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Knowledge, Attitudes, and Practices on the Prevention of Ventilator-Associated Pneumonia among Nurses in ICU Units at Government Hospitals in Saudi Arabia

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ABSTRACT

Background: Nurses working in the ICU require specialized skills and knowledge to provide safe and high-quality care to critically ill patients. Ventilator-Associated Pneumonia (VAP) is a recognized nosocomial infection and a leading cause of high morbidity and mortality. Intensive Care Unit (ICU) nurses are in the best position to assess knowledge, attitude and practices on the prevention of VAP.

Objective: The aim of this study was to assess knowledge, attitude and practices on the prevention of VAP among nurses in ICU Units at Government Hospitals in Saudi Arabia.

Methods: This study used a cross-sectional and descriptive quantitative design conducted 2024 in ICU Units at Government Hospitals in Saudi Arabia (n = 113; census study). A self-structured questionnaire consists of 4 parts, part 1 included socio-demographic data; part 2: included a scale containing 13 questions to assess the knowledge on prevention of VAP. part 3: included four paragraphs to determine the existing attitude of nurses towards prevention of VAP; part 4: included a checklist to describe practice of nurses on prevention of VAP. Results by using the Statistical package for social sciences (SPSS) the level of knowledge of adult intensive care nurses about the prevention of pneumonia associated with ventilators was moderate (58%); the level of attitudes was moderate (66.4%); and the level of practice was high (74%). The most important practices of nurses to prevent VAP were. Hand washing. About 87.6% of nurses wash their hands before entering the ICU, and 90.3% of them wash their hands before touching the patient, while 69.9% wash hands after touching the patient. As for practices related to Suctioning from the ETT/tracheotomy, 87.6% prepare sterile equipment's required during suctioning, while 85.0% insert the catheter into the ETT gently by using aseptic technique.

Conclusion and Recommendations: The current study shows that nurses had moderate levels of total knowledge and attitudes while practice was high. Therefore, Hospital's administrations in collaboration with continuous education committee should focus on establishing educational programs and protocols to prevent and reduce the incidence of VAP and to enhance nurses' knowledge on prevention of VAP.

Keywords: Nurses, ICU, Knowledge, Attitudes, and Practices, Ventilator, Pneumonia

INTRODUCTION

Mechanical ventilation provides respiratory support for critically ill patients and is one of the most significant life-saving advancements in medical science and technology [1]. Patients on mechanical ventilation are at high risk for complications, such as ventilator associated pneumonia (VAP), sepsis, acute respiratory distress syndrome (ARDS), pulmonary embolism, barotrauma, and pulmonary edema [2].

Ventilator-associated pneumonia (VAP) is considered a health care associated infection (HAI). According to the Centers for Disease Control and Prevention [3], HAIs are obtained while in a healthcare organization. The incidence of VAP is 15.6% worldwide, among which the highest incidence is 19.4% in Europe, followed by 16.0% in Asia Pacific, 13.8% in Latin America, and 13.5% in the United States [4]. So, the prevalence rates ranging from 10% to 70% in critical care units [5]. According to the CDC (2018) VAP accounts for 25% of HAIs in the intensive care unit (ICU).

VAP is a common nosocomial infection in ICU occurring > 48 h after endotracheal intubation in patients receiving MV [6]. VAP rates range from 10%–22% of ventilated patients who are critically ill [7]. Critically ill patients on ventilators are susceptible to multiple complications, such as "pneumonia, acute respiratory distress syndrome (ARDS), pulmonary edema, thromboembolism, delirium, and atelectasis" [8]. Traditionally, surveillance for complications of mechanical ventilation has been limited to VAP. The CDC has recommended new surveillance definitions to create a three-tiered system for ventilator-associated events (VAEs) [9]. VAEs were defined and clarified to include serious complications of ventilated patients [10]. Researchers suggest that 55% of VAP cases may be preventable with the use of evidence based (EB) recommendations and protocols [8,11].In addition to the adaptation period, ICU nurses may be unaware of new practice recommendations or guidelines [12]. If nurses are unfamiliar with new recommendations and guidelines, VAP/VAE adherence may be affected. Knowledgeable nurses are the key to recognizing and preventing VAP in ventilated patients.

Therefore, this study aims to assess knowledge, attitudes and practices related to the prevention of VAP among nurses who working in ICUs in governmental hospitals.

MATERIALS AND METHODS

Study Design

The design of this study is a cross-sectional study design study to assess knowledge, attitude and practices on the prevention of VAP among nurses working in intensive care units at governmental hospitals in Saudi Arabia.This study conducted in the period between SeptoOct2024.

Study Participants and Sample Size

This study included all male and female nurses working in ICUs unit in governmental hospitals were included. nurses who were working in ICUs unit were randomly selected and formed the study population. nurses who were working in various positions in hospitals for at least one year prior to the survey period were included in the study. The minimum required sample size was calculated using a 95% confidence level and a 5% margin of error (significance $\alpha = 0.05$) with a 50% response distribution. It was found to be 113 respondents.

Eligibility Criteria

Inclusion Criteria

- Nurses working in adult ICUs at the governmental hospitals.
- Not in a long-term vacation.
- Interested in participating.
- At least one year's experience.

Exclusion criteria

- Trained nurses who did not consented to participate in the study.
- All nurses who were not at work during data collection period
- Nurses with less than one year of work experience

Instruments of the study

Based on the literature review and after interviewing experts who are interacting with the topic at different levels, everything that may help in attaining the analysis objectives were accumulated, examined and formalized to be suited to the study survey and after many phases of brainstorming, talking to supervisor, amending, and researching, a questionnaire was originated.The questionnaire consists of four parts. The following is a detailed description of the questionnaire content:

Section 1: included socio-demographic data, which included gender, age, Place of work, marital status, Place of Residence, educational level, Job position, and experience as a critical care nurse.

Section 2: included a scale containing 13 questions to assess the knowledge on prevention of ventilator associated pneumonia.

Section 3: included four paragraphs to determine the existing attitude of nurses towards prevention of VAP in adult Intensive Care Units.

Section 4: included a checklist to describe the practice of nurses on prevention of VAP in adult Intensive Care Units. As this checklist included several dimensions: Hand washing and it consisted of six paragraphs;

Suctioning from the ETT / tracheotomy and it consists of seven paragraphs; Oral care done and it consists of five paragraphs.

Data Collection
The researcher collected data by himself and by trained assistants using self-administered questionnaires after obtaining consent from the study participants from the hospitals within a duration of one month.

Data Management and Data Analysis
The researcher used Statistical Package for Social Sciences (SPSS, version 26) for data entry and analysis. The research checked all data to avoid any discrepancies. Data examined for coding and entry error. Descriptive data expressed as frequency, mean, standard deviation (SD), and percentages. Inferential statistic tests used as well as independent sample t test, and regression.

RESULTS
Socio-Demographic Characteristics of the Respondents
Table (1) shows the demographic characteristics of the participants. Out of 113 respondents, (59.3 %) were male and (40.7%) were female. According tothe age group, about (46.9%) of the respondents were in the group of 25 to 30years-old and (10.6%) were aged more than 40 years old. Regarding education level, most common of them (90.3%) had bachelor's degree, and (5.3%) had master's degree and (4.4%) had 2 years diploma. Regarding Job position (84.1%) had registered nurse and (11.5%) had senior nurse and (4.4%) had head nurse. About (40.7%) of the participants had experience between 1 to 3 years, while (35.4%) of nurses have more than 7 years.

Table 1.demographic traits of participants (n=113)

	Categories	Frequency	Percent %
Age (years)	< 25 years old	20	17.7%
	25-30 years old	53	46.9%
	31-40 years old	28	24.8%
	> 40 years	12	10.6%
sex	male	67	59.3%
	Female	46	40.7%
Educational level	Diploma	5	4.4%
	Bachelor's degree	102	90.3%
	MSc	6	5.3%
Occupation	Registered nurse	95	84.1%
	Senior Nurse	13	11.5%
	Head nurse	5	4.4%
Years of experience	1-3 years	46	40.7%
	4-6 years	27	23.9%
	≥ 7 years	40	35.4%

The level of knowledge of adult Intensive Care nurses about VAP at governmental Hospitals

Table 2.level of knowledge of adult Intensive Care nurses about prevention of VAP (n=113)

	N. of correct answer (%)	N. of wrong answer (%)
A nurse is required to dispose of a suction catheter	61.9%	38.1%
It is recommended to change humidifiers every	44.2%	55.8%
Insertion of the suction catheter into the endotracheal tube the procedure considered	56.6%	43.4%
Elevation Head of the bed should be ranging from	73.5%	26.5%
Whencaring for a ventilated patient is required to wear sterile gloves during	71.7%	28.3%
A nurse caring for a ventilated patient is required to wash hands	70.8%	29.2%
It is recommended to perform Oral care by using a swab moistened with mouth wash and water	50.4%	49.6%
Continuous education to ICU nurses on prevention of nosocomial infection is associated with	69.9%	30.1%
It is recommended to perform chest physiotherapy for the following	60.2%	39.8%

reason		
From your opinion when using Adjustable beds	52.2%	47.8%
According to your knowledge, early weaning this procedure	59.3%	40.7%
Feeding a ventilated patient is associated with	38.9	55.8%
During the care of ventilated patient maintenance of adequate cuff pressure	38.9%	61.1%
All paragraphs	**58%**	**42%**

The results shown in table (2) show that the level of knowledge of adult intensive care nurses about the prevention of pneumonia associated with ventilators is medium, with a knowledge rate of (58%) and that consider moderate. The fourth paragraph related to elevation head of the bed ranked first, with a knowledge rate of (73.5%), followed by the fifth paragraph related to the need to wear sterile gloves when caring for a patient with pneumonia during ETT suctioning. The lowest knowledge rate associated with maintaining the appropriate cuff pressure when caring for a patient with pneumonia, with a mean knowledge rate of 38.9%

Practices of nurses to prevent ventilator associated pneumonia in adult intensive care units in government hospitals

Table 3.practices of nurses to prevent VAPin ICU (n=113)

	N. of correct answer (%)	N. of wrong answer (%)
A. Hand washing		
Hand washing before entering ICU	87.6%	12.4%
Hand washing Before patient contact	90.3%	9.7%
Hand washing frequently when continuing working with the same patient	69.9%	30.1%
After contact with a source of microorganisms	26.5%	73.5%
Use of alcohol rub	92.0%	8.0%
B. Suctioning from the ETT/tracheotomy		
Cuffed Endotracheal tube used	82.3%	17.7%
ETT cuff pressure maintained	70.8%	29.2%
Hand washing before suctioning	67.3%	32.7%
Wear gloves	83.2%	16.8%
Prepare sterile equipment's required during suctioning	87.6%	12.4%
Insert the catheter into the ETT gently by using aseptic technique Activity and early mobilization done on patient	85.0%	15.0%
Measure the amount and characteristics of secretion	76.1%	23.9%
C. Oral care done		
Hand washing before oral care	77.9%	22.1%
Positioning a patient in a semi recumbent	27.4%	72.6%
Clean mouth using tooth brush or gauze moistened, mouth wash and water with chlorhexidine /povidone	72.6%	27.4%
Use of facemask during suctioning	70.8%	29.2%
Hand washing after oral care	88.5%	11.5%
All practices of nurses to prevent VAP	74%	26%

The results as shown in table (3) the level of practices of adult intensive care nurses about the prevention of pneumonia associated with ventilators is medium, with a practices rate of (74%) and that consider high.According to Hand Washing 87.6% of nurses working in adult intensive care units in government hospitals in the Gaza Strip wash their hands before entering the intensive care unit, and 90.3% of them wash their hands before touching the patient, while 69.9% do this after touching the patient, while 26.5% of nurses wash hands frequently when continuing to work with the same patient.As for practices related to Suctioning from the ETT/tracheotomy 82.3% of nurses used cuffed Endotracheal tube, and 87.6% prepared sterile equipment's required during suctioning, while 85.0% inserted the catheter into the ETT gently by using aseptic technique Activity and early mobilization done on patient, and 83.2% of nurses wearing gloves during handling patients in the intensive care unit .Concerning oral care, 88.5% of nurses Hand washing after oral care, and 77.9% of them Hand washing before oral care, whereas 70.8% of nurses use of facemask during suctioning, while 27.4% of nurses putting position a patient in a semi recumbent.

Attitude of nurses to prevention of VAP among Intensive Care Unit patients at governmental hospitals

Table 4.Means and test values for "attitude of nursesto prevention of VAP(n=113)

Items	Mean	Std. Dev	RII (%)	Test value	P value
All patients are at potential risk of developing VAP.	3.89	0.95	77.80	10.022	0.000
Ventilator associated pneumonia prevention is time consuming for me to carry out	3.42	0.88	68.40	5.11	0.000
In my opinion, patients tend not to get as many VAP now days I do not need to concern myself with Ventilator associated pneumonia Prevention in my job.	3.35	0.86	67.00	4.25	0.000
I do not need to concern myself with Ventilator associated pneumonia Prevention in	2.62	1.26	52.40	-3.20	0.002
All items	**3.32**	**0.93**	**66.40**	**3.15**	**0.000**

"All patients are at potential risk of developing" was ordered in the 1st rank with a mean equal "3.89 (Total degree =5)" and relative importance index "77.80%" and P-value equals 0.000 which is smaller than the level of significance α= 0.05. It can be concluded that the nurses agreed to this item. "Ventilator associated pneumonia prevention is time consuming for me to carry out." was ordered in the 2nd rank with a mean equal "3.42" and relative importance index "68.40%" and P-value equals 0.000 which is smaller than the level of significance α= 0.05. It can be concluded that the respondents agreed to this item. "I do not need to concern myself with Ventilator associated pneumonia Prevention in my job" was ordered in the last rank with a mean equal "2.62" and relative importance index "52.40%" and P-value equals 0.002 which is smaller than the level of significance α= 0.05. It can be concluded that the respondents do not agree to this item

DISCUSSION

Level of Knowledge and Practices Related to VAP Prevention

The results of this study indicate that the level of knowledge among adult intensive care unit (ICU) nurses in governmental hospitals regarding ventilator-associated pneumonia (VAP) prevention is moderate, with a knowledge score of 58%. This suggests a gap that needs to be addressed through continuous training and educational programs. However, there were some aspects where nurses demonstrated a better understanding, such as the importance of elevating the head of the bed, with 73.5% of nurses being knowledgeable about this practice. On the other hand, the lowest knowledge was observed regarding maintaining proper cuff pressure in endotracheal tubes, with a knowledge rate of only 38.9%. the results of this study align with several others that have reported a similar lack of knowledge among nurses about VAP prevention. For instance, a study conducted in Taiwan (Lin, Lai, & Yang, 2014) found that non-ICU-licensed nurses and junior registered nurses (RNs) lacked adequate knowledge about VAP prevention. Similar findings were observed in studies conducted in Turkey, Croatia, and Yemen, where nurses' knowledge of evidence-based interventions to prevent VAP was poor (Al-Sayaghi, 2014; Korhan et al., 2014; Jordan et al., 2014). These results suggest that nurses in different regions face similar challenges in understanding and applying VAP prevention practices.

In contrast, some studies have reported higher knowledge levels among ICU nurses. For example, Wagner et al. (2015) found that nurses' knowledge of VAP prevention interventions was as high as 81%, indicating the positive impact of educational programs and regular training. Similarly, Goncalves et al. (2015) found that nurses reported having good clinical knowledge, especially when managing critically ill patients, due to continuous clinical practice and targeted education. Another study by Ismail and Zahran (2015) demonstrated that a structured training program significantly improved nurses' knowledge of VAP definition and prevention measures, with all nurses being knowledgeable after the program.

Nurses' Practices Related to VAP Prevention

Regarding nurses' practices, the study showed that the overall practice rate was higher than the knowledge rate, with a practice score of 74%. Practices related to hand hygiene and using sterile equipment during suctioning were well adhered to, with high compliance rates. However, certain practices, such as positioning patients in a semi-recumbent position, had a significantly lower compliance rate of 27.4%. This suggests that while there is some adherence to key preventive measures, certain practices may still need more attention and reinforcement. the findings in this study are consistent with previous research showing that adherence to VAP prevention practices is crucial. For example, a study by Su et al. (2017) in two cardiovascular ICUs found that a combined educational program focused on hand hygiene and oral care resulted in a 59% reduction in VAP incidence. Similarly, Shabot et al. (2016) implemented a hand hygiene compliance program in 150 inpatient units across 12

hospitals, resulting in improved hand hygiene rates (from 58.1% to 94.7%) and a reduction in VAP incidence. These studies reinforce the importance of hand hygiene and proper oral care in preventing VAP.

Nurses' Attitudes Toward VAP Prevention

In terms of attitudes, the study showed that nurses generally had a positive attitude toward VAP prevention. They agreed that all patients on ventilators are at risk of developing VAP and recognized the importance of preventive measures. However, some nurses expressed that VAP prevention was time-consuming and challenging to carry out. These findings align with studies like that of Populo (2020), which indicated that while nurses had a positive attitude towards VAP preventive strategies, education did not significantly change their already positive perception.

In contrast, some studies have found that nurses' attitudes can be negatively affected by poor knowledge and a lack of time. For example, Alja'afreh et al. (2018) reported that a significant portion of nurses had negative attitudes toward oral care, with many finding it unpleasant and difficult. These attitudes were likely influenced by insufficient training and the perceived time constraints on completing tasks related to VAP prevention. As highlighted by Özveren and Özden (2015), a lack of knowledge and negative attitudes can hinder compliance with VAP prevention protocols, which ultimately affects patient outcomes.

CONCLUSION AND RECOMMENDATIONS

This study highlights the need for improving both the knowledge and practices related to VAP prevention among ICU nurses. Despite relatively good compliance with some key preventive practices, there are areas such as cuff pressure management and patient positioning that need further attention. Additionally, while nurses' attitudes toward VAP prevention are generally positive, there is a need to address the challenges of time constraints and the perceived difficulty of certain tasks.

Future training programs should focus on addressing these gaps in knowledge, particularly on more advanced preventive measures like maintaining appropriate cuff pressures and positioning patients correctly. Moreover, continuous education and hands-on practice, combined with regular compliance monitoring, are essential for ensuring that VAP prevention strategies are consistently implemented in ICU settings.

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