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Original Article

Surgical Site Infection Prevention Practices and Associated Factors among Nurses Working in Government Hospitals of Harari Regional State and Dire Dawa City Administration, Eastern Ethiopia

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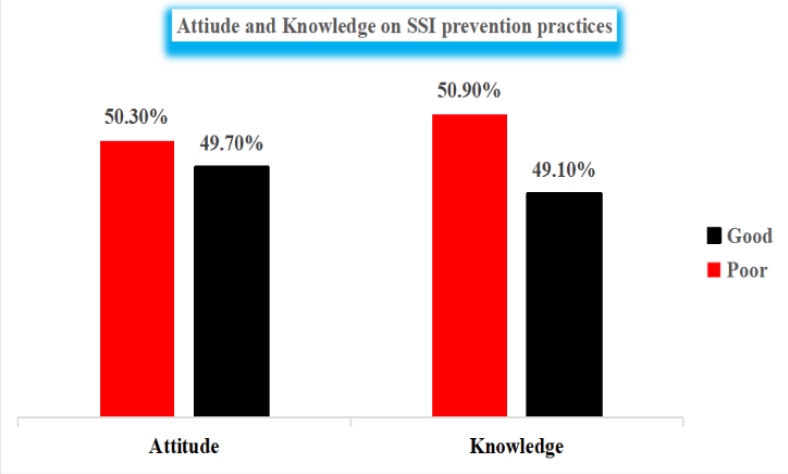
Highlights

This study assessed surgical site infection prevention practices and associated factors among nurses working in government hospitals of Harari Regional State and Dire Dawa City Administration, Eastern Ethiopia from March 01 to 28, 2019.

Editor's summary

Nurses play a major comprehensive role and spans the continuum of care in preventing Surgical site infections. nurses should adhere to evidence based practice towards SSI prevention but, according to literatures there is paucity of information regarding to nurses surgical site infections prevention practices.



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ABSTRACT

Background: Surgical site infections are the most frequent type of preventable hospital acquired infections with a serious and undesirable outcome of surgery associated with increase morbidity, mortality rate, hospital stay, readmission and excess cost. Surgical site infection prevention is one of the most important challenge in delivering optimal nursing care. Studies suggest that the nurses' practices of surgical site infection prevention is not well addressed. Moreover, there is clearly paucity of information, in Africa including the study area. **Objective:** The aim of this study was to assess surgical site infection prevention practices and associated factors among nurses working in government hospitals of Harari Regional State and Dire Dawa City Administration, Eastern Ethiopia from March 01 to 28, 2019. **Method and Materials:** An institutional based cross-sectional study design was employed for a total of 515 nurses. Simple random sampling method was used to select study participants. Data were collected using pretested structured self-administered questionnaire supplemented by observation. Data were checked, coded, entered and cleaned using Epi-data version 3.1 and exported to SPSS version 20 for analysis. Bivariate and multivariate analysis were undertaken and *P* values less than 0.05 at 95% confidence interval were considered as statistically significant. **Result:** The overall self-reported level of SSI prevention practice was found to be 40.8% (95% CI: 36.9%, 45.4%). Nurses with BSc and above [Adjusted odds ratio (AOR) = 2.52, 95% CI (1.14, 5.54)], trained on infection prevention [AOR = 2.22, 95% CI (1.29, 3.82)], good knowledge [AOR = 2.21, 95% CI (1.32, 3.71)], good attitude [AOR = 5.11, 95%CI (3.05, 8.57)], got supply of personal protective equipment [AOR = 2.57, 95% CI (1.46, 4.49)], had management support [AOR = 3.41, 95% CI (1.90, 6.12)], experience of 5 to 10 years [AOR = 5.38, 95%CI (2.82, 10.27)] and ≥ 11 years [AOR = 3.48, 95% CI (1.47, 8.25), were found to be statistically and positively associated with nurses SSI prevention practice. **Conclusion:** In this study, the level of surgical site infection prevention practice was poor. Being BSc and above, being knowledgeable and good attitude, got personal protective equipment, had management support, serving for ≥ 5 years and trained on infection prevention were found to be significantly associated with surgical site infection prevention practice. Updating knowledge and practice of nurses through in-service education and training on latest evidence-based practice, regularly supplying of personal protective equipment, developing hospital policy and procedures for surgical site infection prevention practice is recommended.

Key words: Surgical site infection, Nursing practice, Infection prevention, Government hospitals

摘 要

背景：手术部位感染是可预防的医院获得性感染中最常见的类型，其不良的手术结果与发病率，死亡率，住院时间，再入院和费用增加有关。预防手术部位感染是提供最佳护理的最重要挑战之一。研究表明，护士预防手术部位感染的方法未得到很好的解决。此外，在非洲包括研究地区显然缺乏研究。

目的：本研究的目的是评估 2019 年 3 月 1 日至 28 日在埃塞俄比亚东部哈拉里地区州政府和迪里达瓦市政府的政府医院工作的护士的手术部位感染预防措施及相关因素。

方法和材料：共 515 名护士参与机构的横断面研究设计。使用简单的随机抽样方法来选择研究参与者。使用通过观察补充的预先测试的结构化自我管理调查表收集数据。使用 Epi-data 3.1 版检查，编码，输入和清除数据，然后将其导出到 SPSS 20 版进行分析。研究进行了双变量和多变量分析，在 95%置信区间内的 *P* 值小于 0.05 被认为具有统计学意义。

结果：手术部位感染预防实践的总体自我报告水平为 40.8%（95% CI：36.9%，45.4%）。学士学位及以上的护士[调整后的优势比（AOR）= 2.52，95%CI（1.14，5.54）]，接受过感染预防培训[AOR = 2.22，95% CI（1.29，3.82）]，良好的知识[AOR = 2.21 ，95%CI（1.32，3.71）]，良好的态度[AOR = 5.11，95%CI（3.05，8.57）]，已获得个人防护用品的供应[AOR = 2.57，95%CI（1.46，4.49）]，管理支持[AOR = 3.41，95%CI（1.90，6.12）]，5 至 10 年的经验[AOR = 5.38，95%CI（2.82，10.27）]和≥11 年[AOR = 3.48，95% CI（ 1.47，8.25）被发现与护士手术部位感染预防实践在统计上正相关。

结论：在这项研究中，预防手术部位感染的水平很差。拥有学士学位及以上学历，知识渊博，态度良好，拥有个人防护设备，有管理支持，服务≥5 年并接受过感染预防培训，这与手术部位感染的预防措施有很大关联。建议通过在职教育和最新循证实践培训，定期提供个人防护设备，制定医院政策和预防手术部位感染实践的方法来更新护士的知识和实践。

关键词：手术部位感染；护理实践；感染预防；政府医院

Abbreviations: SSIs, Surgical site infections; HAIs, Hospital acquired infections; CI, Confidence interval; IP, Infection prevention; PPE, Personal protective equipment; AOR, Adjusted odds ratio; BSc, Bachelor of sciences.

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1. BACKGROUND

Surgical site infections (SSIs) are infections of the incision or organ or space that occur within 30 days if no implant is left in place after operation or within one year if implant is in place [1, 2]. It can be superficial incisional (limited to skin or subcutaneous tissue), deep incisional (limited to fascia and/or muscular layers) and organ/space (involves any part of the body, excluding the skin incision, fascia, or muscle layers that is opened or manipulated during the operative procedure) [1, 3].

SSIs are a serious and undesirable outcome of surgery and are a substantial burden to health-care systems, a person and community at large associated with increase morbidity, mortality rate and additional hospital stay, readmission and additional costs [4]. SSIs are believed to account for $3.5 billion to $10 billion annually in healthcare system and attributable for 77% of deaths, up to 7-11 additional postoperative hospital-days and patients with SSI are 2-11 times higher risk of death compared operative patents without SSI [1].

The prevalence of surgical site infection is high in lower middle income countries. For instance in Tanzania 26%, Nigeria Abuja 27.6% [5-6]. Moreover, a prospective study in Sub-Saharan African countries also revealed that rate of SSI was 23.6% [7]. According to Ethiopian studies it ranges from 6.8% to 19.1% [8, 9].

World Health Organization and Centers for Disease Prevention and Control, had developed evidence-based recommendations to reduce prevalence of surgical site infection. For instance Patients should bathe or shower before surgery; on at least one night before surgery, hair should either not be removed or, if absolutely necessary, it should be removed only with a clipper, surgical antibiotic prophylaxis should be administered within 60 min before incision, alcohol-based surgical site skin preparation, glycemic control less than 200mg/dL, and normo thermia above 36 ℃, hand hygiene, sterile wound dressing, surveillance, and develop policies, procedures, [10, 11, 12].

SSI is the second most reported hospital acquired infections (HAIs), accounted 19.6% of HAIs and is associated with 16 million extra days of hospital stay, attributable for 37000 deaths and annual economic impact of 7 billion EUR in Europe and it is the most surveyed and most frequent type of HAI in low- and middle-income countries [10]. For instance, in Africa SSI is the first most reported with a cumulative incidence ranged from 2.5% to 30.9% [13].

Nurses play a major comprehensive role and spans the continuum of care in preventing SSIs. For instance, they can modify SSI risk factors in their daily practice like improper hand hygiene and skin preparation, improper surgical prophylaxis, unnecessary hair removal and improper wound management techniques and also, nurse are the heart and around the clock of the hospital and are responsible for surgical site infection prevention, patient safety and quality nursing care [14]. So, nurses should adhere to evidence based practice towards SSI prevention but, according to literatures there is paucity of information regarding to nurses SSI prevention practices.

Globally researches were conducted to know nurses practice towards SSI prevention aimed to reduce its effects. For instance, a cross sectional study conducted in India on health care professionals towards SSI prevention practice revealed that 64.51% of nurses had good practice [15]. Moreover, a cross sectional study in Palestine revealed that 91.1% of nurses had good practice towards surgical site infection [16]. However, cross sectional mixed study in Bangladesh shows that 44.5% of nurses were always practiced SSI prevention activities [17]. According to Ethiopia a cross sectional study conducted in Bahirdar and Gondar revealed that 45.1% and 48.7% of nurses had good practice towards SSI prevention practice respectively [18, 19].

Despite many studies conducted in the world towards nurses' practice of surgical site infection prevention but most researches depend on descriptive study design and self-reported structured questionnaires only which is mostly exposed to bias. Therefore this study was supplemented self-administered questionnaire by observation of actual performance of nurses' by observational checklist to reduce bias and was explore the association between nurse's SSI prevention practice with nurses' knowledge and attitude of SSI prevention. In Ethiopia, However, studies that has explored practices of nurses towards surgical site infection is limited. Moreover, no evidence concerning nurses' practice towards surgical site infection prevention in Harari regional state and Dire Dawa city administration. Therefore, this study was carried out to investigate nurses' surgical site infection prevention practice and factors associated with the practice.

2. METHODS AND MATERIALS

2.1 Study area and period

The study was conducted in government hospitals of Harari Regional State and Dire Dawa City Administration, Eastern Ethiopia from March 01 to 28, 2019. This study was conducted in six government hospitals where different and multidimensional aspects of health care services being provided to the patient. The three government hospitals are found in Harar namely (HFSUH), (JH) and (HFPH) with a total of 358 nurses and three in Diredawa city administration (DRH), (SECL3H) and (SPLH) with a total of 303 nurses.

HFSUH is a teaching hospital of Haramaya University with a total of 161 beds and 203 nurses (HFSUH, 2018). JH is a regional referral hospital of Harari Regional State with 95 beds 97 nurses (JRH, 2018) and Harar federal police has a total of 58 nurses (HFPH, 2018). Dilchora is a referral hospital of Dire Dawa City Administration with a total of 143 nurses (DRH, 2018). SPLH is a primary hospital with 48 nurses (SPLH, 2018), and South east command level 3 hospital (SECL3H) also has 120 beds and a total of 112 nurses (SECL3H, 2018).

2.2 Study design and population

Institutional based cross-sectional study design was used. The Source Population were employed nurses working in government hospitals of Harari regional state and Dire Dawa city Administration and Study Population were all nurses working in government hospitals of Harari Regional State and Dire Dawa City Administration.

2.3 Literature screening and data extraction

Two researchers independently screened the literature according to inclusion and exclusion criteria. The information extracted from the data including author, publication year, research type, sample size, intervention measure, intervention time and outcome indicators. If there was a disagreement, discussed it with

the third researcher and decided on it.

2.4 Sample size determination

Sample size was calculated separately for each specific objectives. For first objective, sample size was calculated using single population proportions with the following assumptions. 95% confidence level with 5% margin of error, and by assuming the prevalence of good practice towards surgical site infection prevention among nurses 48.7% in the previous study conducted at Gondar University and Debre Markos hospitals (Freahiywot et al., 2015). Based on this assumption, the actual sample size for the study was calculated as follow:

$$n = \frac{\left(\frac{Z\alpha}{2}\right)2P(1-P)}{d2} = 384$$

Where:

n = minimum sample size of the required study; Z = standard normal distribution (1.96) with confidence level of 95%; P = prevalence of good practice towards surgical site infection prevention among nurses in previous study = 48.7% = 0.487; d = is a tolerable margin of error (d = 0.05) and 1-0.467 = 0.513.

For the second objective: double population formula using Epi Info version 7 for individual factors at 95% confidence level with 5% margin of error, 80% power and 1:1 ratio of exposed to unexposed (Table 1).

By considering 10% non-response rate for each objectives the final sample size for the first objective was 422 and for the second objective 524. Comparing the calculated sample size of the two objectives the final sample size was from the second objective. A total of 524 nurses were participated in the survey while 53 (10% of the study participants) were observed.

Table 1: Sample size determination for surgical site infection prevention practices and associated factors among nurses working in government Hospitals of Harari Regional State and Dire Dawa City Administration by using different studies, 2019.

Factor	Assumption	TS	Reference
Sex of nurses	CI: 95% Power: 80% Ratio 1:1 Male: 69.23% Unexposed Female: 56.43% Exposed	476	(Israel *et al.*, 2018)
Age of nurses in years	CI: 95% Power: 80% Ratio 1:1 <30 years: 45.59% Unexposed ⩾ 30 years : 61.45% Exposed	334	(Freahiywot *et al.*, 2015)
Experience of nurses in years	CI: 95% Power: 80% Ratio: 1:1 5-10 years: 59.6% Unexposed >10 years: 75% Exposed	316	(Israel *et al.*, 2018)

2.5 Data collection tools and sampling procedures

Data were collected from the study participants using a pretested structured self-administered questionnaire and observational checklist. Knowledge and practice part of data collection tool were developed by reviewing different literatures. The samples were taken from the three government hospitals found in Harari Region and three government hospitals found in Dire Dawa City Administration by proportional allocation for each hospital and the study participants were selected by simple random sampling for the self-administered questionnaire. For observational checklist in six government hospitals participants were recruited among purposively selected surgical, gynecology/maternity wards and surgical/central intensive care units. A total of 53 nurses for observation were included and were proportionally allocated in each hospital by (HFSUH = 16, DRH = 11, JH = 8, HFPH = 5, SPLH = 4 and, SECL3H = 9 nurses). Participants were selected using simple random sampling technique. Surgical, gynecology/maternity and intensive care, units were purposively selected because of the consideration that surgical procedures including preoperative, intraoperative and post-operative were performed. Sampling frame was taken from hospital human resource management office.

2.6 Data quality control

To ensure the quality of data, training was given for data collectors and supervisors for two days regarding the objective of the study, data collection tool, and ways of data collection. Before actual data collection, pretest was conducted on 30 study participants at Bissidimo General Hospital. All data were checked for completeness and consistency by the principal investigator and supervisors, on the day of data collection. Double data entry was done by two data clerks and consistency of the entered data was cross checked by comparing the two separately entered data. Simple frequencies and cross tabulation was done for missing values and cross checked with hard copies of the collected data.

2.7 Data analysis

The data were checked visually by the principal investigator. Then it was coded, entered and cleaned using Epi-Data version 3.1 software and finally it were exported into SPSS version 20 for analysis. Univarate analysis such as simple frequencies, measures of central tendency and measures of variability was done describe the characteristics of participants and information were presented using tables and figures. For analysis of the outcome variable, SSI prevention practice, first recode of the likert

scale into "not always practice as "0", and always practice and "1" and then summation was done. Finally the mean value was computed then practice was categorized as good for all who score mean and above coded as "1" and "poor" for participants who score below the mean were coded as "0".

The independent variables, knowledge for SSI prevention of the respondent was computed as mean and above was coded as "1" and value below the mean was coded as "0", attitude for SSI prevention practice of the respondent was categorized as value mean and above was coded as "1" and below the mean was coded as "0".

Bivariate analysis, crude odds ratio with 95% confidence interval (CI) was computed to see the association between independent variable and the outcome variable by using binary logistic regression. Independent variables with p-values of ⩽ 0.25 were included in the multi-variable analysis to control confounding factors. Multi-Collinearity was checked to see the linear correlation among the independent variables by using variance inflation factor and standard error. For model fitness Hosmer Lemshow (0.59) and Omnibus tests (0.00) was computed. P values less than 0.05 at 95% confidence interval were considered as statistically significant.

3. OPERATIONAL DEFINITIONS

Good knowledge - level of knowledge participants who scored above or equal to the mean (7.45) value for knowledge related questions regarding SSI prevention practice otherwise "poor knowledge" [19].

Surgical site infection prevention practice- The outcome variable practice of nurses towards SSI prevention was categorized in to two participants who reported (never practice and sometimes practice) on preventive questions was categorized as "not always practice" and those study participants who reported as "usually" and "always" practice on SSI preventive questions was categorized as "always practice". Summation was computed and finally mean SSI prevention practice was calculated and those who score above or equal to mean (6.14) had good practice and bellow mean were categorized as poor practice [18].

Good attitude- The level of attitude of participants who scored above and equal to mean (26.68) value on attitude questions was categorized as "good attitude" and those who score below the mean value was categorized as "poor attitude" [23, 25].

Workload- If one Intensive care trained nurse provide nursing care services for more than two beds or patients in intensive care unit and if one nurse provides nursing care services for more than six (6) patients in inpatient service other than intensive care unit per shift was considered as workload.

4. RESULTS

4.1 Socio-demographic characteristics

In this study, a total of 515 study participants were involved, making response rate of 98.3%. From the total number of respondents, 276 (53.6%) were males. Almost half, 260 (50.5%) of the study participants were with age group 21-29 years. The mean (± SD) age and experience of study participants was 32.08 (± 7.77) and 8.91 (± 7.59) years respectively. Around four fifth, 416 (80.8%) of study participants were bachelor of sciences (BSc) nurses. Almost half of the study participants 261 (50.7%) were married. Regarding working units more than half, 277 (53.8%) of them were working at inpatient and above two third 437 (84.9%) graduated from government institution. Concerning training almost two fifth, 209 (40.6%) of them were trained on infection prevention activities. Regarding experience in nursing profession 215 (41.7%) of respondents had worked for less than five years (Table 2).

Table 2: Sociodemographic characteristics on SSI prevention practices among nurses working in government Hospitals of Harari Regional State and Dire Dawa City Administration Eastern Ethiopia, 2019 (n = 515).

Variable	Category	Frequency (%)
Sex	Male	276 (53.6)
	Female	239 (46.4)
Marital status	Single	215 (41.7)
	Married	261 (50.7)
	Other	39 (7.6)
Age	21-29 years	260 (50.5)
	⩾ 30 years	255 (49.5)
Experience	<5 years	215 (41.7)
	5-10 years	173 (33.6)
	⩾ 11 years	127 (24.7)
Educational qualification	Diploma	84 (16.3)
	BSc and above	431 (83.7)
Working unit	Inpatient	277 (53.8)
	Outpatient	190 (36.9)
	ICU	48 (9.3)
Graduate institution	Government	437 (84.9)
	Private	78 (15.1)

BSc, Bachelor of sciences.

4.2 Nurse related characteristics

Less than half 253 (49.1%) of the respondents had good knowledge towards SSI prevention practices and also about half, 256 (49.7%) of them had good attitude for SSI prevention practices. Among study participants who got infection prevention (IP) guideline in their working unit more than half 123 (58 %) of them were referring for updates. Majority 137 (68.5%) of study participants utilize personal protective equipment (PPE) accordingly ever in their SSI prevention practices among participants who had supply of PPE. One hundred thirty-nine (27.0%) study participants reported washing their hands before and after procedure, and 425 (82.5%) of nurses reported not wash their hands before wearing sterile gloves (Figure 1).

4.3 Work environment related characteristics

Regarding the presence of infection prevention guidelines, 303 (58.8%) respondents reported they had no infection prevention guidelines in their working unit and 315 (61.2%) of study participants reported that they didn't get supply of PPE. Moreover, 346 (67.2%) of study participants did not get continuous supply of water for SSI prevention practices. Regarding workload 202 (62.2%) of nurses working in patient and ICU reported they had workload. Two hundred nine (40.60%) of study participants were trained on infection prevention practice but 306 (59.4%) of them were not trained.

4.4 Overall self-reported SSI prevention practice level

The mean (± SD) self-reported practice score of nurses on SSI prevention was 6.14 (± 3.38). In this study, only 40.8% (95% CI: 36.9%, 45.4%) of study participants reported good practices in SSI prevention activities. (Figure 2).

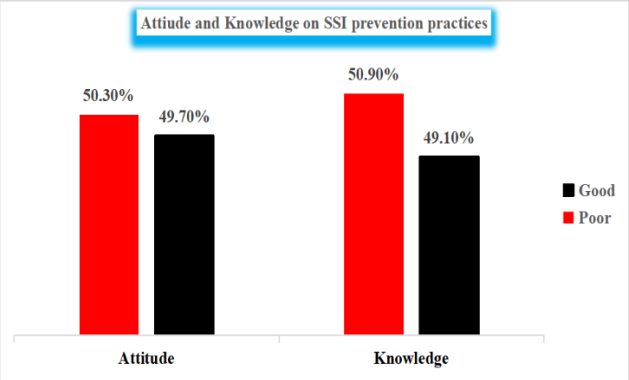

Figure 1: Knowledge and attitude on SSI prevention practices activities among nurses working in government Hospitals of Harar Regional State and Dire Dawa City Administration, Eastern Ethiopia, 2019 (n=515). SSIs, Surgical site infections;

The findings of this study revealed that only 139 (27%) always washed their hands before and after wound care. Only 96 (18.6%) practiced preoperative shaving for SSI prevention, while 419 (81.4%) indicated that they did not always perform this. Moreover, 398 (77.3%) of the nurses did not always administer preoperative prophylactic antibiotic appropriately before surgery and only 117 (22.7%) did.

In this study, more than two fifth, 213 (41.4%) of the study participants reported that they always monitored and asses surgical site condition, and that only 89 (17.3%) of the respondents always assessed body mass index of surgical patients. Moreover, 178 (34.6%) of participants reported that they always used aseptic technique when dressing wounds and also only 112 (21.7%) of study participants reported that they always advised preoperative patients to take shower or bath appropriately.

Almost three fourth, 383 (74.4%) of them reported they always practiced discarding of soiled material in the proper place and less than two third, 339 (65.8%) of them also reported practicing disinfect of the surface of trolley with anti-septic solution. Moreover, 376 (73%) and 250 (48.5%) of study participants reported that they always practiced using povidone iodine and normal saline for cleansing of surgical wounds and using of facemask when wound dressings (Table 3).

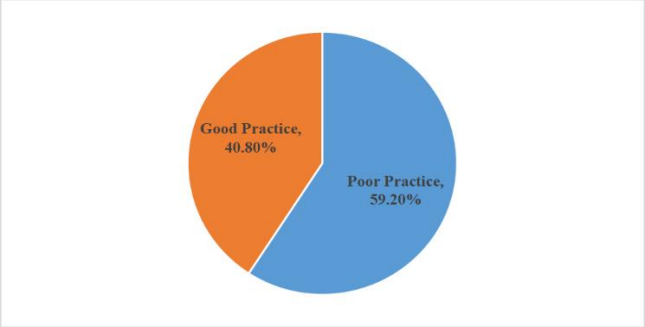

Figure 2: Overall self-reported SSI prevention practices among nurses working in government Hospitals of Harari Regional State and Dire Dawa City Administration Eastern Ethiopia, 2019 (n=515).

4.5 Observational results

Observation was made on nurses while giving SSI prevention activities to the patient in surgical, ICU and Obs/gyne wards in each hospital to supplement self-reported practices. The mean (± SD) age was 29.13 (± 3.86) and majority 41(77.36%) were BSc nurse and 31 (58.5%) were male.

The overall observation SSI prevention practices score was found to be 30.2% (17.8, 43.7%). To determine the practice and validate their responses, 53 observation checklists were analyzed. Out of 53 observed participants, none of them washed their hands before and after a procedure. Eighteen (34%) of study participants used sterile materials and 14(26.4%) of them used aseptic technique when dressing wounds (Figure 3).

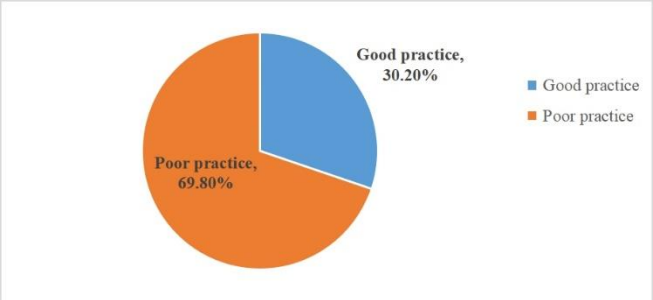

Figure 5: Overall SSI prevention practices observational result among nurses working in government Hospitals of Harari Regional State and Dire Dawa City Administration, Eastern Ethiopia, 2019 (n=53).

4.6 Factors associated with surgical site infection prevention practices among nurses (n = 515)

Bivariate analysis result showed that educational qualification level, work experience, training, availability of personal protec-

tive equipment in working area, presence of infection prevention guideline, training on infection prevention, management support, learning institution, nurses age, knowledge and attitude of nurses towards SSI prevention practice were significantly associated with SSI prevention practice. Variables with *P* values ⩽ 0.25 in the bivariate analysis were candidates for multivariate analysis. In multivariate logistic regression analysis educational qualification, knowledge and attitude of nurses, work experience in nursing profession, infection prevention training, and availability of PPE and management support were significantly associated with SSI prevention practice.

Nurses who had BSc and above were 2.52 times more likely to practice SSI prevention compared with diploma holders [AOR = 2.52, 95% CI (1.14, 5.54)]. Respondents who trained on IP were about 2.22 times more likely to perform SSI prevention activities than nurses who were not trained [Adjusted odds ratio (AOR) = 2.22, 95% CI (1.29, 3.82)].

Table 3: Self-reported surgical site infection prevention practices among nurses working in government Hospitals of Harari Regional State and Dire Dawa City Administration Eastern Ethiopia, 2019 (n = 515).

Self-reported questions	Not always practice (%)	Always practice (%)
I wash my hands before and after changing wound dressing and touching the surgical site	376(73)	139(27)
I wash my hands before wearing sterile gloves	425(82.5)	90(17.5)
I perform pre-operative shaving right before surgery	419(81.4)	96(18.6)
I administer pre-operative prophylactic antibiotic within one hour before surgery	398(77.3)	117(22.7)
I advise my patient to take preoperative showering or bathing with or without antimicrobial agents one night to 1 day before surgery	403(78.3)	112(21.7)
I assess my patient's body mass index (BMI) before and after surgery	426(82.7)	89(17.3)
I use sterilized dressing materials for cleansing surgical wound	337(65.4)	178(34.6)
I used aseptic technique during obtaining swab culture	346(67.2)	169(32.8)
I use an aseptic technique during surgical wound dressing	337(65.4)	178(34.6)
I advise an immunodeficiet patient to maintain personal hygiene	324(62.9)	191(37.1)
I assess and monitor surgical site condition	302(58.6)	213(41.4)
I separate infected from non-infected cases during dressing	268(52)	247(48)
I use face mask during cleansing surgical wound	265(51.5)	250(48.5)
I clean and disinfect the surface of the dressing trolley with antiseptic solution	176(34.2)	339(65.8)
I discard the soiled material in the proper place after performing wound dressing	132(25.6)	383(74.4)
I use povidone-iodine and normal saline for cleansing surgical wound dressing	139(27)	376(73)
Overall self-reported SSI prevention practice	Good Poor	210(40.8) 305(59.2)

The odds of SSI prevention practice were 2.21 times higher among nurses with good knowledge compared to poor knowledge [AOR = 2.21, 95% CI (1.32, 3.71)]. Participants who had good attitude were about 5.11 times more likely to perform SSI prevention activities compared with participants who had poor attitude for SSIs prevention [AOR = 5.11, 95%CI (3.05, 8.57)].

According to experience nurses who worked for 5 to 10 years were about 5.38 times [AOR = 5.38, 95%CI (2.82, 10.27)] and nurses with experience more than or equal to 11 years were about 3.48 times more likely to perform SSI prevention activities [AOR = 3.48, 95% CI (1.47, 8.25)] as compared nurses with less than 5 years' of experience. Participants who got supply of PPE were about 2.57 times more likely to practice SSI prevention activities [AOR = 2.57, 95% CI (1.46, 4.49)] compared to participants who did not. Moreover, nurses who had management support were about 3.41 times more likely to perform SSI prevention activities as compared to nurses who were not supported [AOR = 3.41, 95% CI (1.90, 6.12) (Table 4).

5. DISCUSSION

In this study, level of self-reported SSI prevention practice was found to be low which was supported with observation. The finding of this result has affirmed that being BSc and above, trained on IP, serving for five years and more, being knowledgeable and had good attitude for SSI prevention practice, got supply of PPE and had management support for SSI prevention practice were significantly and positively associated with SSI prevention practice.

5.1 Level of SSI prevention practices

In this study, the overall self-reported SSI prevention practices

was 40.8%. The result was supported with observation, in which 30.2% of study participants performed SSI prevention activities. The findings had confirmed that in most areas of nurses' reported practices and observational result is supportive each other. The findings of this study is comparative with the results of the studies conducted in Bahir Dar and Bangladesh [14, 18].

Table 4: Factors associated with SSI prevention practice among nurses working at government hospitals of Harari Regional state and Dire Dawa city administration, Eastern Ethiopia, 2019 (n = 515).

	Practice		95% CI	
	Good	Poor	COR	AOR
Attitude				
Good	166 (64.8%)	90 (35.2%)	9.01 (5.86, 13.63)	5.11 (3.05, 8.57)***
Poor	44 (17%)	215 (83%)	1	1
Knowledge				
Good	146(57.7%)	107(42.3%)	4.22(2.89, 6.15)	2.21(1.32, 3.71) **
Poor	64(24.4%)	198(75.6%)	1	1
Training				
Yes	137(65.6%)	72(34.4%)	6.07(4.12, 8.95)	2.22(1.29, 3.82) **
No	73(23.9%)	233(76.1%)	1	1
Education				
BSc and above	198(45.9%)	233(54.1%)	5.09(2.69, 9.67)	2.52(1.14, 5.54) *
Diploma	12(14.3%)	72(85.7%)	1	1
Age				
21-29 years	93(35.8%)	167(64.2)	1	1
>=30 years	117(45.9%)	138(54.1%)	1.52(1.07, 2.17)	0.59(0.31, 1.12)
Experience				
<5 years	48(22.3%)	167(77.7%)	1	1
5-10 years	111(64.2%)	62(35.8%)	6.23(3.98, 9.74)	5.38(2.82, 10.27) ***
>=11 years	51(40.2%)	76(59.8%)	2.33(1,45, 3.77)	3.48(1.47, 8.25) **
PPE availability				
Yes	133(66.5%)	67(33.5%)	6.136(4.15, 9.06)	2.57(1.46, 4.49) **
No	77(24.4%)	238(75.6%)	1	1
Management support				
Yes	126(74.6%)	43(25.4%)	9.14(5.98, 13.97)	3.41(1.90, 6.12)***
No	84(24.3%)	262(75.7%)	1	1
Presence of guideline				
Yes	113(53.3%)	99(46.7%)	2.42(1.69, 3.48)	1.14(0.65, 1.98)
No	97(32%)	206(68%)	1	1
Continuous supply of water				
Yes	91(47.9%)	99(52.1%)	1.59(1.11, 2.29)	0.73(0.43, 1.24)
No	119(36.6%)	206(63.4%)	1	1
Learning institution				
Government	190(43.5%)	247(56.5%)	2.23(1.29,3.84)	1.50(0.68, 3.29)
Private	20(25.6%)	58(74.4%)	1	1
Sex				
Male	115(41.7%)	161(58.3%)	0.92(0.65, 1.31)	
Female	95(39.7%)	144(60.3%)	1	
Marital status				
Single	92(42.8%)	123 (57.2%)	1	
Married	108 (41.4%)	153 (58.6%)	0.94 (0.65, 1.36)	
Other	10 (25.6%)	29 (74.4%)	0.46 (0.21, 1.09)	
Working unit				
ICU	17 (35.4%)	31 (64.6%)	0.6 4(0.33, 1.22)	
Inpatient	105 (37.9%)	172 (62.1%)	0.71 (0.487, 1.29)	
Outpatient	88 (46.3%)	102 (53.7%)	1	

CI, Confidence interval; AOR, Adjusted odds ratio.

However, the result is lower than in India, Zambia, Palestine, and Gondar and in Jordan (15, 16, {Patil, 2018 #942}{Patil, 2018 #942}{Patil, 2018 #942}23]. The difference could be probably explained by the differences in operational definition of SSI prevention practice, study setting, sampling technique and availability of resources. For instance, in India SSI prevention practice is categorized in to three, used small sample size and include only one tertiary hospital. In Jordan also participants were only from ICU and in Palestine used purposive sampling technique which is most exposed for bias.

Moreover, the result is higher than a study conducted in Yemen and Iran [24, 25]. The dissimilarity could be hospital facilities, in operational definition of SSI prevention practice, participant related factors, sociodemographic characteristics, study setting, sample size and sampling technique. For example in Yemen only 85 study participants in private hospitals were included and 60% of study participants were three year diploma holders and also only 4% of then has good knowledge and in Iran only 145 study participants were included.

5.2 Factors associated with SSI prevention practices

In this study, participants experience in nursing profession was significantly associated with SSI prevention practice. Study participants with experience of greater than or equal to five years were more likely practicing SSI prevention activities compared to participants who have less than five years' experience. The finding of this study is comparable with Debre Markos, Bahir Dar and Jimma Ethiopia [18, 21]. This could be mean that as the number of years of practice increases, nurses are more likely to be exposed repeatedly to surgical environments and become more experienced through working with senior staff. As the number of years of practice in nursing increases, the importance of lifelong learning is understood within the meaning of maintaining competency, providing high-quality nursing care, and enhancing future career opportunities [20] indicating that practice makes perfect.

The findings of this study, revealed that participants with BSc and above were more likely to practice SSI prevention activities compared with diploma. This is in line to a study in Debre Markos, Ethiopia [21] indicating that as nurses level of educational qualification increases the use of evidence based practice with the integration of best research evidence with clinical expertise with patient value increases for SSI prevention which further improves the quality of care. The result is not comparable with northwest Ethiopia [19]. The discrepancy may be due sociodemographic characteristics and hospital facilities.

In this study, participants who had taken IP training were more likely to perform SSIs prevention activities compared with participants who were not trained. This result is in line with a study conducted in Gonder and Bahir Dar, Ethiopia [18, 27]. The possible explanation for this finding could be the fact that training on current guidelines could upgrade the knowledge and skill of professionals in that they would easily understand basic principles, recommendations, and standards of practice and implement them consistently. Moreover, up to date knowledge and skill regarding SSI prevention could also increase the confidence of nurses in complying with recommended guidelines.

The odds of good practice of SSI prevention practice was higher among study participants with good knowledge of SSI prevention compared to poor knowledge for SSI prevention. This finding is in line with a study in Ethiopia [22]. This is the fact that performance of the skill cannot stand alone; it is always supported by the knowledge and judgment. As knowledge is a critical component of nurses' decision making, therefore, nursing practice is accomplished through the application of critical thinking, judgment and skill which is grounded in the principles of nursing. Moreover, it increases confidence and readiness of nurses in the implementation of SSI prevention strategies.

In this study, attitude was strongly significantly associated with SSI prevention of study participants. In which participants who had good attitudes for SSI prevention were more likely to practice SSI prevention activities compared with poor attitude. This result is comparable in Ethiopia [22]. This could be linked to the fact that as attitude is a way of reasoning formed through experience that influences behavior or individual choice of action, it positively translated in to actual practice in SSI prevention practice. Moreover, the stronger the person's intention to perform a particular task is more likely a person will perform that particular task (i.e. in this case SSI prevention practice measures).

Study participants who had supply of PPE were more likely to practice SSI prevention measures compared who didn't get PPE. This is comparable to a study in Bahir Dar and Gondar, Ethiopia [23, 27]. This could be explained by the fact that nurses require some kind of PPE which needs to be accessible at the point of use. The implication is that level of self-reported SSI prevention practice is higher among participants who had sufficient supply of all PPE when there is increased demand or need for replacement of worn out items. Moreover, frequent inaccessibility of personal protective equipment could decrease the motivation of previously energetic staff and could be a reason for poor SSI prevention practice.

In this study, management support for SSI prevention practice was associated with SSI prevention practice. Participants who had management support were more likely practice SSI prevention activities. This is in agreement with a study in Gondar, Ethiopia (Tariku et al., 2017). This may be due to the fact that management bodies could play a key role and are responsible to make accessible all necessary consumable materials for those nurses who need it and to build safe workplace safety climate for nurses, and health professionals at large. Good management support often motivates staff for effective teamwork through sharing of relevant knowledge and skill and increases their commitment in the implementation of SSI prevention activities. Moreover, management support could also increase SSI prevention practice of nurses by recognizing role models and establishing a rewarding system for those who consistently implement recommended guidelines and policies.

6. STRENGTH AND LIMITATION OF THE STUDY

6.1 Strengths of the study

This study used observational check list to support self-reported data. The outcome variable was collected by using a 4-point Likert scale rather than using Yes or No. Moreover, this study includes more Hospitals from primary to tertiary level and adequate sample size. Since, SSI rate is a key performance indicator of medical and nursing care received by surgical patients and an

indirect measure of infection prevention practices in the hospital so, by monitoring surgical site infection hospitals can assess the adequacy of SSI prevention practices in the hospital and take action to address any problems identified. Therefore, this study will be the current base line data for nurses' SSI prevention practice in the study area.

6.2 Limitations of the study

Since the study was assessed self-reported practice there might be social desirability and recall bias. Hawthorne effect may be introduced (nurses may change their usual practice) when they feel that they are under study during observation. This was minimized by explaining the purpose of the research and avoiding detail explanation of what to be observed. Another limitation is observational bias since the study was collected by nurse professionals. This was also minimized by training and supervision of observers critically and using more than one observer per hospital.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

In this study, self-reported level of SSI prevention practices was low, supported by observation. Being BSc and above, being knowledgeable and had good attitude for SSI prevention, got supply of PPE, had management support, serving for $\geqslant$ 5 years and trained on IP were found to be significantly and positively associated with nurses' good SSI prevention practices.

7.2 Recommendations

Based on the findings of this study, the following recommendations were made for nurses, Hospitals, Harari Regional and Diredawa City Administration Health Bureau and researchers. Nurses should use and up to date their knowledge to empower others and drive system change, evidence based practice for the prevention of SSIs, as nursing knowledge is evidence based and practice in an active and changing environment, openly sharing and evaluating best practices and gaining knowledge with interdisciplinary teams especially with physicians.

Hospitals, Harari Regional and Diredawa City Administration Health Bureau Should up to date knowledge and practice of nurses' through continuing in-service educational programs; emphasizing latest evidence-based SSI prevention practice and providing training for newly recruited nurses about SSI prevention at regular intervals. They should develop written SSIs prevention policy and procedures for their own hospital and allocate budget and resource regularly for SSI prevention and provision of performance monitoring system (to ensure consistent utilization of evidences and PPE). They also recognizing role models, establishing rewarding system and benchmark best practices.

For researchers: Further study including other health professionals (surgeons), factors like job satisfaction and observation while surgical team works surgical procedures to Identify barriers for SSI using qualitative study design.

Authors' contributions

Getaneh Desalew: Wrote the proposal and he was a principal investigator.
Dr. Bezatu Mengistie: He was a co advisor.
Dr Biftu Geda: He was a major advisor.
Solomon Demis: He was an editor and prepared the manuscript.
Asmamaw Demis: He analyzed the data.

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Patient consent

Not applicable.

Ethics approval

The study obtained ethical approval and clearance from Haramaya University CMHS Institutional Health Research Ethics Review Committee. Permission was also secured from the respective hospital administrators. The study obtained ethical approval from Haramaya University CMHS Institutional Health Research Ethics Review Committee. Permission was also secured from the respective hospital administrators he respondents were informed of their right to refuse or decline participation in the study at any time and refusing to participate in the study will not affect them. Participants' confidentiality of information was assured by excluding names and identifiers in the questionnaire. Informed verbal consent for observation and informed voluntary written and signed consent for self-administered questionnaire were obtained from all respondents prior to the study.

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