Nurses' Knowledge and Practices Regarding Devices Associated Infection at Intensive Care Units

Amina Mohamed Mostafa[1, 2], Zeinab A. Allam[3], Atteia Gad ELhak Ibrahim[4], Sheren Mohammed Diab [5]

[1] Master student of Critical Care Nursing, Faculty of Nursing, Tanta University, Egypt.

[2] Nursing Specialist at Kafer Elsheikh University Hospital, Egypt.

[3, 5]Assistant Professor of Critical Care & Emergency Nursing, Faculty of Nursing, Tanta University, Egypt.

[4]Anesthesia Surgical Intensive Care Unit & Pain Medicine, Faculty of Medicine, Tanta University, Egypt.

Corresponding author: Amina Mohamed Mostafa

Email: aminamohamedm1992@gmail.com

Abstract

Background: Critical care nurses have an important role in preventing devices associated infections. So, it is important for assessing critical care nurses' knowledge and practice which is the key factor in reducing devices associated infection. **Aim:** Assess nurses' knowledge and practices regarding devices associated infection at intensive care unit. **Design:** A descriptive research design was utilized in current study. **Setting:** The study was conducted at the Surgical Intensive Care Unit and Traumatology Medicine Intensive Care Unit at Tanta Emergency Hospital in Tanta University hospital. **Sample:** All nurses, 80 nurses were working in the previously mentioned settings who give care for mechanically ventilated patients. **Tools**: Two data collection tools were used; Tool I: Assessment of Nurses' knowledge about devices associated infection which consists of Nurses' Socio-demographic Characteristics and Nurses' Knowledge Questionnaire Regarding Devices Associated Infection and Tool II: Observational Checklist regarding Nurses, Practice of Devices Associated Infection. **Results:** Demonstrates that, 61.25% of the studied nurses had fair level of knowledge compared to 22.50% of them had good level of knowledge regarding DAI. Also, 60.00% of the studied nurses had satisfactory level compared to 40.00% of them had unsatisfactory practices level. **Conclusion:** The studied nurses who had fair level of knowledge had satisfactory level of practices with statistical significance relation between total level of knowledge and total level of practices with p value = 0.047. **Recommendations:** Continuous education and training programs for nurses are recommended to enhance their knowledge and practices related to device-associated infections.

Keywords: Devices Associated Infection, Intensive Care Units Nurses, Knowledge, Practices.

Introduction

A critically ill patient who has a life-threatening multisystem process can experience significant morbidity and requires pharmacological management and mechanical device support such as intravenous devices, urinary catheters, and mechanical ventilators to support vital organ functions or reverse specific organ dysfunctions **(Kayambankadzanja et al., 2022)**. Devices-associated infections (DAIs) are major patient safety problems in hospitals, especially in intensive care units (ICUs) **(Jaggi et al., 2019)**.

Healthcare-associated infections (HAI) are infections acquired after 48 h of admission, up to 30 days of discharge, and up to one year in case of implants, which were not evident or under incubation at admission **(Morris et al., 2019)**. Ventilator-associated pneumonia (VAP), central-line-associated bloodstream infections (CLABSI), and catheter-related urinary tract infections (CAUTI) are the most commonly encountered Device-Associated HAI (DA-HAI). They are considered the principal contributors to healthcare hazards and threats to patient safety **(Vincent et al., 2020b)**.

Patients in ICU with multiple comorbidities are on artificial ventilation, inotropes, central venous catheterization/central line, urinary catheterization, parenteral nutrition, and other supports, which render them susceptible to HAI. Multidrug-resistant (MDR) pathogens persisting in the ICU environment cause opportunistic infections, more so in association with using devices **(Afhami et al., 2019)**.

The incidence of DA-HAI depends on access to ICU, frequency and duration of use of devices, infection control practices, and immune constitution of patients. The rates of HAI in high-income countries' ICUs are approximately 5–10% vis-a-vis 2–10 times higher incidence in lower- and middle-income countries **(Liu et al., 2020; Böll et al., 2021)**.

Ongoing surveillance of HAI helps characterize infections, etiology, sources, DA-HAI rates, and resistors, thus forming a guideline for targeted interventions for patients, healthcare professionals (HCP), and institutional policies **(Werneburg, 2022; Gilhooly, Green, McCann, Black, & Moonesinghe, 2019).**

In VAP, hospital-acquired pneumonia that occurs more than 48 hours after mechanical ventilation is a common complication of mechanical ventilation with a high mortality rate **(Hassan, El-Gilany, El-Mashad & Abdelaal, 2019)**.

Central line-associated bloodstream infections remain a significant complication of central venous catheters and a leading cause of hospital-acquired infections in the critical care unit **(Sakr et al., 2021)**.

CAUTI is the most common HAI and cause of secondary bloodstream infections **(Morris et al., 2019)**.

Significance of the study

Critical care nurses have an important role in preventing devices associated infections, so they must have the ability to know how to prevent infection associated with these devices and provide high-quality of

care. This is accomplished by using practices that have been shown effective for assessment and maintenance procedures during the hospital stay. A well-trained nursing team follows the fundamental guidelines for avoiding many issues linked to the use of medical devices. So, it is important for assessing critical care nurses' knowledge and practice which is the key factor in reducing devices associated infection and decrease critically ill patients' morbidity and mortality rate **(Kharel, Bist & Mishra, 2021; Emonet et al., 2019)**.

Aim of the study

The aim of the current study was to assess nurses' Knowledge and practices regarding devices associated with infection at the ICU.

Research questions

- What are the nurses' knowledge levels regarding devices associated infection at Intensive Care Units ?
- What are the nurses' practices levels regarding devices associated infection at Intensive Care Units?

Subjects and Methods

Research design

Descriptive research

Setting

This present study was conducted in the surgical intensive care unit and traumatology medicine intensive care unit at Tanta Emergency Hospital in Tanta University hospital.

The nurses' inclusion criteria

The inclusion criteria of the nurses included 80 nurses working in the previously mentioned settings who care for mechanically ventilated patients (50 nurses work at Anesthesia Intensive Care Unit and 30 at the traumatology medicine intensive care unit).

Tools for data collection

Two tools were used to evaluate nurses' knowledge and practices regarding DAI at the ICU after reviewing the relevant kinds of literature. It is composed of two parts as follows:

Tool I: Assessment of Nurses' Knowledge about DAI:

The researcher developed this tool after reviewing relevant literature **(Salu, Okyere, Charles-Unadike & Ananga, 2023)** to collect baseline data pertinent to the current study. It consisted of two parts:

Part (a): Nurses' Socio-demographic Characteristics; to assess data related to nurses' age, sex, marital status, level of education, total years of experience in the previously mentioned unit, previous and current training program about the DAI

Part (b): Nurses' Knowledge Questionnaire regarding DAI: It was used to assess nurses' Knowledge regarding devices associated with infection care. It included the following:

Knowledge about DAI included the definition of DAI, types of devices, risk factors, and components of the infection chain **(Vincent et al., 2020)**.

Knowledge regarding the standard precautions, such as the definition of standard precautions (SPs), measures of SPs, types of hand hygiene, indications of hand hygiene, required time, and personal protective equipment **(Werneburg, 2022)**.

Knowledge related to different kinds of DAI included Knowledge

about VAP, central line-associated bloodstream infection, and catheter-associated urinary tract infection (Papazian, Klompas & Luyt, 2020). The scoring system of Knowledge was presented as follows: Correct and complete answers were scored (2), correct and incomplete answers were scored (1), and incorrect answers were scored (0). The total scoring system of nurses' Knowledge was summed, calculated, and classified as the following:

- **Good Knowledge** was considered 80% or more of the total score.
- **Fair Knowledge** was considered 60% of the total score to less than 80%.
- **Poor Knowledge** was considered less than 60% of the total score.

Tool II: Observational Checklist regarding Nurses, Practice of Devices Associated Infection:
The researcher developed this tool after reviewing relevant literature to assess nurses' practice regarding DAI. **(Soundaram et al., 2020)**. The observational checklist covered the following five domains: Hand hygiene, personal protective equipment, VAP, CLABSI, and CAUTI.

Scoring system of nurses' practice:
Three levels of scoring for each item in the checklist were utilized as follows: Done was scored (1), not done was scored (0), the scoring system was calculated and classified as follows:
Satisfactory if the total score of practice is ≥ 80%, and unsatisfactory if the total score of practice is < 80.

Method
The study was accomplished through the following steps
1. Administrative process
An official permission from the faculty of nursing was delivered to the appropriate authorities at the two selected units to conduct the study. This study will be conducted at the Surgical Intensive Care Unit and Traumatology Medicine Intensive Care Unit at Tanta Emergency Hospital in Tanta University hospital which is affiliated to the Ministry of Higher Education and Scientific Research.

2. Ethical considerations
Ethical committee approval of the faculty of Nursing at Tanta University was obtained, code No: 189-1-2023 and ethical committee of faculty of medicine, code No: 36264MS31-1-23.

- The nature of the study was not causing any harm or pain to the entire subjects.
- Confidentiality and privacy were taken into consideration for each nurse during data collection.
- A code number was used instead of names.
- Written consent to participate in this study was obtained and she/he had the right to withdraw from the study at any time they needed.

3. Tool development
- Structured questionnaire tools were developed by the researcher to assess nurses' knowledge and Practices regarding devices associated infection at intensive care units several literature help to develop the tools and experts in the

field of Critical care nursing department approved it.

- All questions covered several aspects of knowledge about devices associated infection. Structured questions contain (6) questions for obtaining Socio-demographic data of the nurses and (26) questions for assessing knowledge regarding devices associated infection at Intensive Care Units.

4. Tool validity
- The tool of the study was developed by researchers for clarity and applicability by five experts in critical care nursing and biostatistics to ensure their validity and modifications were done.

5. The pilot study
- A pilot study was carried out before starting the data collection and it was done on a sample of (10%) nurses to test the feasibility, applicability of the tools and necessary modifications was done, and they involved the subjects.
- The researcher carried out individual assessments for each nurse in the ICU department to collect the general and specific data about the devices associated with infection.

6. Reliability statistics
- Alpha Cronbach's test was used to test tool I and tool II reliability and reliability factors were 0.817 and 0.836 respectively.

7. Data collection
- The data were collected over a period of 6 months starting from the beginning of March 2023 to the end of August 2023.

- An interview was conducted with each nurse, and it was in the morning and afternoon shift.
- The sheets were distributed to the nurses to fill it and after that it was collected.

Statistical analysis
The collected data was organized, tabulated and statistically analyzed using SPSS software statistical computer package version 26. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison was done using Chi-square test (χ^2).

For comparison between means for two variables in a group, paired samples T-test was use

d. For comparison between means for more than two variables in a group, the F-value analysis of variance (ANOVA) was calculated.

Correlation between variables was evaluated using Pearson and Spearman's correlation coefficient r. A significance was adopted at $P<0.05$ for interpretation of results of tests of significance (*). Also, a highly significance was adopted at $P<0.01$ for interpretation of results of tests of significance **(Burt, 2013)**.

Results
Table 1: Distribution of studied nurses according to their socio demographic characteristics.

As regards the age of the studied nurses, it was noticed that 50% of the studied nurses were in the age group from (28-<38) years old with mean$\pm$SD 27.71$\pm$3.234 years. Also 76.25% and 57.5% of them were females and single respectively. In relation to education, it was observed that 81.25% of them had bachelor's

degree in nursing and 62.5% worked at anesthesia ICU.

Finally, regarding previous experience at ICU and training about DAI, it was shown that 63.75% of nurses had more than 5 years of experience with mean+SD 3.94±3.316 years and 23.75% of nurses attend training programs for 2 weeks about DAI.

Figure 1: Ddistribution of the studied nurses according to correct knowledge regarding devices associated infection:

This figure illustrates that nearly three quarters (75.38%, 71.75 and 72.3%) of the studied nurses had correct knowledge regarding DAI, VAP and CLABSI, respectively. Additionally, nearly two third (68.0% and 67.8%) of them had correct knowledge regarding standard precautions and CAUTI, respectively.

Table 2: Distribution of the studied nurses according to their total levels of knowledge regarding devices associated infection.

This table shows that nearly two thirds 61.25% of the studied nurses had fair level of knowledge compared to less than quarter 22.30% of them had good level of knowledge regarding DAI.

Figure 2: Distribution of the studied nurses regarding their total practice domains levels about devices associated infection

This figure represents that, the highest percent (73.75%, 68.75%, 66.25%, 56.25% and 53.75%) of the studied nurses had satisfactory level of practices regarding hand hygiene, VAP, CLABSI, PPE and CAUTI, respectively. In addition to, 60.00% of the studied nurses had satisfactory level compared to 40.00% of them had unsatisfactory practices level.

Table 3: Relation between total knowledge level and total practice level of the studied nurses regarding devices associated with infection. it was noticed that, the studied nurses who had fair level of knowledge had satisfactory level of practices with statistical significance relation between total level of knowledge and total level of practices which p value = 0.047.

Table 4: Relation between socio-demographic characteristics and their total knowledge score of the studied nurses.

This table revealed that nurses aged between 28 and 38 years, who have had completed post-graduate studies and are employed in the Traumatology Intensive Care Unit (ICU), possess 5 to 10 years of experience and have undergone 1 to 2 training sessions on DAI, demonstrate high mean scores in DAI practices, specifically: 37.60±5.835, 37.08±5.563, 40.50±1.915, 38.87±5.770, 37.63±5.956, and 37.86±5.416, respectively. Furthermore, a significant correlation was identified between the types of ICU in which the nurses work and their total knowledge score, with a p-value of 0.011.

Table 5: Relation between socio-demographic characteristics of the studied nurses and their total mean scores of practices about devices associated infection.

The analysis indicates a statistically significant relationship between the total practice levels of the studied

nurses and their type of work in the ICU, as well as their training regarding DAI. Nurses working in the Anesthesia ICU achieved a mean score of 52.24 ± 6.751, while those in the Traumatology ICU had a mean score of 47.40 ± 8.811. Additionally, nurses who received more than two weeks of training on DAI attained a higher mean score of 52.89 ± 7.578 compared to their counterparts. Furthermore, significant correlations were observed between the type of ICU work, training on devices associated with infections, and the overall mean practice scores of the studied nurses, with p-values of 0.007 and 0.022, respectively.

Table 1: Percent distribution of studied nurses according to their socio demographic characteristics.

| Demographic Characteristics	The studied nurses (n=80)	
	N	%
Age (in years)		
- (<28)	39	48.75
- (28-<38)	40	50.00
- (38-<48)	1	1.25
Range **Mean ± SD**	(22-43) 27.71±3.234	
Gender		
- Male	19	23.75
- Female	61	76.25
Marital status		
- Single	46	57.50
- Married	34	42.50
Educational level		
- Diplome	1	1.25
- Technical institute	10	12.50
- Bachelor	65	81.25
- Postgraduate	4	5.00
Type of ICU		
- Anesthesia ICU	50	62.50
- Traumatology Medicine ICU	30	37.50
Years of experience		
- < 5	51	63.75
- (5-10)	27	33.75
- >10	2	2.50
Range **Mean ± SD**	(1-25) 3.94±3.316	
Previous training about DAI (in weeks)		
- None	29	36.25
- <1	17	21.25
- (1-2)	15	18.75
- >2	19	23.75

DAI: Devices Associated Infection
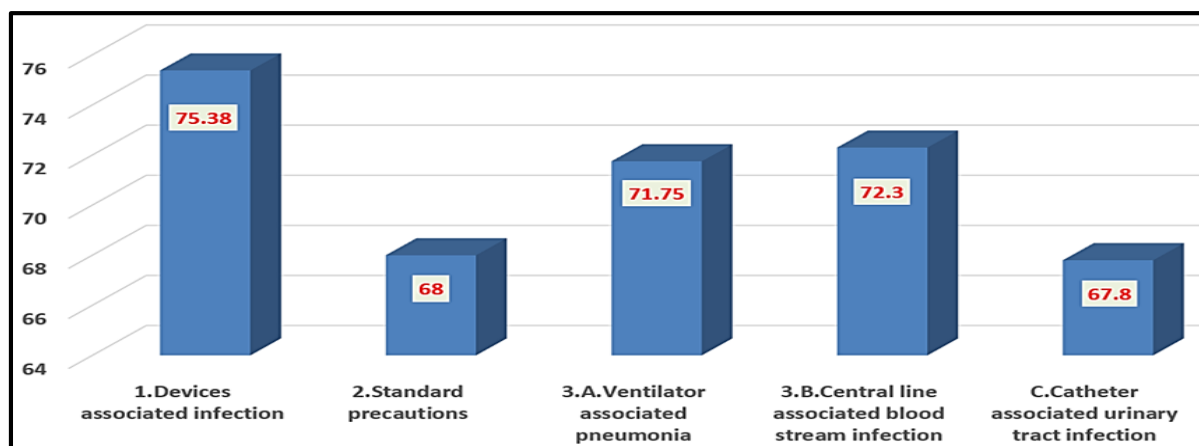
Figure 1: Percent distribution of the studied nurses according to correct knowledge regarding devices associated infection.

Table 2: Distribution of the studied nurses according to their total levels of knowledge regarding   devices associated infection.

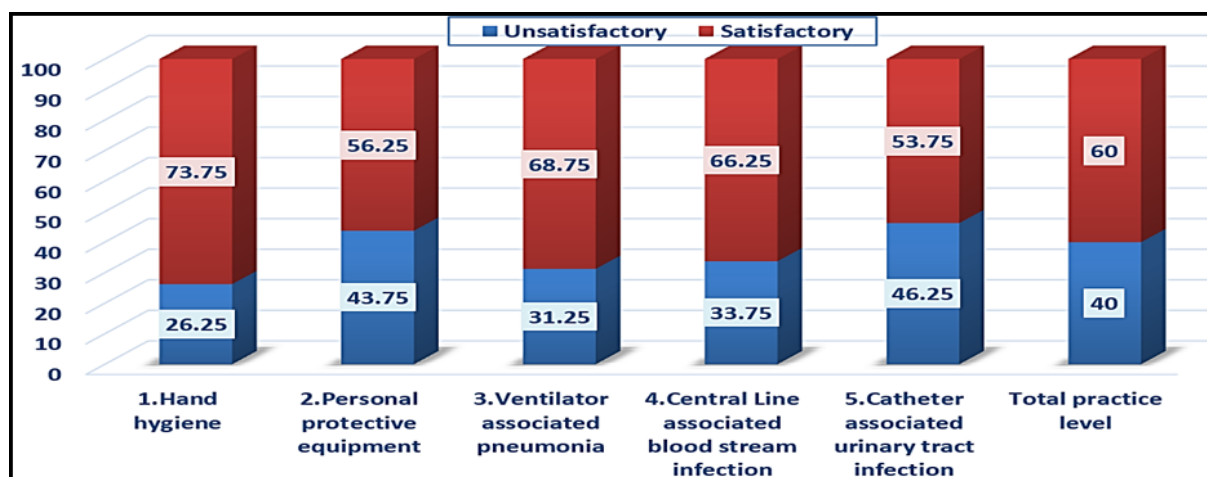| Total level of Knowledge	The Studied Nurse	
	No	%
Poor	13	16.25
Fair	49	61.25
Good	18	22.50

Figure 2: Distribution of the studied nurses regarding their total practice domains levels about devices associated infection.

Table 3: Relation between total knowledge level and total practice level of the studied nurses regarding devices associated with infection.

Total knowledge level	The studied nurses (n=80) Total practice level				χ^2 P
	Unsatisfactory (n=32)		Satisfactory (n=48)		
	N	%	N	%	
- Poor	7	8.75	6	7.50	6.127
- Fair	15	18.75	34	42.50	0.047*
- Good	10	12.50	8	10.00	

* Significant at level P<0.05

Table 4: Relation between socio-demographic characteristics and their total knowledge score of the studied nurses.

Characteristics	The studied nurses (n=80) Total knowledge score Mean ± SD	F/t P
Age (in years)		
- (<28)	36.56±5.715	0.295
- (28-<38)	37.60±5.835	0.746
- (38-<48)	35.00±0.00	
Gender		
- Male	35.89±6.163	0.627
- Female	37.08±5.563	0.431
Educational level		
- Diplome	35.00±0.00	
- Technical institute	33.80±6.828	1.604
- Bachelor	37.06±5.559	0.196
- Postgraduate	40.50±1.915	
Type of ICU		
- Anesthesia ICU	35.56±5.327	6.788
- Traumatology Medicine ICU	38.87±5.770	0.011*
Years of experience		
- < 5	36.37±5.667	
- (5-10)	37.63±5.956	0.427
- >10	36.50±2.121	0.654
Previous training about DAI (in weeks)		
- None	37.33±6.126	
- <1	36.41±4.963	0.967
- (1-2)	37.86±5.416	0.413
- >2	35.11±6.350	

* Significant at level P<0.05

Table 5: Relation between socio-demographic characteristics of the studied nurses and their total mean scores of practices about devices associated infection.

Characteristics	The studied nurses (n=80) Total practice score Mean ± SD	F/t P
Age (in years)		
- (<28)	50.18±8.651	0.058
- (28-<38)	50.70±7.290	0.944
- (38-<48)	49.00±0.00	
Gender		
- Male	48.58±9.800	1.369
- Female	51.00±7.200	0.246
Educational level		
- Diplome	49.00±0.00	0.312
- Technical institute	52.30±5.250	0.817
- Bachelor	50.05±8.367	
- Post graduate	52.25±6.702	
Type of ICU		
- Anesthesia ICU	52.24±6.751	7.640
- Traumatology Medicine ICU	47.40±8.811	0.007*
Years of experience		
- < 5	50.00±8.266	0.202
- (5-10)	51.15±7.518	0.818
- >10	51.50±3.536	
Previous training about DAI (in weeks)		
- None	52.24±6.791	3.410
- <1	46.00±8.860	0.022*
- (1-2)	48.80±7.360	
- >2	52.89±7.578	

* Significant at level P<0.05

Discussion

Prevention of DAI is critical to improving patient outcomes and reducing healthcare costs. Strategies for prevention of DAI include appropriate use of devices ،adherence to infection control guidelines, and implementation of evidence-based interventions. Healthcare providers must remain aware about their efforts to reduce DAI and improve patient outcomes **(Septimus and Moody, 2016)**.

Section I: Nurses' socio-demographic characteristics.

Half of nurses had age ranging from 28-38 years old with mean age of 27.71±3.234 years old and were female and single. In terms of education, most of the nurses had a bachelor's degree in nursing. In the researcher point of view this might be related to that, most of those affiliated with the nursing profession in Egypt are female, also half of them were single must be due to that most of

them have a bachelor's degree, so they care more about education than engagement.

This came in line with **Tafere, Belachew, Feleke, & Adal, (2023)** who showed that the majority of nurses were female, had a bachelor's degree and never married. Furthermore, **Gerida, El-Sheikh, & Abdelraouf, (2022)** who reported that nurses' mean age was 27.53 years and 70% and 73.3% of nurses were female and had bachelor's degree of nursing respectively.

This finding is contradicted by **Awad, Elfeky, Sultan, & Abo Seda, (2019)** who showed that the majority of the studied sample had a diploma in nursing education and **Kadium, (2015)** carried out their study about improving nurses' knowledge to reduce catheter-related bloodstream infection in a haemodialysis unit and demonstrated that the most of studied sample had basic nursing diploma.

The present study showed that the majority of the nurses worked in the anaesthesia ICU, while one third of them worked in the trauma ICU. Moreover, less than two-thirds of the nurses had more than 5 years of experience in the ICU, in the researcher point of view, this might be related to that, half of them had age ranging from 28-38 years old with mean age of 27.71±3.234 years old. Additionally, more than a third of the nurses had not received previous training on devices associated with infection, and a quarter of them had attended training programs on AID in the past 2 weeks.

This finding is in the same line, **Tafere et al., (2023)** showed that the

majority of nurses had less than 10 years of work experience. Additionally **Gerida et al., (2022)** who reported that he mean of nurses' years of experience in nursing carrier was 4.8 years and the mean of nurses' years of experience in PCICU was 4.5 years. On the other hand, the finding was contradicted by **Wei, Markert, Connelly, & Polenakovik, (2021)** who carried out a study about CLABSI and revealed that the experience years in the studied sample were less than five years.

Section II: Nurse's level of knowledge regarding devices-associated infection.

In the current study, nearly three quarters of the studied nurses had correct knowledge regarding DAI, VAP and CLABSI. Additionally, nearly two third of them had correct knowledge regarding standard precautions and CAUTI, in the researcher point of view this could be related to that, majority of the studied nurses had bachelor degree.

This finding agreed with **Shahbaz, Sarwar, Hayat, & Sarwar, (2024)** revealed that nurses demonstrated satisfactory knowledge regarding CLABSI prevention. Also, **Mong et al., (2021)** reported that more than two thirds of the studied nurses had good knowledge of CAUTI prevention. While, this results disagreed with **Getahun et al., (2022)** found that less than half of the studied nurses had poor knowledge regarding VAP. Also, **Salu, Okyere, Charles-Unadike & Ananga, (2023)** revealed that less than one third of the studied nurses had good knowledge regarding standard precautions.

In the present study, it was observed that nearly two third of the studied nurses had fair level of total knowledge compared to less than one quarter of them had good level of total knowledge regarding DAI. From the researcher point of view, this disparity could be attributed to factors such as limited access to ongoing education, inadequate training resources, or insufficient participation in relevant seminars and workshops. Understanding these underlying reasons is crucial for improving overall knowledge among nurses.

In line with the current results, **Ahmed and Kafl, (2019)** reported that approximately one third had a satisfactory level. Also, **Qayyum, Waqas, & Sattar, (2010)** found that the studied nurses had poor knowledge about device associated infections and their routes of spread. While, this findings disagree to **Ibrahim, Said, & Hamdy, (2011)** who found that the majority of their studied group had good knowledge about methods of transfection of infection.

Section III: Nurses' level of practices regarding devices associated infection.

The present study found that the highest percent of the studied nurses had satisfactory level regarding hand hygiene, VAP, CLABSI, PPE and CAUTI. In addition to, less than two thirds of the studied nurses had satisfactory level compared to more than one third of them had unsatisfactory practices level. This result is in agreement with **Sobeh, Mahmoud, & Abdelkader, (2023)** revealed that majority of the studied nurses had good practices level. Also, **Kaur, Dhaliwal, Randhawa, & Singh, (2021)** reported that less than two thirds of the studied nurses had adequate level of practices regarding CAUTI. Additionally, **Muhammad, Khan, Saleem, Muhammad, & Jamal, (2022)** revealed that the highest percentage of the studied nurses had good practices regarding PPE use. While, this finding disagreed with **Veer & Sharma, (2023)** found that more than half of the studied nurses had poor practices regarding CLABSI. Also, **Abad, Formalejo, & Mantaring, (2021)** reported that majority of nurses had poor adherence to specific components of the VAP bundle.

Section IV: Relations between total level of knowledge and total level of practice of the studied nurses regarding to devices associated infection.

In the present study, it was noticed that the studied nurses who had fair level of knowledge had satisfactory level of practice with statistical significance relation between total level of knowledge and practice. From researcher point of view, this implies that nurses may be able to implement effective practices, potentially as a result of their experience or the influence of workplace protocols, despite having a basic understanding. Hands-on training and mentoring may enhance their practical skills, enabling them to perform essential tasks with proficiency.

These findings underscore the significance of bridging knowledge gaps through ongoing education to

improve patient care outcomes by enhancing knowledge and practice.

In the same line, **Desoky, Mohamed, Shafik, & Nabawy, (2022)** found that there was a statistically significant difference with positive correlation between total nurses" knowledge and practices scores. Supporting this findings, **Said, Yassien, & Ali, (2020)** revealed that there is high significant statistical positive correlation between total knowledge about DAI and total practice of nurses.

Also, **Mohamed, Abood, Gamal, & Ali, (2013)** indicated that nurses with good level of knowledge have fair practices this might be due to positive relationship between knowledge and practices.

Furthermore, **Elghareb et al., (2012)** showed that there was a moderate positive statistically significant correlation between nurses' knowledge and practice score.

The findings of the current study contrast with those of **Day et al. (2002),** who reported that no correlation between working experience and the level of knowledge.

Section V: Relations between socio-demographic characteristics of the studied nurses on their total knowledge and practices score about associated infection.

There was a significant relation between type of working at ICU and total knowledge with no significant relation between age, years of experience and total knowledge level. The findings suggest that the nature of work undertaken by nurses in the ICU has a substantial effect on their overall knowledge. This implies that particular roles or responsibilities may facilitate enhanced learning and exposure to critical information. Conversely, factors such as age and years of experience do not seem to significantly affect total knowledge levels, indicating that knowledge acquisition is likely more influenced by job-specific tasks rather than general experience or seniority. This underscores the importance of implementing role-based training programs to ensure that all nurses attain high levels of knowledge, irrespective of their position or experience.

Our findings are supported by **Said et al., (2020)** who showed that there is no statistically significance between total knowledge scores in relation to gender, age, qualification and years of experiences in the field of nursing. Moreover, **Jarelnape, (2023)** addressed the relationship between demographic characteristics and the knowledge of nursing staff regarding aseptic techniques. The results showed that there was no significant relation between age and level of knowledge. Moreover, this finding aligns with a previous study that has shown that there was no significant correlation between age and knowledge scores related to infection control practices **(Abalkhail et al., 2021)**

These findings are disagreed by **Abdullah et al., (2014)**, who revealed a higher tendency of bachelor nurses to have higher mean knowledge scores and those who have less than one year of experience got higher

mean knowledge scores than others, with significant statistical difference.

Also, **Rushdy, Youssef, & Elfeky, (2015)** revealed a significant statistical difference between mean knowledge score and the degree of nursing education and **Awad et al., (2019)** showed that there was negative significant statistical correlations found between total knowledge scores and age, years of experience in the ICU.

The present study showed a statistically significant relation between the nurses' total practices level and type of working in ICU and previous training about devices associated infection. This suggests that the nurses who work in anesthesia ICU, have more training about devices associated infection that enhance nurses' skills of prevention of devices associated infections. This result supported by **Parsons and Walters, (2019)** found that nurses practicing in ICUs have strong clinical skills to care for persons with life-threatening injuries and illnesses. They must have a systematic method to organize care, be good multitaskers, and have stellar critical thinking and diagnostic reasoning skills.

Contrasted to this findings, **Said et al., (2020)** showed that there is highly statistically significant difference between total practice scores and years of experience in the intensive care unit. However, **Barsuk et al., (2015)** who concluded that total years in nursing had a significant negative correlation with overall baseline performance. Furthermore, **Hill, (2010)** conducted a study on

improving quality and patient's safety and revealed that the years of experience had a positive impact on the quality of care provided.

Conclusions:

The findings revealed knowledge gaps in specific important areas such as hand hygiene, use of personal protective equipment, and prevention of device-associated bloodstream infections; this study emphasized the need for targeted educational interventions to enhance nurses' knowledge and improve compliance with infection control practices regarding different invasive devices used in ICU.

Recommendations

- Continuous education and training programs for nurses are recommended to enhance their knowledge and practices related to device-associated infections.
- Implementing checklists can ensure adherence to standard precautions and guidelines.
- Develop and implement on job training sessions for newly hired nurses regarding devices associated infection.

Recommendation for administration

- Intensive care units should establish policies aligned with these standards, and regular evaluation and monitoring of nurses' knowledge and practices should be conducted to ensure effective infection prevention.

Recommendations for further researcher studies

- Future studies should target diverse populations in order to test whether similar factors are

similarly important for devices associated infection knowledge and practices among nurses.
- Replication of the same study on larger probability sample at different geographical locations for data generalizability.

Limitations:

The fact that the sample size was relatively small, which may have affected the power of the study. The study was conducted in a single center, which may have limited the generalizability of the results. The study did not include other healthcare professionals, such as physicians and allied health professionals, who also play a role in preventing infection-associated devices.

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