions “Hygiene and skin preparation, controlling under line medical conditions, maintain nutritional support and Administration of prophylactic antibiotic” Even though these procedures are simple the nurse might not apply it.

Regarding to postoperative time period the nurses had got good results (84.44%) in contrast with the study done by Oluwakemi *et al*¹⁶ which were poor. In Postoperative practices the nurses may have good experience in the routine activities done in the surgical ward. Secondly, due to the collaboration of physicians who participate in the work area. The third factor could be observational evaluation of wound assessment and monitoring (they can easily identify infected from no infected clinically), surgical wound care with aseptic precautions (they

know how to apply sterile techniques) and nutritional status (they have good knowledge about the effect of nutrition on wound healing). In line with the study done by Fatimah *et al* (2020) in Malaysia found that good practice result in postoperative¹.

Factors affecting Practice on prevention of SSI- Demographic and knowledge on prevention

Out of the many factors that might potentially affect the practice on prevention of SSI, only years of experience was found to be significantly related. The findings revealed that participants having 6 to 10 years of total experience having significantly higher practice score compared to those who had 1 to 5 year of experience. Similarly, those with 6 to 10 years of experience have significantly higher practice score to those having 11 or above years of experience. The first reason could be; those who have 1 to 5 years of experience have lack of skills in manipulating sterile technique. Another reason could be; due to short period of time in surgical ward. On the other hand, those who have 6 to 10 years of experience might be involved in surgical ward for long period of time and get enough exposure to the routine activities in the ward. Besides, those who have 11 or above year of experience they might be inattention, influenced by the social life and age factor as a result of this factors they can decline in their work motivation.

In addition, practice on prevention of SSI was positively significantly associated with knowledge on prevention of SSI. This result is mostly due to the inherent nature of the knowledge and practice in which with increase in knowledge, practice also increases. However, other contrary results were observed in studies conducted in Pakistan in which knowledge was negatively correlated with practice score¹⁹.

Table No.1: Frequency distribution of the Number of beds at the referral hospitals by surgical wards

S.No	Hospital	Surgical Ward	Number of Beds
1	Halibet	OPW	40
		GSW	30
		BW	16
2	Orotta	SWA	35
		SWB	24
		GYW	16
		ENT	20
		MPOW	15
3	Total	-	196

Table No.2: Frequency distribution of the nurses/staff at the referral hospitals by surgical wards

S.No	Hospital	Surgical Ward	Number of staff nurses
1	Halibet	OPW	30
		GSW	21
2	Orotta	BW	20
		SWA	14
		SWB	15
		GYW	22
		ENT	10
		MPOW	10
		3	Total

Table No.3: Scores Level of Knowledge and Practice

S.No	Scores (%)	Level of knowledge/practice
1	<60.00	Very low
2	60.00-69.99	Low
3	70.00-79.99	moderate
4	80.00-89.99	High
5	90.00-100.00	very high

TableNo.4: Socio-demographic characteristics of the study participants (N=142)

S.No	Variable	Frequency	Percent
Age (Mean=30.86, SD=9.37, Min. 20 and Max.=61)			
1	20 to 25	52	36.6
2	26 to 35	60	42.3
3	36 or above	30	21.1
Sex			
4	Male	48	33.8
5	Female	94	66.2
Marital Status			
6	Single	79	55.6
7	Married	61	43
8	Widowed	2	1.4
9	Divorced	0	0
Educational level (n=141)			
10	Health Assistant nurse	73	51.4

11	Diploma in nursing	54	38
12	B.Sc in nursing	14	9.9
Total years of experience (Median=6.00, IQR=9, Min.=1 and Max.=35)			
13	1 to 5 years	68	47.9
14	6 to 10 years	29	20.4
15	11 or above	43	30.3
Experience in surgical ward (Median=3.00, IQR=3.75, Min.=0 and Max.=35)			
16	1 to 5 years	104	73.2
17	6 or above	35	24.6
Ever taken training			
18	Yes	89	62.7
19	No	53	37.3

Table No.5: Percentage distribution of nurses regarding their knowledge on pre-operative prevention of SSI questions (N=142)

S.No	Knowledge Questions	Frequency	Percent
Hygiene and Skin preparation			
1	Best method of preoperative shaving	33	23.24
2	Best time for pre-operative hair removal	27	19.01
3	Best agent for pre-operative skin preparation	102	71.83
4	Purpose for pre-operative skin preparation	126	88.73
5	Way of disinfecting surgical site before surgery	98	69.01
6	Purpose of pre-operative showering	101	71.13
7	Best skin agent for pre-operative showering to prevent SSI	115	80.99
8	Correct purpose for surgical hand washing	122	85.92
9	Correct steps of hand washing	74	52.11
Controlling underlying medical condition			
10	Correct level of blood sugar which enhances WBC to prevent SSI	92	64.79
Maintaining nutritional status			
11	Regarding malnourished surgical patients	87	61.27
12	Assessing patient's nutrition status laboratories	106	74.65
13	Purpose of maintenance of normal nutritional status for surgical patients	114	80.28
14	Regarding surgical patients with compromised immune system	106	74.65
15	Prevention of infection of patient with immune deficiency disorder	49	34.51
Prophylactic antibiotics			
16	Regarding prophylaxis antibiotic	118	83.10
17	Time of administration for prophylaxis antibiotic to surgical patients	83	58.45

Table No.6: Percentage distribution of nurses regarding their knowledge on post-operative prevention of SSI questions (N=142)

S.No	Knowledge Questions	Frequency	Percent
Surgical wound care with aseptic precaution			
1	Best agent for pre-operative skin preparation	102	71.83
2	Benefit of wound dressing	101	71.13
3	Time of change for surgical wound dressing	23	16.20
4	Selection of dressing solution	89	62.68
Wound Assessment and monitoring of SSI			
5	Regarding diagnosis of SSI	40	28.17
6	Regarding sign of SSI	93	65.49
7	Laboratory used to ensure SSI	62	43.66
Nutritional support			
8	Kind of diet provided for post-operative patients	113	79.58

Table No.7: Comparison of knowledge score across the categories of demographic variables (N=142)

S.No	Variable	Mean	SD	F/t-value	p-value
Age					
1	20 to 25	14.63	3.06	1.001	0.37
2	26 to 35	15.47	3.08		
3	36 or above	15.1	3.1		
Sex					
4	Male	15.63	3.05	1.49	0.139
5	Female	14.81	3.11		
Marital Status					
6	Single	14.96	3.04	-0.79	0.431
7	Married	15.38	3.13		
Educational level					
8	Health Assistant nurse	14.92	3.01	1.54	0.219
9	Diploma in nursing	14.89	3.18		
10	BSc in nursing	16.43	3.11		
Total years of experience					
11	1 to 5 years	14.9	2.97	0.21	0.811
12	6 to 10 years	15.34	3.81		
13	11 or above	15.05	2.81		
Experience in surgical ward					
14	1 to 5 years	15.07	3.23	0.3	0.766
15	6 or above	14.89	2.74		
Ever taken training					
16	Yes	15.17	3.13	0.42	0.678
17	No	14.94	3.09		

Table No.8: Percentage distribution of nurses on their pre-operative practice of prevention of SSI (N=142)

S.No	Practice Question	Never N (%)	Rarely/ sometimes N (%)	Often/ always N (%)
Hygiene and Skin preparation				
1	I perform pre-operative shaving right before surgery	37(26.1)	53(37.3)	52(36.6)
2	I advise my patient to take pre-operative showering 6-12 hours before surgery	18(12.7)	34(23.9)	90(63.4)
3	I advise my patient to take pre-operative showering with antimicrobial agent	31(21.8)	37(26.1)	74(52.1)
4	I learn shaving method from others and apply to pre-operative patients	19(13.4)	45(31.7)	78(54.9)
5	I advise immunodeficiency disorder patient to maintain personal hygiene	8(5.6)	23(16.2)	111(78.2)
6	Alcohol and chlorhexidinegluconate is most common antimicrobial used in my ward	1(0.7)	16(11.3)	125(88.0)
Controlling underlying medical condition				
7	I perform prescribed glucose test before and after surgery in a diabetic patient	3(2.1)	26(18.3)	113(79.6)
8	I administer injection insulin or give oral medication as ordered in diabetic patient	8(5.7)	22(15.6)	11(78.7)
9	I assess my patient BMI before and after surgery	37(26.1)	49(34.5)	56(39.4)
10	I advise a malnourished patient with compromised immune system avoiding contact people who have infection	17(12.0)	32(22.5)	93(65.5)
Maintaining nutritional status				
11	I advise a malnourished patient to take vegetables and fruits before and after surgery	10 (7.0)	30 (21.1)	102(71.8)
12	I advise obese patients to less intake of carbohydrate	7 (4.9)	30 (21.1)	105(73.9)
Prophylactic antibiotics				
13	I administer pre-operative prophylactic antibiotic within one hour before surgery	29 (20.4)	34 (23.9)	79(55.6)

Table No.9: Percentage distribution of nurses on their post-operative practice of prevention of SSI (N=142)

S.No	Practice Question	Never N (%)	Rarely/ sometimes N (%)	Often/ always N (%)
Surgical wound care with aseptic precaution				
1	I wash my hands before and after changing wound dressing and touching the surgical site	6(4.2)	28(19.7)	108(76.1)
2	I wash my hands before wearing sterile gloves	10(7.0)	37(26.1)	95(66.9)
3	I use sterilized dressing materials for cleansing surgical wound dressing	1(0.7)	4(2.8)	137(96.5)
4	I use povidone-iodine and normal saline for cleansing	0(0)	8(5.6)	134(94.4)

	surgical wound dressing			
5	I use an aseptic technique during surgical wound dressing	2(1.4)	18(12.7)	122(85.9)
6	I use face mask during cleansing surgical wound dressing	14(9.9)	28(19.7)	100(70.4)
7	I clean and disinfect the surface of the dressing trolley with antiseptic solution	3(2.1)	12(8.5)	127(89.4)
8	I discard the soiled material in the proper place after performing wound dressing	0(0)	9(6.3)	133(93.7)
Wound Assessment and monitoring of SSI				
9	I use an aseptic technique during obtaining swab culture	11 (7.7)	26 (18.3)	105(73.9)
10	I assess and monitor surgical site infection	3 (2.1)	15 (10.6)	124(87.3)
11	I separate infected from non-infected cases during dressing	4 (2.8)	19 (13.4)	119(83.8)
Nutritional support				
12	I advise a malnourished patient to intake nutritious diet	6(4.2)	28(19.7)	108(76.1)

Table No.10: Comparison of self-reported practice score across the categories of demographic variables (N=142)

S.No	Variable		Mean	SD	F/t-value	p-value
1	Age	20 to 25	76.19	10.41	0.15	0.858
		26 to 35	76.72	12.2		
		36 or above	77.63	11.11		
2	Sex	Male	77.46	11.83	0.56	0.578
		Female	76.34	11.03		
3	Marital Status	Single	77.01	10.59	0.36	0.718
		Married	76.31	12.34		
		Widowed	-	-		
4	Educational level	Health Assistant nurse	77.51	11.3	0.73	0.484
		Diploma in nursing	76.19	11.3		
		BSc in nursing	73.71	11.14		
5	Total years of experience	1 to 5 years	74.91	11.29	3.75	0.026
		6 to 10 years	81.52	10.51		
		11 or above	75.86	11.06		
6	Experience in surgical ward	1 to 5 years	76.67	11.52	0.15	0.882
		6 or above	76.34	10.85		
7	Ever taken training	Yes	77.26	10.54	0.74	0.461
		No	75.81	12.46		
8	-	-	-	Spearman's correlation		p-value
9	Knowledge	-	-	0.201		0.016

Table No.11: Pair-wise comparison of the categories of total years of experience using LSD post-hoc test (N=142)

S.No	Group 1	Group 2	MD (95% CI)	p-value
1	6 to 10 years	1 to 5 years	6.61(1.75, 11.46)	0.008
2	6 to 10 years	11 or above years	5.66(0.40, 10.91)	0.035

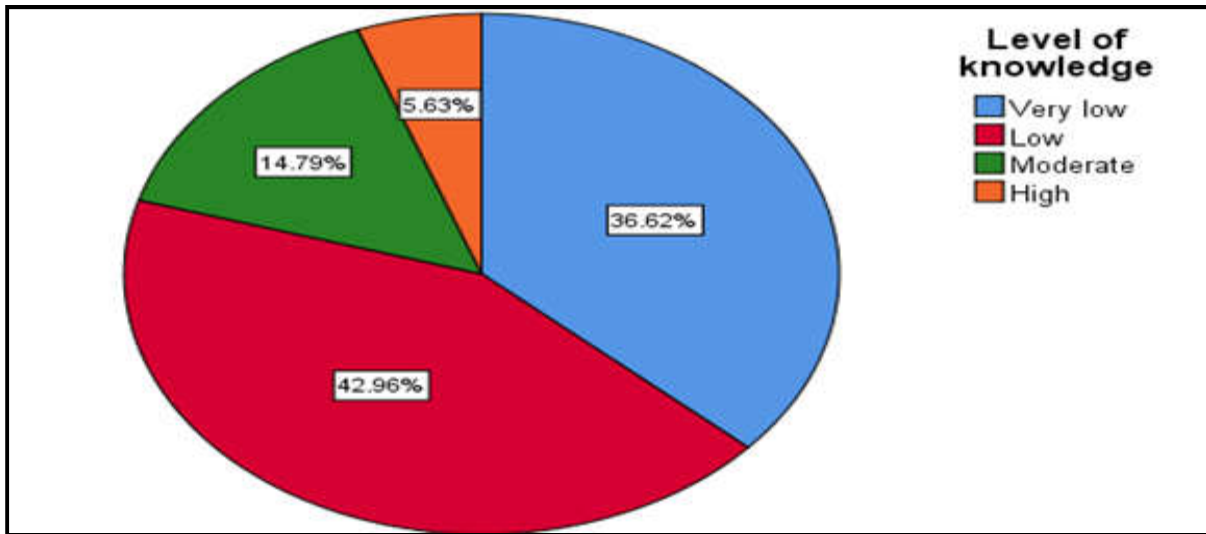


Figure No.1: Percentage distribution of nurses regarding the knowledge on prevention of SSI

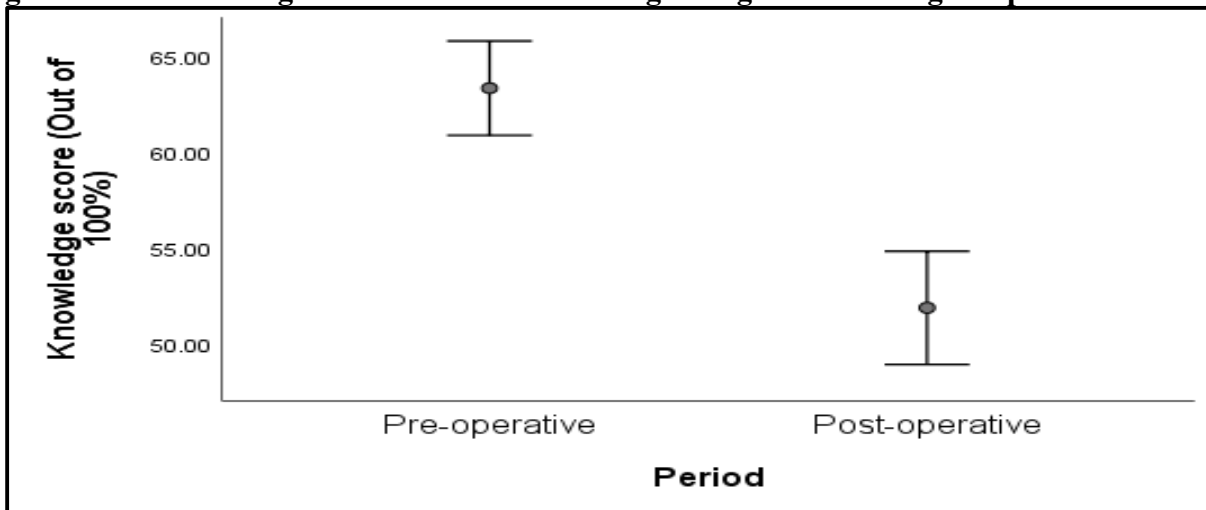


Figure No.2: Error bar plot comparing the knowledge scores at pre-operative and post-operative time periods (out of 100%)

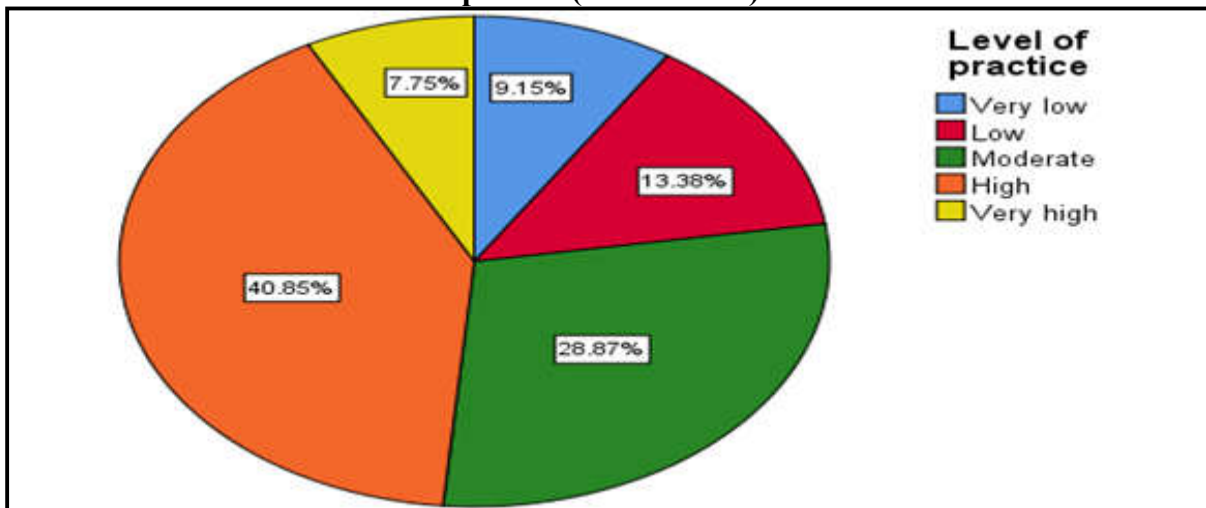


Figure No.3: Percentage distribution of the nurses regarding practice on prevention of SSI

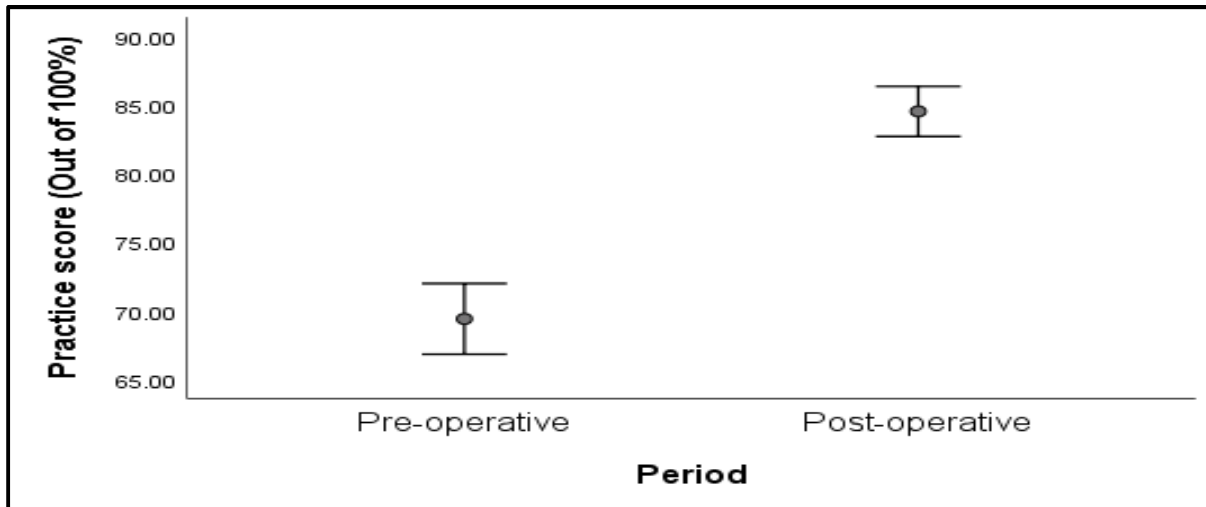


Figure No.4: Error bar plot comparing the practice scores at pre-operative and post-operative time periods (out of 100%)

CONCLUSION

The result showed that the nurse had low level of knowledge and good level of practice towards the prevention of SSI. The study concluded that the overall knowledge and practice of nurses has positive correlation. This indicates that poor knowledge linked with practice among the nurses in the study. Age, sex, marital status, educational level, work experience, total year in surgical ward and training given found out to be insignificant.

Nursing practice related to prevention of SSIs is not satisfactory. Therefore, efforts to transform nurses' knowledge into practice is an important concern for educational and awareness programs to improve knowledge and practice changes in regard to prevention of SSI are also needed.

RECOMMENDATION

The study recommends continuing in-service programs should be the successful strategies of infection control measures, particularly in reducing the rate of SSI, such as

1. Well-structured and continue educational programs,
2. Adequate supervision and support as well as regular supply of necessary consumables.
3. Supplies were considered essential elements to enhance the nurses competency regarding the prevention of SSI and might eliminate

knowledge deficit in order to improve quality of care and patient safety from suffering SSI.

4. Continuous in-service educational programs and regular monitoring should be implemented by the hospital organization to update the evidence based knowledge and practice of nurses.
5. This study is limited on the selected hospitals and the study could be enhanced by conducting in the other hospitals which provide surgical service.

LIMITATION

Using questionnaire to assess practice of nurses in the study may not accurately represent their actual perception on the prevention of SSI. Cause and effect relationship could not be established as the study was cross sectional.

IMPLICATION TO THE FIELD OF NURSING

The research findings will enable the organization to develop and organize training programs by identifying the gaps in knowledge and practices of nurses towards prevention of surgical site infection. Efficient knowledge and good practices by the nurses can facilitate patient care and may contribute to decrease the rate of infection in the hospitals. Moreover, the study results will help for the further research in nursing profession.

ABBREVIATIONS

ANOVA: Analysis of variety; BW: Burn Ward; CI: Confidence Interval; GSW: General Surgical Ward; GYW: Gynecological Ward; IQR: Inter Quartile Range; M: Mean; MD: Median; MPOW: Maternal Post- Operative Ward; OCMHS: Orotta College of Medicine and Health Sciences; r: regression; SD: Standard Deviation; SPSS: Statistical Package for the Social Sciences; SSI: Surgical Site Infection; SWA: Surgical Ward A; SWB: Surgical Ward B.

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CONFLICT OF INTEREST

None declared.

AUTHORS' CONTRIBUTIONS

All authors participated in all phases of the study including topic selection, design, data collection, data analysis and interpretation. Samuel, Anjana Kuriakose and Dr. Linto contributes to write this manuscript.

AVAILABILITY OF DATA AND MATERIALS

The complete data set supporting the conclusions of this article is available from the corresponding author and can be accessed up on reasonable request.

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