

Assessment of Nurses' Knowledge and Practice Regarding Prevention of Ventilator Associated Pneumonia In Neonates

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ABSTRACT

Background: Ventilator-associated pneumonia is a prevalent and dangerous issue among newborns who are mechanically ventilated. It is interrelated with longer hospital stays, high morbidity and mortality rate. **The study aimed** to assess nurses' knowledge and practice regarding prevention of ventilator-associated pneumonia in neonates. **Subjects and methods: Design:** A descriptive cross-sectional design was applied in this study. **Setting:** The research was done the study in neonatal intensive care units at three hospitals affiliated to the universal health insurance in Port Said Governorate. **Subjects:** The study sample was sixty nurses working in neonatal intensive care units and forty neonates on mechanical ventilation. **Tools:** Data were obtained through questionnaire sheet and observational checklists. **Results:** The present study showed that approximately one third of the studied nurses had satisfactory total knowledge regarding ventilator associated pneumonia and its prevention while nearly two thirds of them had unsatisfactory total knowledge. Also, few studied nurses had adequate total practice score regarding prevention of ventilator associated pneumonia, while most of them had inadequate total practice score regarding prevention of ventilator associated pneumonia. **Conclusion:** There was a statically significant positive correlation between total score of nurses' knowledge and their total practice score about preventing ventilator associated pneumonia. **Recommendation:** To keep nurses' skills and knowledge up to date on the prevention of neonatal ventilator-associated pneumonia, an ongoing training program is recommended.

Keywords: Knowledge, Neonates, Nurses, Practice, Ventilator associated pneumonia.

INTRODUCTION

The neonatal period is considered the first month of life after birth. The infant has physiological and anatomical changes during this time as neonate adjusts to his new environment throughout this time (Adewale, 2021). Neonates have different characteristics that make them more vulnerable to nosocomial infections. The skin and mucous membranes are spongy and less effective against infection. In addition, there is an underdeveloped immune system. Newborns admitted to neonatal intensive care units (NICU) are at higher risk of developing nosocomial infections due to the severity of neonatal illness and exposure to invasive medical devices such as central venous catheters and mechanical ventilators (MV) (Thatrimontrichai et al., 2017). Mechanical ventilator is an essential feature of modern NICU care, but it carries several risks and hazards like ventilator associated pneumonia (VAP) (Chakkarapani, 2020).

Advances in mechanical ventilation in NICUs have significantly increased the survival rate of newborns in recent decades, particularly those are extremely preterm. Significant problems occasionally occur in this population. Surprisingly, VAP accounts for 6.8–32.2% of neonatal nosocomial infections and is a significant consequence in neonates who are mechanically ventilated. Newborns patients are more vulnerable due to immature immune system and exposure to various intrusive medical devices (Sodhi et al., 2018)

Ventilator associated pneumonia is predisposed by a number of risk factors. Preterm birth and days on MV may be the most important risk factors along with low birth weight (Mohamed, Ali & Refaat, 2022). Additionally, severe underlying disease, use of broad spectrum antibiotics, longer hospital stay and widespread use of invasive devices and procedures also considered VAP precipitating factors (Safdar et al., 2016). The susceptibility of newborns to healthcare-acquired infections is increased by developmental disorders of immune system, such as increased skin and mucosal permeability, declined complement activity, and lower immunoglobulin levels (CDC, 2017).

Moreover, Applying numerous evidence-based practices concurrently has shown to result in greater practice enhancements than the benefits of each practice taken individually, so implementing VAP prevention practices in neonates has been approved to minimize the frequency of VAP in NICU. (Leistner, Piening, Gastmeier, Geffers & Schwab, 2017). These practices should include hand hygiene, head positioning in

ventilated neonates, the utility of closed multipurpose suction catheters, the frequency at which suctioning systems should be changed, regularly changing breathing circuits, evaluations of extubation readiness and cautious assessments of the necessity for reintubation, the use of medications that impaired acidity of the stomach, the use of antibiotics for bowel decontamination and oral hygiene, and the usage of separate oral and tracheal intubation systems (McBeth et al., 2018)

Since nurses are one of the most important health care resources directly affecting patient health care, they are responsible for preventive measures and care of newborns on MV. Nurses have a positive influence on care of ventilated newborns and avoiding side effects because they are always nearby and taking care of newborns (Zolfaghari, Aeen, Noghabi, & Mehran, 2015). Therefore, NICU nursing staff at critical care field play a vital role in the inhibition of VAP and associated risk factors. They need to be aware of expected complications so they can take protective measures to boost the quality of care in hospitals (Khanali-Mojen, Rassouli, Tajalli, Baghestani & Jafari, 2019).

Significance of the study:

In the NICU, bacteremia is the most common nosocomial infection, followed by ventilator-associated pneumonia. Different NICUs data found the incidence of VAP between 0 and 52 VAP infections per 1000 ventilator days. VAP is a big problem as it has negative social and economic consequences (Gokce et al., 2018) Additionally, the incidence of VAP has been reported to account for 27.2% of nosocomial infections in the neonatal intensive care unit of Assiut University Hospital in Egypt (Gohr, El Tayeb & Shalaby, 2021)

Since nurses are responsible for the continuous care of ventilated newborns in the NICU for 24 hours, their knowledge and skills are essential to delivering patient care. Making the right decisions at the right time also helps to reduce hazards to the newborns. Additionally, the use of structured teaching programs on knowledge and use of care bundle will aid in preventing VAP, greatly lowering the risk of morbidity (Dipanjali, Shivanada, & Yashoda, 2021). So that, this study was performed to assess nursing staff knowledge and practice regarding prevention of ventilator-associated pneumonia in neonates.

AIM OF THE STUDY:

The study was aimed to assess nurses' knowledge and practice regarding prevention of ventilator-associated pneumonia in neonates.

Research Objectives:

- Assess nurses' knowledge regarding prevention of ventilator-associated pneumonia in neonates.
- Assess nurses' practice regarding prevention of ventilator-associated pneumonia in neonates
- Find out relation between nurses total knowledge & practice score regarding prevention of ventilator-associated pneumonia in neonates.

Research questions:

- 1- What are the nurses' knowledge and practice regarding prevention of ventilator-associated pneumonia in neonates?
- 2- What are the relation between nurses' total knowledge & practice regarding prevention of ventilator-associated pneumonia in neonates?

SUBJECTS AND METHODS:

D) Technical design

Study design

A descriptive cross-sectional study design was utilized in conducting this study.

Study setting

This study was done at neonatal intensive care units (NICU) in three hospitals affiliated to the universal health insurance in Port Said governorate namely El-Salam hospital & Specialized obstetric hospital and Al-Hayat hospital .

Study sample

Convenience sampling included all available nurses working in the previous mentioned settings (Sixty nurses) and forty neonates undergoing mechanical ventilation were available in the time of data collection

Data collection tools:

Two tools were used for data collection:

Tool (I): Questionnaire sheet about prevention of ventilator-associated pneumonia to assess the nurses' knowledge about prevention of VAP in neonates, it was adapted

from El-bilgahy, Ouda, Hashem, and Ellassmy (2016) in an Arabic language and some modifications done by the researcher. It consisted of two main parts:

Part (I): (A) Characteristics of the studied nurses which included: age, educational level, years of experience in NICUs, social status and number of training courses about prevention of VAP in neonates.

(B) Demographic and clinical data of mechanically ventilated neonates such as age on admission, gender, gestational age, birth weight, medical diagnosis, type of delivery and duration of mechanical ventilation.

Part (2): Assess the nursing staff knowledge about prevention of VAP in NICUs. It comprised 30 multiple choice questions about VAP and its prevention in NICU.

Scoring system:

Towards nurses' knowledge: the answers were calculated utilizing model answer performed by the researchers, the correct answer was given the score 1 and incorrect or unknown answer was given the score zero. The scores obtained for each question was summed up to get the total score of nurses' knowledge. The total nurses' score was calculated then converted to percentage and evaluated as follows: the knowledge was considered satisfactory if the percent score was 75% and more, unsatisfactory knowledge if less than 75%. % (Akl, Sadoon, & Sayed, 2020).

Tool (II): Observation Checklist for prevention of Ventilator-associated pneumonia, it was established based on (Smith, Duell & Martin, 2018; Bowden & Greenberg, 2016; and CDC, 2015). The observation checklists were utilized to and evaluate the neonatal nursing staff practice about prevention of ventilator-associated pneumonia at NICU. This tool included the actual nurses' preventive practices such as: hand washing and wearing gloves, endotracheal tube suctioning technique, oral care, axillary temperature, chest physiotherapy and neonate's position.

Scoring system of observational checklists:

The scoring system for the observational checklist was settled as "done" take score (1), and "not done" take score (0). The total score of the checklists were 89 grades. Total nurses' score was calculated then converted to percentage and evaluated as follows: Adequate $\geq 75\%$ & inadequate less than 75% %. (Akl, Sadoon, & Sayed, 2020).

II) Operational Design

The operational design comprised preparatory phase, content validity, reliability of the tool, pilot study, and fieldwork.

Preparatory phase

During this phase, the researcher reviewed local and international related literature using internet search, textbooks, and scientific journals. This helped in increasing acquaintance with the study topic and in the preparation of the data collection tools.

Content Validity of the study tools:

Once the tools were prepared in their preliminary forms, they were presented to a panel of seven experts in pediatric nursing and medical surgical nursing and pediatric medicine for face and content validation. The tools were then adjusted based upon the recommendations of these experts. Changes were done according to the experts opinions. This phase was carried out in a period of three months

Reliability of study tools:

Cronbach's alpha coefficient was calculated to examine the reliability of research tools based on their internal consistency. The value of tool 1 was ($\alpha = 0.78$) and tool 2 ($\alpha = 0.9$).

Pilot study

A pilot study was performed after the development and validation of the study tools and before starting the data collection phase. It was done on a sample of about 10% of the main study sample who working in El-Salam hospital, Al-Hayat hospital and Specialized obstetric hospital. Based on the findings of the pilot study, certain modifications of the tools were done, and the researcher excluded the pilot nurses from the main study sample and the number of pilot sample was 7 nurses. It was conducted at the time from the beginning of April (2021) to the end of May (2021).

Fieldwork

Collection of data was performed over 3 months from 1st of March to the end of May 2021. After obtaining the official permission to perform the study and after finalization of tools, the researcher met with nurses individually and illustrated to them the purpose of

the study and oral consent of each nurse with obtained before their participation. Personal communication with attending pediatricians and nurses was carried out to ensure cooperation in study setting. The researchers visited the pervious mentioned study settings, two days/week (Saturday and Sunday). Each nurse was interviewed individually; the time that was spent in completing questionnaire sheet was 25- 35 minutes. Available nurses (number 60) were observed for two times during different shifts to ensure the continuity of care.

III) Administrative Design

Before starting any step in the study, an official letter from dean of the faculty of nursing was sent to universal health insurance about the selected stettings of the study to inform the directors of the mentioned hospital and the head of each neonatal intensive care unit in Port Said governorate to conduct the study after explaining the aim of the study.

Ethical considerations

An approval was taken from Research Ethics Committee of the Faculty of Nursing, Port-Said University {Code Number: NUR (9/7/2020). Furthermore, an approval was taken from each participant (neonatal nurses) after explanation of the study purpose and data collection process to be familiar with the importance of her participation. Additionally, the researcher confirmed that the information obtained was confidential and to be used only for the purpose of the study. The researcher emphasized that their participation was voluntary and each nurse has the right to withdraw from the study at any times as well as confidentiality was assured.

IV) Statistical Design

Data entry and statistical analysis were performed using SPSS version 20.0 statistic package. Analysis and interpretation of data were conducted

- Descriptive statistics including numbers, percentages or mean and standard deviation to describe different characteristics.
- Kolmogorov- Smirnov test was used to explore the normality of the data distribution.
- Univariate analysis including: t- test, ANOVA test, Kruskal wallis test and Mann Whitney test were used to test the significant results of qualitative variables.

- Pearson correlation coefficient was conducted to demonstrate correlation between knowledge and practice among the studied nurses regarding prevention of VAP
- p value ≤ 0.05 was considered statistical significance and highly significance if <0.01

RESULTS:

According to the data, 56.7% of the studied nurses were aged between 30 to less than 35 years with mean 36.5 ± 8.9 and 66.6% of the nurses were married. Regarding to educational level, 53.3% of the studied nurses graduated from technical nursing institutes and 41.1% of them had baccalaureate nursing degree. Additionally fewer than half of the nursing staff (45%) had 1 to fewer than 3 years of experience in NICUs. Furthermore, fewer than two thirds (60%) of the studied nurses didn't attended any courses about prevention of VAP in NICUs.

Table (1): reveals that 40% of the studied nurses stated the correct definition of VAP, while 60% of them replied incorrect definition of VAP. In relation to nurses' knowledge about risk factors and signs & symptoms of VAP, 25% of the studied nurses reported all risk factors of VAP and 20% of the studied nurses reported all signs and symptoms. In addition, Minority of the studied nurses answered early VAP onset From 48 to 72 h after tracheal intubation, while majority of them replied incorrectly regarding early VAP onset

Table (2): shows that, among 60 nurses, 20% of them answered ventilator circuit should be changed for every new patient or when visibly soiled or malfunction to prevent VAP and 40% answered ventilator circuit should be changed every 48hr or when clinically indicated. Regarding frequency of changing humidifier, half of the studied nurses answered humidifier should be changed every 48 hours to prevent VAP and 10% of them answered humidifier should be changed every 5-7 days or when clinically indicated. Regarding recommended type of humidifier, half of the studied nurses answered heat and moisture exchanger humidifier as recommended type of humidifier and 25% of them answered both types of humidifiers as recommended type of humidifier. Also this table shows that 60% of the studied nurses answered oral route as recommended route for ETT and minority of them answered nasal route as recommended route for ETT.

It was clear from **figure (1)** only 35% of the studied nurses had satisfactory total knowledge regarding VAP prevention while 65% of them had unsatisfactory total knowledge regarding VAP prevention

Table (3) detects that only 30 % of the studied nurses had adequate total practice regarding hand washing and wearing gloves, while most of them (70%) had inadequate total practice score regarding hand washing and wearing gloves. In addition, 40%, 75% of them had adequate total practice in relation to ETT suction and axillary temperature respectively. According to oral care, none of the studied nurses had adequate practice score.

Regarding chest physiotherapy and neonate's position practices to prevent VAP, only 35%, 20% of the studied nurses had adequate total practice score respectively.

Figure (2) reveals that nearly one quarter of the studied nurses (26.7%) had adequate total practice score regarding VAP prevention while most of them (73.3%) had inadequate total practice score regarding VAP prevention

Table (4) demonstrates that there was statically significant positive correlation between total score of nurses' knowledge and their total practice score regarding VAP prevention.

Table (5) shows that there was no statistically significant association between nurses' total knowledge scores regarding prevention of VAP and their characteristics, except for statistically significant differences ($P < 0.05$) between nurses' total knowledge scores and educational level & attending previous training program about VAP prevention.

Table (6) clarifies that a statistical significance association found among nursing staff total practice scores regarding prevention of VAP and age in years ($p= 0.001^{**}$) & years of experience at NICU ($P= 0.020^{*}$) and attending previous training program about VAP prevention ($P= 0.014^{*}$).

Table (1): Distribution of nurses' knowledge about ventilator associated pneumonia (n=60)

Variable	Options	Frequency	Percent
Definition of VAP	Hospital acquired pneumonia for neonates on MV for more than 48 h.	24	40.0
	Pneumonia in neonates that occurs in 24 hr after intubation and MV	36	60.0
Risk factors for VAP (#)	Low immunity	31	51.6
	Supine position	5	8.3
	ETT from nose	8	13.3
	Reintubation	3	5.0
	No hand washing & no gloving	15	25.0
	All of the above	15	25.0
Signs & symptoms of VAP (#)	Temperature instability	27	45.0
	Leukopenia or leukocytosis	14	23.3
	Increased respiratory secretion	10	16.7
	Chest wheezing	9	15.0
	Decreased o2 saturation	9	15.0
	All of the above	12	20.0
Early VAP onset	Less than 48 h after tracheal intubation	24	40.0
	From 48 to 72 h after tracheal intubation	6	10.0
	After 96 h from tracheal intubation	30	50.0
Total	60		

(#) More than one answer

Table (2): Distribution of nurses' knowledge regarding oral care and mechanical ventilation equipment to prevent VAP (n=60)

Variable	Options	Frequency	Percent
Recommended solution for oral care	Chlorhexidine gluconate	0	0.0
	Normal saline	48	80.0
	Breast milk	12	20.0
Frequency of ventilator circuit changes	Every 48 hours (or when clinically indicated)	24	40.0
	Every 5-7 days (or when clinically indicated)	24	40.0
	Every new patient or when visibly soiled or malfunction	12	20.0
Frequency of changing humidifier	Every 48 hours	30	50.0
	Every 72 hours	24	40.0
	Every 5- 7 days (or when clinically indicated)	6	10.0
Type of humidifier recommended	Heated humidifiers	15	25.0
	Heat and moisture exchangers	30	50.0
	Both types of humidifiers	15	25.0
Drain tubing condensation away	routinely away from the patient before treatment and before changing positions	15	25.0
	away from patient frequently	35	58.3
	The risk of VAP is unaffected by ventilator circuit condensation.	10	16.7
Oral versus nasal route for ETT to prevent VAP	Oral intubation is recommended	36	60.0
	Nasal intubation is recommended	4	6.7
	Both routes are recommended	20	33.3
Total		60	

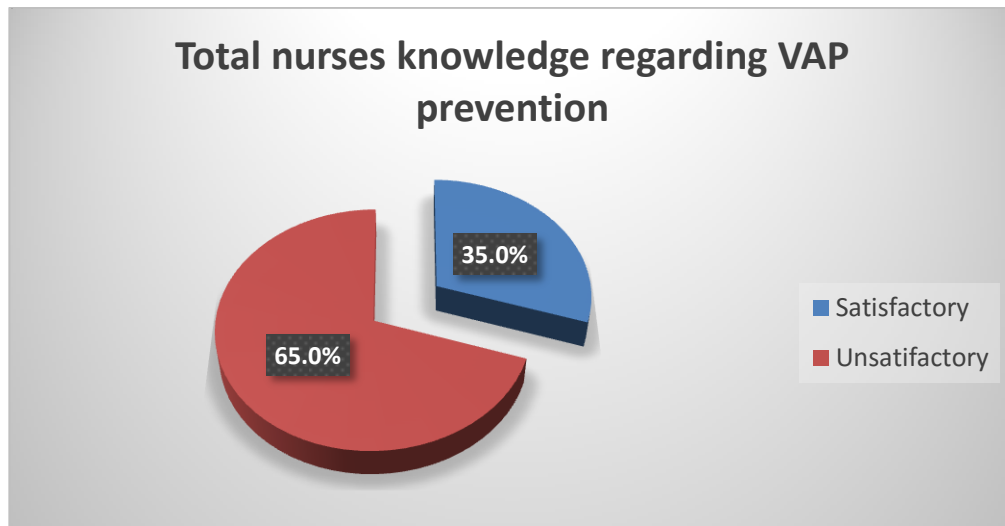


Figure (1): Percentage distribution of total nurses' knowledge regarding prevention of ventilator associated pneumonia (n=60)

Table (3): Distribution of total nurses' practice about prevention of ventilator-associated pneumonia (n=60)

VAP preventive practices	Maximum score	Adequate		Inadequate	
		No.	%	No.	%
Hand washing & wearing gloves	15	18	30.0	42	70.0
Endotracheal tube suction	25	24	40	36	60.0
Oral care	13	0	0.0	60	100.0
Axillary temperature	15	45	75.0	15	25.0
Chest physiotherapy	12	21	35.0	39	65.0
Neonate's position	9	12	20.0	48	80.0
Total	89	16	26.7	44	73.3

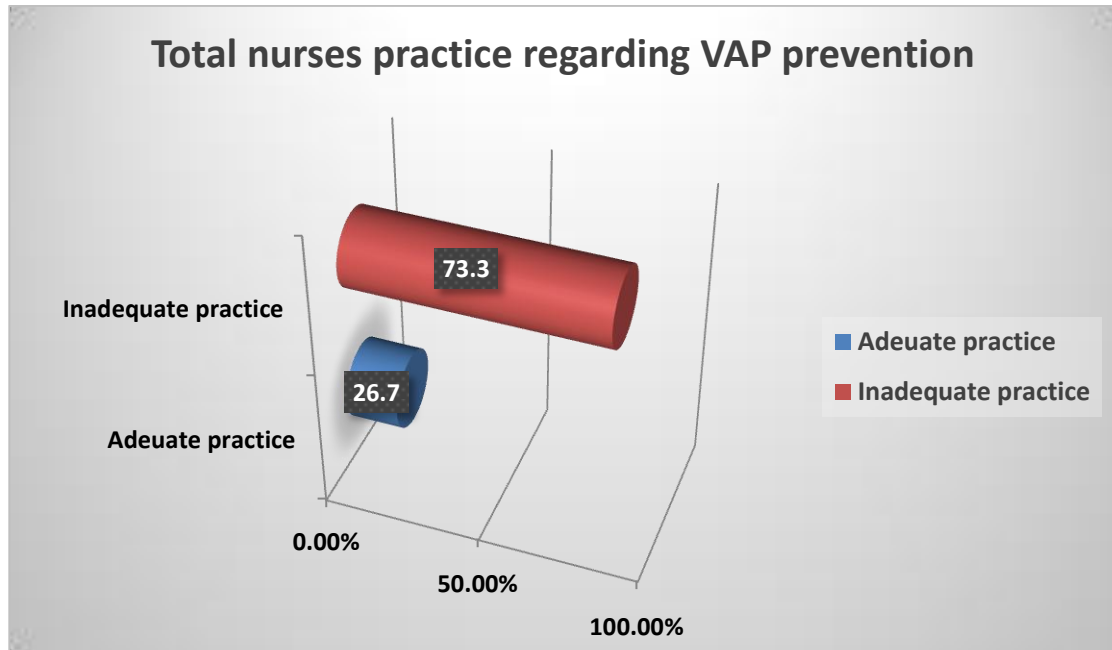


Figure (2): Percentage distribution of total nurses' practice regarding ventilator-associated pneumonia prevention (n=60)

Table (4): Correlation among total nurses' knowledge score about ventilator associated pneumonia prevention and their total practice score

Items	Total knowledge score	
	r	P- value
Total practice score	0.289	0.04*

r: Pearson correlation coefficient.

*Significant at $P \leq 0.05$

Table (5): Relation between nurses' total knowledge mean scores and characteristics of the studied nurses

<i>Characteristics</i>	<i>Total knowledge score</i>		
	<i>Mean ± SD</i>	<i>Statistical test</i>	<i>Significance</i>
<i>Age in years:</i> 20 < 25 25 < 30 30 < 35 ≥ 35 years	13.6±7.9 18.4±7.0 23.25±10.76 12.0±6.0	Z=1.887	P=0.059
<i>Marital status:</i> Single Married Widowed Divorced	14.64±4.07 13.75±2.01 18.5±0.607 16.5±5.45	F= 3.177	P= 0.204
<i>Educational level:</i> Baccalaureate nursing degree. Technical nursing institute. Secondary nursing school.	21.5±10.9 15.7±11.3 18.7±7.9	KWX2=13.09	P=0.014*
<i>Years of experience in NICU</i> < 1 1-3 4-6 ≥ 7 years	7.5±2.8 6.8±4.2 11.8±1.9 9.4±4.3	KWX2=6.77	P=0.079
<i>Attendance training courses about neonatal VAP</i> Yes (two) No	14.7±7.5 13.8±9.1	Z=19.65	P=0.024*

t: Student's t-test.

KW2: Kruskal Wallis test.

Z: Mann Whitney test.F: ANOVA test

(*) Statistically significant at P< 0.05

(**) Highly statistical significance at P< 0.001.

Table (6): Relation between nurses' practice mean scores & characteristics of the studied nurses

Characteristics	Total practice score		
	Mean ± SD	Statistical test	Significance
Age in years:			
20 < 25	18.53±7.17	F= 15.19	P= 0.001**
25 < 30	16.61±4.91		
30 < 35	19.25±5.76		
≥ 35 years	24.0±2.0		
Marital status:			
Single	17.64±6.07	F= 1.487	P= 0.230
Married	17.75±5.01		
Widowed	23.5±2.707		
Divorced	19.5±8.45		
Educational level:			
Baccalaureate nursing degree.	10.7±3.3	KW χ^2 =3.096	P=0.114
Technical nursing institute.	10.2±3.9		
Secondary nursing school.	7.6±6.4		
Years of experience in NICU			
< 1	15.9±7.5	KW χ^2 =12.824	P=0.020*
1-3	16.0±10.5		
4-6	21.2±12.4		
≥ 7 years	19.9±7.3		
Attendance of previous training courses about prevention of VAP in neonate			
Yes (two)	17.7±9.5	Z=5.413	P=0.014*
No	16.8±8.1		

t: Student's t-test.

KWX2: Kruskal Wallis test.

Z: Mann Whitney test.

F: ANOVA test

(*) Statistically significant at $P < 0.05$

(**) Highly statistical significance at $P < 0.001$.

DISCUSSION:

The distinctive feature of ventilator-associated pneumonia (VAP) is the emergence of pneumonia 48 hours or more post intubation. It is the second most frequent cause for using antibiotics in neonatal intensive care units (Peters et al., 2019). It is linked with higher incidence of bronchopulmonary dysplasia, prolonged hospital stay and mechanical ventilation (Dell'Orto et al., 2019). Despite efforts to stop VAP, this syndrome still frequently affects critically ill newborns, causing significant morbidity and mortality. One of the greatest threats to critical care unit teams around the world is the prevention and control of nosocomial infections. By using infection management strategies like VAP prevention techniques, the incidence of VAP can be decreased. The protection of nosocomial infections, particularly VAP in neonates, is thought to be based on knowledge (Goerens, Lehnick, Büttcher, & Schwendener-Scholl, 2018). So that the current study aimed to assess nurses' knowledge and practice regarding prevention of ventilator-associated pneumonia in neonates.

Regarding the studied nurses' total knowledge, nearly one third of the nursing staff had satisfactory knowledge about VAP & its prevention, while slightly less than two thirds of them had unsatisfactory total knowledge score. This result may be related to the fact that three fifths of the nursing staff didn't attend training courses about VAP prevention and also may be due to work overload which in turn affect nurses' knowledge. Moreover, this could be associated with hospitals and health care institutions didn't have any recommended guidelines about VAP prevention.

This study was parallel to the study conducted by Abou Zed and Mohamed (2019) who found that minority of nursing staff had satisfactory knowledge before application of nursing guidelines. While, most of the study nurses had satisfactory knowledge scores immediately post implementation of nursing guidelines. Also, these results were congruent with Sanders-Thompson (2020) who reported that the nursing staff had a poor level of knowledge prior to teaching compared to nurses' knowledge after teaching, $p < 0.001$.

As regard to nurses' knowledge about definition of VAP, the current study revealed that, greater than half of the nursing staff defined VAP as pneumonia occurs in 24 hr after intubation which reflects incorrect answer. It may be due to VAP is not a medical diagnosis during neonate's admission in NICU but it is a serious complication of

mechanical ventilator, so that it was difficult for nurses to define it correctly. This result was in agreement with Hussien, Ghrayeb and Al- khatib (2017), who said that nursing staff had poor general knowledge regarding VAP definition pretest.

As regards to nurses' knowledge about risk factors of VAP , more than half of the studied nurses reported that low immunity was the main risk factor and one quarter of them reported no hand washing and wearing gloves were the main risk factor of VAP and only one quarter replied all risk factor which reflecting the correct answer. This might be due to nurse concern that neonates admitted to NICU had low immunity, making them highly susceptible to any infection as VAP. The current study result was supported by Amin, Samra, and Lawend (2021) whose found in their study that, there were significant improvement in knowledge about risk factors of VAP through all program phases. On contrary with Mahfoz, El Sayed, and Ahmed (2022), who found that half of the studied nurses replied the correct answer regarding risk factors of VAP.

In relation to nurses' knowledge about signs & symptoms of VAP, the current findings revealed that, nearly half of the studied nurses mentioned increasing respiratory secretions & becoming green as the main sign of VAP and 23.3 of them reported temperature instability as the main signs and symptoms of VAP. It may be attributed to nurse' concern that pneumonia is a type of lower respiratory infection firstly must be associated with increased respiratory secretions and changing sputum characteristics to green color which include increasing respiratory secretions.

Additionally, this is similar to Idress (2017) in Sudan, who reported average knowledge score was (43.28) percent for signs and symptoms of ventilator- associated pneumonia.

The results of the present study showed that large percentage of nursing staff always reported washing their hands before & after care of neonate, rubbing hands with alcohol, wearing gloves for every newborn and wearing gloves before every procedure. This result may be related to the effect of continuous instructions which given by infection control team in hospital. This result was consistent with Elbilgahy et al. (2016), found that majority of the nurses reported always washing their hands and wearing gloves before training implementation.

The results of the present study pointed out that none of the studied nurses used chlorhexidine solution in performing oral hygiene on mechanically ventilated neonate. This may be followed up). This may be due to unavailability of resources as chlorhexidine solution in NICU and certain hospitals policies, which do not support the practice. Another reason, the studied nurses didn't know the effectiveness of chlorhexidine in preventing VAP, because of no written published protocols about importance of chlorhexidine solution in performing oral care of mechanically ventilated neonates.

In contrast with the foregoing result, Osti et al. (2017) who said that Oral decontamination with pharmacological interventions decreases the incidence of VAP by decreasing colonization of the oropharynx including twice daily use of chlorhexidine mouthwash. On the other hand, Abou Zed and Mohamed, (2019), who reported that significant improvements in nurses practice were noticed regarding oral care with Chlorhexidine solution shortly post implementation program guidelines, while mean nursing staff practices before application of Chlorhexidine use was 5.81 ± 2.79 improved to 11.33 ± 0.71 post program.

Regarding nurses knowledge about care of mechanical ventilator, the finding of the present study indicated that one fifth of them replied correctly about frequency of ventilator circuit changes, while majority of them replied incorrectly regarding frequency ventilator circuit changes. This result attributed to lack of training sessions while more than half of the studied nurses didn't attend any courses about VAP prevention in NICU. Another reason, NICU unit didn't have any protocols regarding frequency of ventilator circuit change & frequency of humidifier changes. This low score before program implementation might be influenced by the clinical practice of the technician who is in charge of managing these systems.

Along similar lines with Akl, Saadoon and Sayed (2020), who found that nearly one fifth of nurses had satisfactory knowledge regarding frequency of ventilator circuit changes pre application of VAP care bundle, compared to majority of them had satisfactory knowledge post application of VAP bundle. Also, the study was supported by Kaş Güner and Kutlutürkan (2021), who said that it is recommended that only one respiratory circuit is used in patients undergoing MV and replaced only when there is mechanical damage or contamination (blood, vomiting or purulent secretion).

In the light of the study findings, none of the studied nurses reported correctly that closed suction systems are recommended. This might be due to common suction system used in NICUs in Port Said Governorate is an open suction system because of unavailability of closed suction catheter in NICUs. This explanation was emphasized by Elmansoury and Said (2017) who reported that closed suction system used to minimize hazards and complications associated with endotracheal suctioning and to reduce VAP prevalence. Conversely, a study done by Selamat, Aung and Soe (2021), who found most of the participants performed closed suction system in suctioning by 93.3% during assessment phase.

In relation to nurses' knowledge about route of ETT insertion, this study represented that it was found that three fifths of the studied nurses replied correctly that the oral route was recommended to prevent VAP. This finding is emphasized by NHSN / CDC (2021) reporting, it is recommended the use of an orotracheal tube rather than nasotracheal tube, because the use of nasotracheal intubation increases the risk of VAP due to infected secretions aspiration from the sinuses. Along similar lines, the current findings supported by Selamat et al. (2021) who mentioned, large number of the participants correctly answered that oral route is recommended for the prevention of VAP, and fewest participants responded incorrectly, indicating that nurses know that the oral route is preferred for endotracheal intubation.

As regards nurses' knowledge about ETT suction frequency, the findings of the current study revealed that half of the studied nurses replied correctly performing suctioning as needed. This may be attributed to nurses' unfamiliarity about the complications of constant suctioning or it may be due to nurses' terror of ETT obstruction due to secretions accumulation. This explanation is confirmed by CDC, (2019) recommended that suctioning should be performed on an as needed basis after adequate evaluation of neonates, rather than a routine procedure to avoid complications such as hypoxemia and bradycardia. Similarly, Pinilla-González et al. (2021) who reported that the suction procedure was accomplished according to the NICU protocol. Procedure should be performed by two nurses to ensure aseptic technique, only when ETT was obstructed and only when indispensable and using a dual suction system: one for the oral cavity and another for the airway both connected to a close-suction system.

Regarding nurses' total practice, the current study revealed that the smallest number of the nursing staff had adequate practice compared to largest number of them had inadequate total practice score. This may be due to no supervision and no role models which may lead to absence of adherence to VAP prevention guidelines. Additionally, lack of training that is appreciated by the fact that a high percentage of the studied nurses did not participate in any training courses regarding VAP prevention.

These findings are in line with Amin et al. (2021), who discovered that the majority of nursing staff were incompetent prior to the training program as opposed to the minority following it. Nearly one-fifth of them were proficient before to the training program, and the majority were competent right away. However, Mostafa, Khalil, El Mazahy, and Abed Ella (2016) found that all nurses received enough training on mechanically ventilated babies, and this finding conflicts with their findings.

The current findings revealed that most of the nursing staff had inadequate practice score regarding hand washing and gloving. The finding of the current study may be due to decreasing the number of NICU nurses and work overload may contribute to lack of adherence to hand washing & gloving and also, lack of resources (sinks, gloves, and soap). This result was disagreed with Abdel-Fattah, Shafik, and Mostafa (2018), who found that more than half of nurses had a good level of practice regarding hand washing

The current results showed that all of the studied nurses performed saline instillation during ETT suction to dissolve secretions. This might be due to acquired old bad practices about "saline instillation for dissolving secretion" as older nursing staff educate skills to the newly nursing staff. Moreover, this result attributed to lack of nurses' awareness about harmful consequences of saline instillation. This finding was similar to the study conducted by Elbilgahy et al. (2016), who demonstrated that all of the studied nurses introduced saline into endotracheal tube for dissolving secretions before training program, while none of them installed saline into EET post program and after 3 months of program. Also, congruent with Hooven and Polin (2017) reported that ETT instillation of saline solution or distilled water was avoided.

The current study showed that only one fifth of the studied nurses had adequate practice score in relation neonate's position. This may be due to lack of expert role models, lack of supervision, fear of uncertain side effects, and unfavorable patient

outcomes may consider barriers for nurses' adherence to adequate performance of neonate's position.

These findings agree with those of Abou Zed and Mohammed (2019), who demonstrated that the mean (5.33 2.06 & 11.44 0, 83) of pre- and post-training neonatal placements was connected to a p-improvement value of 0.01. However, they reported that, in contrast to Mostafa et al. (2016), the majority of the nurses they looked at had appropriate practise scores for job change.

In addition, the present study elaborated that there was a statistical positive correlation between total nurses' knowledge score and total nurses' practice scores regarding VAP prevention. This explanation is expected because good theoretical knowledge regarding VAP prevention essentially reflected adequate practices and also, knowledge is still the first step toward implementation of VAP prevention practices. This study disagreed with Madhuvu, Endacott, Plummer, and Morphet (2020), who illustrated that there was no relationship among nursing staff knowledge and compliance to evidence-based guidelines concerning VAP. While most of the nursing staff understood the evidence-based guidelines and didn't follow in practice.

The present study showed statistical significance difference noticed among nurses' knowledge and their characteristics as educational level and attending previous training program about VAP prevention. This finding was predicted as level of education affects positively the performance of nurses as more educated nurses, more competent care. And also, when nurses attend training program, it help nurses to refresh their information and update their knowledge. Satisfactory knowledge regarding VAP which in turn reflect adequate practice regarding VAP prevention

The present study disagreed with Hussien et al. (2017), who reported that no significant differences concerning general knowledge & gender & educational level ($p=0.164$), previous training ($p=0.816$), and years of experiences ($p=0.333$), while there was significant variance among knowledge scores & place of work ($p= 0.011$). On contrary, the current study findings were in contract with Dipanjali et al. (2021), highlighted an absence of a significant association among pre-test knowledge level and age, education, experience as a critical care nurse, previous training and its prevention and number of babies allotted for care to nursing staff per shift ($p>0.01$).

Concerning the relation between nurses' total practice mean scores and their characteristics, the current study elaborated that there was statistically significant association between nurses' total practice scores regarding prevention of VAP and their age & years of experience in NICU and attending previous training program about VAP prevention. It means that the age of nurses also impacted to their practices which mean scores of practice were higher among nurses aged more than 35 years and attending training program regarding VAP prevention.

Furthermore, these results were in the same line with Ahmed, Mohammed, and Elwasefy, (2019) who illustrated the relation between characteristics of studied subjects and their total practice score pre, immediate post and at follow up after applying of preventive bundle guidelines. It is evident that there is statistically significant relation among nursing staff age, level of education, years of experience in NICU and their practice. Contrary, the current study findings were dissimilar with John, Venkatesan, Satchi, and Thiagarajan (2017), who viewed that there was no significant association between other demographic characteristics like age, professional qualification, total years of experience as staff nurse and exposure to In-service education regarding VAP Bundle compliance ($p>0.05$)

CONCLUSION:

Based on the findings of the present study, the study concluded that there was a statically significant positive correlation between total score of nurses' knowledge and their total practice score regarding prevention of ventilator associated pneumonia in neonates.

RECOMMENDATIONS:

Depend on the findings of the current study, the study recommended that continuous education for updating nurses' knowledge and performance regarding prevention of ventilator associated pneumonia in neonates should be provided.

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تقييم معلومات وممارسات الممرضين تجاه الوقاية من الالتهاب الرئوي المصاحب للتنفس

الاصطناعي في الاطفال حديثي الولادة

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الخلاصة

المقدمة: يعد الالتهاب الرئوي المصاحب للتنفس الاصطناعي مشكلة منتشرة وخطيرة بين الأطفال حديثي الولادة الذين يخضعون للتهوية الميكانيكية، يؤدي الى اطالة الإقامة بالمستشفى وارتفاع معدل المرض والوفيات. **الهدف:** لتقييم معلومات وممارسات الممرضين فيما يتعلق بالوقاية من الالتهاب الرئوي المصاحب للتنفس الاصطناعي عند الأطفال حديثي الولادة. **التصميم:** تم استخدام التصميم الوصفي المقطعي. **مكان إجراء الدراسة:** أجريت هذه الدراسة في وحدات العناية المركزة لحديثي الولادة في ثلاث مستشفيات تابعة للتأمين الصحي الشامل بمحافظة بورسعيد. **عينة البحث:** ستون ممرض وممرضة يعملان بوحدات العناية المركزة لحديثي الولادة في مدينة بورسعيد بغض النظر عن سنهم أو مؤهلاتهم، وأربعون طفل حديثي الولادة متصلين بجهاز التنفس الاصطناعي. **أدوات جمع البيانات:** تم استخدام استمارة ستيبان واستمارة ملاحظة لتقييم معلومات وممارسات الممرضين عن الوقاية من الالتهاب الرئوي المرتبط بأجهزة التنفس الاصطناعي. **النتائج:** ثلث الممرضين تقريبا كان لديهم درجة إجمالية مرضية من المعلومات فيما يتعلق بالالتهاب الرئوي المصاحب لجهاز التنفس الاصطناعي والوقاية منه، بينما كان العدد الأكبر منهم لديهم درجة إجمالية غير مرضية من المعلومات. أيضًا ، عدد قليل من الممرضين كان لديهم درجة إجمالية ملائمة من الممارسات فيما يتعلق بالوقاية من الالتهاب الرئوي المصاحب لجهاز التنفس الاصطناعي ، في حين أن معظم الممرضين لم يكن لديهم درجة إجمالية ملائمة من الممارسات. **الخلاصة:** وجود علاقة ارتباطية موجبة ذات دلالة إحصائية بين مجموع درجات معلومات الممرضات ودرجات ممارستهم الكلية حول الوقاية من الالتهاب الرئوي المصاحب لجهاز التنفس الاصطناعي. **التوصيات:** التعليم المستمر لتحديث معرفة وأداء الممرضين عن الالتهاب الرئوي المصاحب للتنفس الاصطناعي وطرق الوقاية منه في الاطفال حديثي الولادة.

الكلمات المرشدة: الأطفال حديثي الولادة، الالتهاب الرئوي المصاحب للتنفس الاصطناعي، الممرضين، الوقاية، معلومات ، ممارسات .