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Nurses' Performance Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia

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ABSTRACT

Background: Ventilator Associated Pneumonia is the most prevalent hospital-acquired infection that develops as a complication in patients undergoing mechanical ventilation after 48 hours from the intubation time. Contributing to increased morbidity and mortality rates. **Aim:** This study aimed to assess nurses' performance regarding ventilator associated pneumonia bundle. **Research design:** A descriptive design was used for conducting the study. **Setting:** The study was carried out in General Intensive Care Unit at Beni-Suef University Hospital. **Subjects:** Convenience sample of all available nurses were included in the study in the previously mentioned settings. **Data Collection Tools:** Data were obtained through two tools, **I** - Nurses' self-administered questionnaire, it included nurses' demographic characteristics and nurses' knowledge, **II** - Nurses' practice observational checklist. **Results:** More than three quarters of studied nurses aged between 20-25 years, more than half of them had technical nursing institute. The majority of studied nurses had unsatisfactory knowledge levels regarding ventilator associated pneumonia bundle of care for prevention of ventilator associated pneumonia and most of them had incompetent levels of practice regarding bundle of care for prevention of ventilator associated pneumonia. Also there was highly statistically significant difference between the nurses' performance, level of knowledge and practice regarding ventilator associated pneumonia bundle. **Conclusion:** the majority of the study nurses had unsatisfactory knowledge and most of them had incompetent level of practice regarding ventilator associated pneumonia bundle. **Recommendations:** developing educational and in-service training programs to enhance nurses' knowledge and application of the ventilator associated pneumonia bundle.

Keywords: Knowledge, Practice, Performance, Ventilator Associated Pneumonia, Ventilator bundle

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a lower respiratory tract infection that develops as a complication in patients on mechanical ventilation (MV). The infection was not apparent at the time of hospital admission, but it continued more than 48 hours after intubation and mechanical ventilation. Furthermore, it is a major source of morbidity and mortality, longer hospital stays, higher health-care expenses, and delayed weaning in ventilated patients, making it a critical ICU issue. As a result, decreasing VAP is one of the national patient safety goals ***(Madhuvu et al.,2022).***

Patients on mechanical ventilation are at greater risk of acquiring ventilator-associated

pneumonia (VAP), which can be caused by a variety of factors. There are numerous factors that contribute to the development of VAP. It was divided into modifiable and non-modifiable risk factors. Non-modifiable risk factors include male sex, advanced age, a history of respiratory disease, head trauma, post-surgical recovery, Acute Respiratory Distress Syndrome (ARDS), and coma. While modifiable risk factors that are possibly adjustable include lying supine, stomach over distension, and ventilator circuit colonization. **(*Karunarathna et al., 2024).***

The American Association of Critical-Care Nurses (AACN) and the Institute for Healthcare Improvement (IHI) have proposed multiple strategies to reduce the occurrence of VAP. It is known as the "ventilator bundle," and it is a group of evidence-based practices. When used simultaneously, these treatments dramatically reduce ventilator-associated pneumonia (VAP) in patients on mechanical ventilation. Also, the care bundle method has been demonstrated to be successful in lowering VAP incidence. Therefore all interventions in the bundle need to be implemented collectively and reliably. ***(Buterako et al.,2022;Leong et al .,2024).***

Furthermore, These measures, which are depending on the best practice guidelines for patients on mechanical ventilation. The bundle includes the following components; elevating the Head of the Bed (HOB) by 30 to 45 degrees, taking daily sedation vacations, assessing the patient's readiness to extubate, prophylactic treatment for peptic ulcer disease, prophylactic treatment for deep vein thrombosis (DVT), and daily oral care with chlorhexidine (***Holmes et al.,2022;Hassan et al.,2022).***

The VAP bundle was created for providing an approach in VAP prevention because VAP is considered a serious risk for MV patients. A critical care nurses provide care to MV patients. Moreover, play an crucial role in preventing the development of VAP. Furthermore, ventilator associated pneumonia reduction is mostly dependent on nursing interventions due to nurses are at the center of attempts to improve hospital care quality. Therefore, It is essential for nurses to recognize the significance of preventative methods and constantly apply them in their practice. it is the responsibility of the nurses to implicate the VAP bundle to lower the VAP incidence ***(Attia et al., 2018;Rehmani et al.,2024).***

Furthermore, nurses are the backbone of any intensive care unit, as they have more direct patient interaction than any other member of the healthcare team. Nurses have an important role in respiratory care, and they are alone responsible for implementing the majority of VAP prevention interventions. The nurses' responsibilities include implementing the VAP bundle. Furthermore, whose knowledge, beliefs, and performance influence the health outcome. ***(Mugheed et al.,2022)***.

Furthermore, intensive care nurses are essential members of a multidisciplinary team who play an significant role in the care of hospitalized patients. To ensure the highest quality of nursing care, A firm basis of scientific knowledge must guide nursing practice. Following the evidence-based interventions for preventing ventilator-associated pneumonia can help achieve this, which will eventually improve patient outcomes. Moreover, will reduce the length of the patient's stay in the intensive care unit, their hospital stay, and lower healthcare costs ***(Shivananda & Yashoda .,2021).***

SIGNIFICANCE OF THE STUDY

Ventilator-associated pneumonia is considered a serious health issue worldwide, with undeveloped countries having the highest number of healthcare-associated infections. VAP is also a major source of patient morbidity and mortality in intensive care units (ICUs) and one of the most common nosocomial infections, with a prevalence rate ranging from 10% to 70%. VAP is associated with an estimated mortality ranging from 16.2 to 74.17%. ***(Kharel et al.,2021).***

Furthermore, VAP can cause increasing in the length of stay in hospital with a rate of 20%–30%. In the ICU, the VAP incidence is 22.8% in patients connected with mechanical

ventilation. Moreover, the VAP rate was shown to account for 47% of all infections among ICU patients, and can occur in 9%–27% of all intubated patients, which could contribute to serious consequence. Therefore intensive care nurse has an significant and crucial role in preventing VAP. Also, should be updated with the latest evidence-based practice to reduce such complication ***(ALaswad & Bayoumi.,2022).***

Pneumonia accounts for about 15% of all hospital-associated infections around the world. According to the CDC's National Nosocomial Infection Surveillance System (NNIS). Although the global prevalence of VAP has reduced, it remains extremely high. The European Centre for Disease Prevention and Control (ECDC) stated that the incidence of VAP in Europe was 8.9 per 1000 days of IMV. The reported incidence of IMV in the United States ranges from 1.2 to 8.5 cases per 1000 days, depending on the data source. **(Plata et al., 2022).**

Ventilator-associated pneumonia occurrence in Egyptian ICUs ranged from 16% to 75%. In comparison with its incidence World Wide, 10–28%, it is about 2.5 times more. The mortality rate of ventilator patients who develop VAP is 46%, compared to 32% for ventilator patients who do not develop VAP. Therefore, application of VCB is considered a standard of care for ventilated patients for saving their live and improves outcomes***(Mohammed et al., 2023).***

Therefore, VAP has severe consequences, including increasing the length of ICU and hospital stays, which can raise overall health-care costs. Furthermore, it plays an significant role in developing antimicrobial resistance secondary to the burden that results from the treatment of the respiratory tract infection in the ICU, which contributes to delayed extubation and higher mortality and morbidity rates. Therefore, VAP is considered an expensive complication***(Abdulrahman et al.,2024).***

AIM OF THE STUDY

The aim of the study was to assess the nurses' performance regarding bundle of care for prevention of ventilator associated pneumonia at intensive care unit Beni-Suef University Hospital.

Research questions

1- What is the nurses' level of knowledge regarding bundle of care for prevention of ventilator associated pneumonia?

2- What is the nurses' level of practices regarding bundle of care for prevention of ventilator associated pneumonia?

SUBJECTS AND METHODS

Technical design

The technical design encompassed the research design, setting, subjects, and tools for data collection.

Research design.

A descriptive exploratory design was utilized to achieve the aim of the study.

Setting

The present study was carried out in Beni-Suef University Hospital's General Intensive Care Unit, the hospital consists of 16 main departments, and 11 units providing multi services. The hospital consists of seven-floor building. General Intensive Care Unit is located on the third floor of the hospital and has 19 beds, 12 ventilators, 19 monitors, and 3 emergency carts distributed among three rooms.

Subjects:

Sample type and size : Convenience sample of all available nurses (50 nurse male and female) used in current study, who are working in the previously mentioned settings and give direct nursing care and directly contact with critical ill patients regardless their age, education, sex, education and years of experience.

Tools of data collection:

Data were collected using the following two tools:

Tool (I): Nurses' Knowledge Questionnaire:-

Consists of two parts:-

Part 1- Socio Demographic Characteristics of Nurses :

This tool consists of staff nurses' characteristics. It include nurse's age, sex, level of education, marital status, years of experience in intensive care unit and any training courses regarding VAP prevention.

Part 2 - Nurses' Knowledge Regarding VAP Bundle :

This tool It was adapted from***(Sobeih et al.,2018)*** aimed to assess level of nurses' knowledge regarding VAP bundle among patients on mechanical ventilation and it consisted of 35 questions in form of multiple choice questions (MCQs).Depending upon the scoring system used and overall mean score earned. It was included ; a ventilator associated pneumonia, a ventilator associated pneumonia bundle, head of bed elevation, early weaning from mechanical ventilator, deep vein thrombosis prophylaxis, peptic ulcer disease prophylaxis, oral care, endotracheal tube, endotracheal suctioning and a ventilator care measures.

Scoring system: The correct answer was scored "1", while the incorrect was scored zero. Evaluation of knowledge was considered to be satisfactory level of knowledge when ≥75%, while unsatisfactory level of knowledge when <75% ***(Sobeih et al.,2018)***

Tool II - Nurses' Observation Checklist: This tool It was adapted from ***(Sobeih et al.,2018)*****.** It aimed to assess the nurses' level of practices of VAP bundle between mechanically ventilated patients and it was included 5 items: routine hand washing, oral care, tracheal suctioning, patient positioning and ventilator care measures.

Scoring system: each items was scored by done = 1 or not done= zero. Evaluation of practice was considered to be competent level when ≥90%, while incompetent level when <90% ***(Sobeih et al.,2018).***

Operational design

The operational design contain preparatory phase, content validity, pilot study and field work.

Preparatory phase:

It included reviewing of related literature, and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and magazine, to develop tools for data collection.

Tools Validity and reliability

- **Content Validity:**

The content validity of the established tools was tested for clarity and applicability by five experts all of them were assistant professors of medical surgical nursing department at Faculty of Nursing Beni-Seuf University. The expertise evaluate the tool for clarity of sentences, relevance, accuracy, comprehensiveness, simplicity and applicability, minor modification was done. Finally, the final forms were developed.

Reliability:

The reliability for the study was calculated by: The Cronbach Alpha was calculated for both knowledge (0.802), practice (0.767) to confirm the reliability of the questionnaire by test- retest on two occasions of the pilot of the instrument on the same population, and the cronbach alpha was greater than the recommended value of 0.7

Pilot study:

A pilot study was implemented on (10%) five nurses from the study nurses to test the clarity, applicability, possibility and relevance of the tools used and to determine the needed time for the application of the study tools. The nurses who were included in the pilot study were excluded from the sample replaced by others.

Field Work

- An approval letter obtained from Bani-suef university hospital directors and nursing directors.
- The aim of the study was simply explained to nurses who participated in study prior to data collection. The investigator was collect the data from the nurses and nurse's informal consent to participate in the study was obtained after the researcher explained to the nurses the

objective of the study and confidentiality was preserved.

- The data was collected from nurses at Beni-Suef University Hospital in general ICU. Two days per week at the beginning of morning shift ,the researcher was attended the shifts that was scheduled in the morning. to collect data from nurses and to observe nurses practice due to routine patients' procedures begin at the beginning of the shift and stayed with them along day shift.
- The investigator was gave the self-administered questionnaire sheet to the nurses in their workplace; each questionnaire was taken 30 to 45 minutes to fill it. Nurse's performance were assessed using observational checklist by the researcher at Beni-Suef University Hospital.
- Three nurses observed in the day maximally during providing the care for mechanically ventilated patients in their work place then they fill questionnaire sheet according their endorsement shifts distribution to maintain nurse patient ratio1to1and according to patient critical condition.
- Data collection started and completed within 6 months. (from beginning of June2023 to end of November 2023)

Administrative design

To carry out this study, A written approval letter was being issued from the Faculty of Nursing-Beni-suef University. The letter was being directed to the general manager of Beni-Suef University Hospitals are seeking for collaboration and permission to conduct this study. Moreover, explaining the purpose of the study to obtain the permission for conducting this study.

Ethical considerations:

Approval of the study protocol was obtained from the Scientific Research Ethical Committee of the Faculty of medicine , Beni-Suef University. Written consent was obtained from each participant to participate in the study after the researcher clarify and discussion the aims, objectives and expected outcomes from the study. Anonymity and confidentiality of participants were assured and they were given the right to choose to participate or not participate in the study, and the right to withdraw from the study at any time without giving any explanation. They are secured that all the gathered information were confidential and used for the research purpose only.

Statistical design

The data was collected, organized, categorized, tabulated and statistically analyzed using the statistical package for social science (SPSS) version (21) to assess nurses' level of knowledge, practice, regarding VAP bundle. Data were presented in tables and graphs. The statistical analysis included; percentage (%), the arithmetic mean ($\overline{X}$), standard deviation (SD) and chi-square (X2**&** P-value).

RESULTS

Table (1): summarized the distribution of studied nurses' socio-demographic characteristics. Regarding their ages, more than three quarter of studied nurses (76%) were aged between 20 and 25 years with mean age (24.20±2.08). Concerning their gender, less than three quarters of studied nurses (72%) were female. Pertaining to their educational qualifications, more than half of studied nurses (56%) had technical nursing institute. Regarding their experience and training, more than half of studied nurses had less than two years of experience and less than three quarters them had training courses regarding VAP(56% and 72%) respectively.

Table (2): . displayed the distribution of studied nurses' knowledge levels regarding bundle of care for prevention of ventilator associated pneumonia. Related to knowledge items, More than three quarters of studied nurses 76% had unsatisfactory knowledge about ventilator associated pneumonia and VAP bundle. Also, more than half of them had unsatisfactory knowledge about DVT. Additionally, almost all of studied nurses 100% had un satisfactory knowledge about PUDs.

Figure (1): Illustrated that, Frequency Distribution of Studied Nurses' Knowledge Levels Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia the minority 12% of the studied nurses had satisfactory level of knowledge regarding ventilator associated pneumonia bundle, while the majority of them 88% had unsatisfactory level of knowledge regarding ventilator associated pneumonia bundle.

Table (3):. Illustrated the distribution of studied nurse' practices levels regarding bundle of care for prevention of ventilator associated pneumonia. Related to practice items, the majority of studied nurses 80% had incompetent level of practice on hand washing. Also the most of them had incompetent level regarding tracheal suctioning and ventilator care measures practice (92% and 96%) respectively. Furthermore, almost all of them (100%) had incompetent level of practice regarding oral care and patient positioning.

Figure (2): Showed that, the minority 4% only of the studied nurses have competent level of practice regarding ventilator associated pneumonia bundle, while most of them 96% have incompetent level of practice regarding regarding ventilator associated pneumonia bundle.

Table (4): Summarized the correlation matrix between studied nurses' knowledge and their practice regarding ventilator associated pneumonia bundle of care. Using Pearson's correlation coefficients, there were highly statistically significant difference between the nurses' level of knowledge regarding ventilator associated pneumonia bundle and their practice.

Table (5): revealed the relation between studied nurses' socio-demographic characteristics and their knowledge regarding ventilator associated pneumonia bundle of care. There were highly significant statistical relation between studied nurses' knowledge and their age. Also there were significant statistical relation between studied nurses' knowledge and their gender and educational qualification. While There were non-significant statistical relation between studied nurses' knowledge and their years of experiences and their training courses.

Table (6): summarized the relation between studied nurses' socio-demographic characteristics and their practice regarding ventilator associated pneumonia bundle of care . There were insignificant difference (No difference) between studied nurses' practice and their socio-demographic characteristics ,While there were significant statistical relation between studied nurses' practice and their training courses only.

Table (1): Frequency Distribution of Studied Nurses' Socio-Demographic Characteristics (N=50**).**

Personal characteristics	No.	%
Age (years)		
– 20 < 25	38	76
– 25 < 30	12	24
Mean±SD	**24.20±2.08**	
Gender		
– Male	14	28
– Female	36	72
Nursing Qualifications		
– Nursing Technical Institute	28	56
– Bachelor of Nursing	18	36

– Post graduate	4	8
Experience (years)		
– < 2	28	56
– 2 < 4	14	28
– 4 < 6	4	8
– ≥ 6	4	8
Mean±SD	**2.76±1.81**	
Training courses on VAP		
– Yes	36	72
– No	14	28

Table (2): Frequency Distribution of Studied Nurses' Knowledge Levels Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia (N=50).

Knowledge items	Unsatisfactory		Satisfactory	
	No.	%	No.	%
Ventilator associated pneumonia (VAP)	38	76	12	24
VAP bundle and patient care	38	76	12	24
Deep venous thrombosis (DVT)	28	56	22	44
Peptic ulcer disease(PUD)	50	100	0	0
Nurses' Overall Knowledge Levels	**44**	**88**	**6**	**12**

Fig.(1): Frequency Distribution of Studied Nurses' Knowledge Levels Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia (N=50)

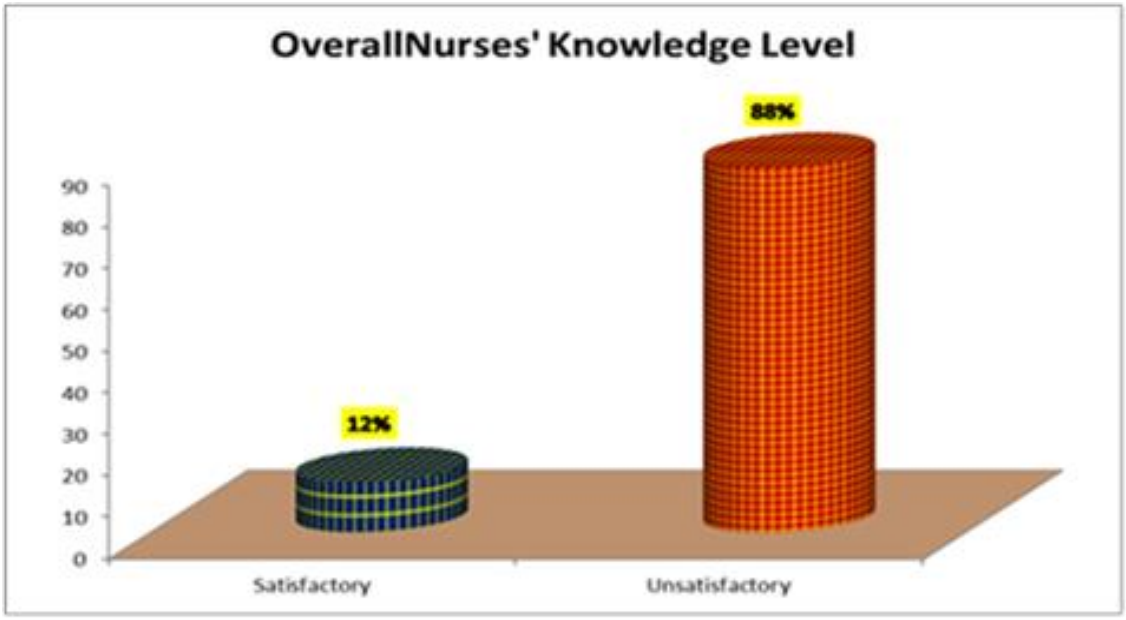

Table (3): Frequency Distribution of Studied Nurse' Practice Levels Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia (N=50

Nurses' Practice Items	Incompetent		Competent	
	No.	%	No.	%
Routine hand washing	40	80	10	20
Oral care for dependent patient	50	100	0	0
Tracheal suctioning	46	92	4	8
Positioning	50	100	0	0
Ventilator care measure	48	96	2	4
Nurses' Overall Practice Levels	**48**	**96**	**2**	**4**

Fig. (2): Frequency Distribution of Studied Nurse' Practice Levels Regarding Bundle of Care for Prevention of Ventilator Associated Pneumonia (N=50).

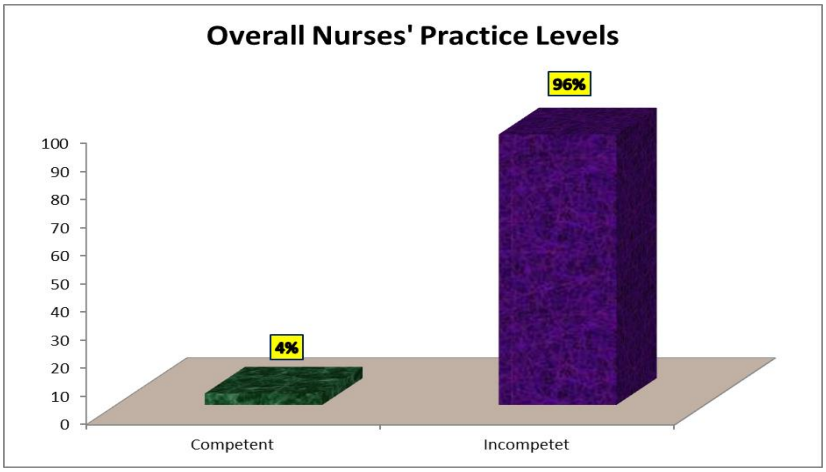

Table (4): Correlation Matrix between Studied Nurses' Knowledge and their Practice Regarding Ventilator Associated Pneumonia Bundle of Care (N=50)

Variables		Total Practice	Hand washing	Oral Care	Suctioning	Positioning	Vent.care
Total Knowledge	***r***	0.645	0.342	0.337	0.135	0.114	-0.267
	P-Value	0.000**	0.015*	0.017*	0.349	0.431	0.061
Total Practice	***r***		0.638	0.639	0.685	0.807	0.634
	P-Value		0.000**	0.000**	0.000**	0.000**	0.000**
Hand washing	***r***			0.274	0.383	0.224	0.021
	P-Value			0.054	0.006**	0.118	0.886
Oral Care	***r***				0.239	0.499	-0.226
	P-Value				0.094	0.000**	0.114
Suctioning	***r***					0.555	-0.157
	P-Value					0.000**	0.277
Positioning	***r***						0.080
	P-Value						0.582

** Correlation is significant at the 0.01 level (2 tailed).

* Correlation is significant at the 0.05 level (2 tailed).

Table (5): Relation between Studied Nurses' Socio-Demographic Characteristics and their Knowledge Regarding Ventilator Associated Pneumonia Bundle of Care (N=50).

Socio-demographic Characteristics	Knowledge Levels				χ^2	P-value
	Unsatisfactory		Satisfactory			
	No.	%	No.	%		
Age						
– 20 < 25	36	72	2	4	6.805	0.009**
– 25 < 30	8	16	4	8		
Gender						
– Male	10	20	4	8	5.05	0.025*
– Female	34	68	2	4		
Nursing Qualifications						
– Nursing Technical Institute	26	52	2	4	6.109	0.047*
– Bachelor of Nursing	16	32	2	4		
– Post graduate	2	4	2	4		
Years of Experience						
– < 2	22	44	6	12	5.357	0.147
– 2 < 4	14	28	0	0		
– 4 < 6	4	8	0	0		
– ≥6	4	8	0	0		
Training						
– Yes	30	60	6	12	2.652	0.103
– No	14	28	0	0		

Table (6) Relation between studied nurses' socio-demographic characteristics and their practice regarding ventilator associated pneumonia bundle of care (N=50).

Socio-demographic Characteristics	Practice Levels				χ^2	P-value
	Incompetent		Competent			
	No.	%	No.	%		
Age						
– 20 < 25	36	72	2	4	0.658	0.417
– 25 < 30	12	24	0	0		
Gender						
– Male	14	28	0	0	0.810	0.368
– Female	34	68	2	4		
Nursing Qualifications						
– Nursing Technical Institute	26	52	2	4		

– Bachelor of Nursing	18	36	0	0	1.637	0.441
– Post graduate	4	8	0	0		
Years of Experience						
– < 2	26	52	2	4	1.637	0.651
– 2 < 4	14	28	0	0		
– 4 < 6	4	8	0	0		
– ≥6	4	8	0	0		
Training						
– Yes	36	72	0	0	5.357	0.021*
– No	12	24	4	8		

DISCUSSION

Ventilator-associated pneumonia (VAP) is the most prevalent and lethal type of hospital-acquired infections that can be defined as nosocomial pneumonia in mechanically ventilated patients, which develops more than 48 hours after intubation and initiation of mechanical ventilation (MV) and is associated with significant mortality and morbidity, makes up to 86% percent of nosocomial pneumonias, prolonged ventilation, increased antibiotic use, emergence of multidrug resistance **(Hegazy et al., 2020).**

The current study is a descriptive research study aimed to evaluate nurses' knowledge and practice regarding ventilator-associated pneumonia (VAP) bundle to reduce the incidence of ventilator-associated pneumonia (VAP) In General Intensive Care Unit In A Beni-Suef University Hospital. Our goals were to assess intensive care nurses' level of knowledge and practice regarding bundle of care for prevention of ventilator associated pneumonia.

Pertaining the study nurse's demographic characteristics, the result of the present study presented that more than three quarters of the studied nurses surveyed were between the ages of 20 and 25. This explains why the majority of those nurses were recent graduates, youthful, and able to cope with the demands of critical care. This finding is congruent with what **Soni (2018**) observed in a study titled "Knowledge, Adherence, and Barriers to the Prevention of Ventilator-Associated Pneumonia among Nurses," in which the majority of the nurses evaluated were aged 20 to 25.

Whenever this finding is contradicted with **Bankanie et al.,(2021),** in a study titled "Assessment of knowledge and compliance to evidence-based guidelines for VAP prevention among ICU nurses in Tanzania"**,** who accomlished a descriptive study to identify ICU nurses' knowledge and compliance with evidence-based guidelines to prevent VAP and he discovered that the majority of the study nurses were **31** to **39**years of age.

Pertaining to their gender, the current study results revealed that, less than three quarters of the studied nurses were females which could be interpreted that old perception that nursing profession is caring job that more suitable for females more than males, The higher proportion of nurses in Egypt were females, which could be attributed to the fact that nursing studies in Egyptian universities were solely open to females until fifteen years ago.

This results consist with what was reported by **Jalal et al.,(2022)** who stated that the most of their respondents were female and with **Abad et al.,(2021)** in a study titled " Assessment of knowledge and implementation practices of the ventilator acquired pneumonia (VAP) bundle in the intensive care unit of a private hospital" who reported that the majority of their studied sample were females. Conversely this finding is contradicted with **Getahun et al.,(2022)** in a study titled "Knowledge of intensive care nurses' towards prevention of ventilator-associated pneumonia in North West

Ethiopia referral hospitals" who found that the majority of the their studied nurses were males.

Related to their educational level, the current study found that more than half of the nurses examined had a technical nursing institute, while the remainder had a nursing bachelor's degree. This can elaborate the current position of nursing qualification, since bachelor nursing job as administrator more than practitioner. Furthermore, this is in agreement with **Hammouda, et al.(2022)** who report that 67% of their participants were graduated from the Technical Nursing Institute

Also with **Al-jaradi (2020),** in a study titled "Knowledge of ICU Nurses toward prevention of ventilator associated pneumonia at public hospitals in Sana'a, City-Yemen" who found that more than half of the their studied nurses had either diploma or advanced diploma in nursing **.**This finding is contradicted with **Al-Sayaghi (2021)** who reported that the majority of the their sample population practiced with a bachelor's degree it displayed higher knowledge levels compared to those with a Diploma or technical institute

Pertaining to studied nurses' years of experience in critical care unit, the current study revealed that more than half of the studied nurses had experience less than two year, this could be due to their young age. This finding is consistent with what was reported by **Al-jaradi et al.,(2020),** which found more than half of their studied nurse had from 1-3 years of experience in ICU .On the opposite side this result is contradicted with many studies as; **Hussein et al.,(2023)** in a study titled "Knowledge of Ventilator Care Bundles among Registered Nurses in the Intensive Care Unit at Sarawak General Hospital, Malaysia**"** who found that more than two third of their studied nurses had from five to ten years of experience in ICU

In relation to attendance to training courses about VAP , the current study revealed that more than two third of the studied nurses had training courses about VAP this finding in contrary with **El-Sayed et al.(2023)** in a study titled "Assessment of Nurses' Knowledge and Practice Regarding Prevention of Ventilator Associated Pneumonia In Neonates" who report that the majority of their participants had not any courses about VAP training. This study finding consistent with ***Alkhazali et al. (2021),*** found that most nurses gained their knowledge in-service training program.

Concerning overall nurses' knowledge of ventilator-associated pneumonia bundle. The current study found that the majority of the studied nurses had inadequate knowledge regarding the ventilator-associated pneumonia bundle. From the researcher's viewpoint, this could be related to that. This inadequacy of nurses' knowledge reflects the fact that more than half of the studied nurses only technical institute and do not have a special degree in ICU nursing, lack of exposure to such information, lack of nurses' supervision, lack of orientation program prior to work as well as lack of care conferences during work, non-availability of procedure books specially prepared for the critical care areas, and lack of direction, so they are not prepared or knowledgeable.

Additionally, this results are congruent with **Rehmani et al.,(2024)** who stated that the majority of their critical care nurses with varied educational levels, regardless of their years of experience, had unexpectedly low knowledge ratings about ventilator-associated pneumonia and VAP bundle preventive strategies. Also with, **Alreshidi et al.,(2024)** in a study titled "Nurses' Knowledge on the Prevention of Ventilator-Associated Pneumonia (VAP) among Critically Ill Patients" who found that the majority of their studied nurses have low baseline of knowledge about VAP preventive guidelines during the pre-test **in king salman specialist hospital, Saudi Arabia.**

Furthermore, In accordance with current study findings**, AL-Moutiwty et al.,(2023)** in a study titled "Nurses' Knowledge and Skills Regarding Care Bundle guideline in Mosul Hospitals" also found that knowledge of evidence-based interventions for preventing VAP is significantly decreased among more than half of nurses working in ICUs.

On the other hand, this finding is contradicted with, **Hussein et al.,(2023)**who reported that, their ICU nurses have high-level knowledge of the VCB. Due to most of their studied nurses more qualified registered nurses work in ICU for more than five years with bachelor's degree and ICU nurses' knowledge on VAP preventive strategies was adequate. Also In contradiction with the study finding of **Hassan et al. (2021)** in a study titled "Assessment of knowledge and practice of ICU nurses regarding prevention of ventilator-associated pneumonia (VAP) at a tertiary care hospital" mentioned that most ICU nurses had moderate knowledge about ventilator-associated pneumonia preventive measures.

As regards to the total nurses' practice regarding ventilator associated pneumonia bundle, the current study found that the majority of the nurses investigated had an incompetent level of practice. From the researcher's perspective This could be attributed to a number of variables, including the fact that more than half of the nurses only attended the Nursing Technical Institute and did not have a specific degree in ICU nursing, were recent graduates, and were solely responsible for mechanically ventilated patients.

furthermore, they had lack of experience in critical care units (more than half of the studied nurses had experience less than two years), a lack of education in the university about VAP prevention, a lack of professionalism and guidance, a lack of in-service training cources prior to working in critical care units, practice in ICUs that was not based on research findings, fear of unintended adverse effects and undesirable patient outcomes ,a lack of supplies (such as sterile gloves, suction catheters, bottles of distilled water and chlorhexidine solution, and kinetics beds) required for the proper implementation of procedures as tracheal suctioning and oral care.

Additionally ,infection control measures regarding VAP bundle are unavailable , there is a nursing staff shortage, which increases work overload, insufficiency of close nursing supervision and lack of motivation and financial reward. lack of strategies and protocols as the most typical impediments encountered in clinical practice environments. Furthermore. The lack of education was the most commonly stated barrier to optimal VAP management,. Ongoing and regular education has been intensely recommended as the basis of nurses' knowledge and compliance improvement for VAP management

This finding agrees with ***Abad et al. (2021),*** who report during the study on "Assessment of knowledge and implementation practices of the ventilator acquired pneumonia (VAP) bundle in the intensive care unit of a private hospital who reported that their ICU nurses' practice on VAP prevention was found to be inadequate, and that no VAP preventive policy is available in the study ICUs. According to the study, from the investigator point of view this explains changes in nursing practice among ICUs, as well as why not all evidence is translated into practice. Furthermore, the study's findings pointed out the importance of creating and implementing a VAP prevention plan in intensive care units. Nurses should also receive infection control and VAP prevention training.

Furthermore, this finding was consistent with ***Hassan et al., (2021),*** who indicated that most staff nurses had unsatisfactory practice and needed prevention of VAP guidelines to improve nurses' performance.. As well, ***Getahun et al. (2022),*** who revealed that ICU nurses who had taken training on VAP prevention were more skilled than nurses who had not received regular training.

In addition to, this Findings were consistent with a study conducted by **Weheida et al (2022*)*** in study titled "Effect of designed bundle protocol about ventilator-associated pneumonia on nurses' performance, compliance, and patient outcomes" *and with* **Uma and Amoldeep (2022*)*** reported a statistically significant difference in the post-test practices score among experimental group than pre-test practices score of the control group.

On opposite side this finding is contradicted with ***Bankanie et al. (2021),***

who illustrated that the mean self-reported of compliance to evidence-based strategies for the prevention of ventilator-associated pneumonia was high during the study about " Assessment of knowledge and compliance to evidence-based guidelines for VAP prevention among ICU nurses in Tanzania,". Also contradicted with **Nurul Aqilah et al (2021)** in a study titled "Critical Care Nurses' Knowledge and Practices on Ventilator-Associated Pneumonia." who stated that their studied nurses had good practices related to VAP prevention protocol. The findings also indicated that hospital management periodically review the adherence to the ventilator care bundles checklist to prevent VAP.

As regard Correlation Matrix between Studied Nurses' Knowledge and their Practice Regarding Ventilator Associated Pneumonia Bundle of Care, based on the results of the current study, it was found that there was highly statistically significant difference between the nurses' level of knowledge regarding ventilator associated pneumonia bundle and their practice. This result is similar **El-Sayed et al, (2023))** who stated that it was observed that there was an relation between knowledge, and practice of intensive care nurses regarding prevention of VAP. This finding contradict with **Kalyan et al (2020)** and with **Bankanie et al (2021)** who revealed that there were no correlation between nurses' knowledge and their practice regarding VAP prevention

Related to Relation between Studied Nurses' Socio-Demographic Characteristics and their Knowledge Regarding Ventilator Associated Pneumonia Bundle of Care, the results of the current study revealed that there was highly statistically significant difference between the nurses' level of knowledge regarding ventilator associated pneumonia bundle and their demographic characteristics their age. This findings Contradict with **Abdulrahman et al (2024)** in a study titled "Knowledge of ICU nurses toward prevention of ventilator associated pneumonia at public hospital in Najran" who report no statistically significant difference between the nurses' level of knowledge regarding ventilator associated pneumonia bundle and their demographic characteristics their age

Also there were significant statistical relation between studied nurses' knowledge and their gender and educational qualification, nurses with Bachelor degree were found having adequate knowledge compared to nurses with technical institute or Diploma holders, due to extensive nature of education given to bachelors. The results of the current study revealed that there This finding goes in the same line with **Abdulrahman et al (2024)** who stated that in the current study educational level of the study participants showed significant association in their knowledge.

This study showed that was non statistically significant difference between the nurses' level of knowledge regarding ventilator associated pneumonia bundle and their demographic characteristics their level of experience in ICUs and their training courses regarding VAP bundle this findings consist with **Al-jaradi (2020)** who report their study did not find any significant association between knowledge level and years of ICU experience or ICU training. also with **Madhuvu et al (2020**) in a study titled "Healthcare professional views on barriers to implementation of evidence-based practice in prevention of ventilator-associated events: a qualitative descriptive study."

While contradict with **selamat et al (2021)** in a study titled "Critical care nurses' knowledge and practices on ventilator-associated pneumonia" their result showed that there was a significance difference between nurses' years of experience in ICUs and their knowledge and their practice about VAP prevention.

Regarding relation between Studied Nurses' Socio-Demographic Characteristics and their Practice Regarding Ventilator Associated Pneumonia Bundle of Care The current study revealed that there was no statistically significant difference between the nurses' level of practice regarding ventilator associated pneumonia bundle and their demographic characteristics . This finding contradict with **Hammouda et al**

(2022) who stated that their study illustrated a statistically significant relationship between the nurses' total practice scores, and their educational level, years of ICU work experience, and attendance of previous in-service training programs on care of patients on MV before the training sessions. This means that nurses with more experience and proper ICU training had better practice of VB than other nurses

The current study illustrated that there was statistically significant difference between the nurses' level of practice regarding ventilator associated pneumonia bundle and their demographic characteristics, training courses only,These results are consistent with **Ibrahim et al (2021** who found a significant relation between the studied nurses' total level of the bundle of care practices and their personal training courses

CONCLUSION

Based on the result of the current study and research questions, it can be concluded that:

The majority of the study nurses had unsatisfactory knowledge and most of them had incompetent practice level regarding ventilator associated pneumonia (VAP) bundle. As well as there was highly statistically significant difference between the nurses' total level of knowledge regarding ventilator associated pneumonia bundle and their total level of practice. Additionally, there were highly significant statistical relation between studied nurses' knowledge and their demographic characteristics; their age. Also there were significant statistical relation between studied nurses' knowledge and their gender and educational qualification. While there was insignificant difference between studied nurses' knowledge and their years of experiences and their training courses. Moreover there was insignificant difference between studied nurses' practice and their socio-demographic characteristics.

RECOMMENDATIONS

Based on the current study's findings the following recommendations are suggeste

- Continuous and consistent in-service education and training programs to improve VAP bundle knowledge and practices.
- A ventilator bundle checklist should be developed and followed by all nursing staff to prevent complications in mechanically ventilated patients.
- To generalize the findings, the study needs be replicated with a larger sample size and broad hospital settings.
- Future research should assess ICU nurses' knowledge, and practices regarding VAP bundles in mechanically ventilated patients before and after implementing an instructional program.

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