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ASSESSING THE KNOWLEDGE LEVEL OF ICU NURSES REGARDING PREVENTION OF VENTILATOR-ASSOCIATED PNEUMONIA AT MARDAN MEDICAL COMPLEX, MARDAN

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Abstract

Background

Ventilator-associated pneumonia (VAP) is a major healthcare-associated infection in intensive care units and is associated with increased morbidity, mortality, and healthcare costs. ICU nurses play a critical role in preventing VAP through adherence to evidence-based guidelines; however, inadequate knowledge may hinder effective implementation of preventive strategies.

Objective

To assess the level of knowledge among ICU nurses at Mardan Medical Complex regarding the prevention of ventilator-associated pneumonia and to identify areas requiring educational improvement.

Materials and Methods

A descriptive cross-sectional study was conducted among 71 ICU nurses working at Mardan Medical Complex, Mardan. Universal sampling was used. Data were collected using an adopted and validated structured questionnaire focusing on knowledge related to VAP prevention. Data were analysed using SPSS version 26, employing descriptive statistics including frequencies, percentages, means, and standard deviations.

Results

Among 71 ICU nurses, 78.8% were aged 20–40 years and 63.4% held a Generic BSN. Overall, 50.7% had moderate knowledge of VAP prevention, 25.4% good, and 23.9% poor. Knowledge was highest for head-of-bed elevation (83.1%) and oral care (77.5%), and lowest for sedation interruption (45.1%) and ventilator circuit management (40.8%). Good knowledge increased with ICU experience (13.6% in <2 years vs. 36.9% in >5 years).

Conclusion

The study identified notable knowledge gaps among ICU nurses regarding VAP

prevention. Targeted educational interventions and continuous professional development programs are recommended to enhance compliance with evidence-based VAP prevention strategies.

INTRODUCTION

Background of the study: Ventilator-associated pneumonia (VAP) was identified as a serious healthcare-associated infection that developed in patients who had undergone mechanical ventilation for a duration exceeding 48 hours (Papazian et al., 2020). Clinically, VAP was characterized by the presence of new or progressive pulmonary infiltrates on chest imaging, accompanied by systemic and respiratory manifestations such as fever, leucocytosis or leukopenia, purulent tracheal secretions, impaired gas exchange, and microbiological confirmation of a causative pathogen (Mumtaz et al., 2023). The occurrence of VAP was consistently associated with adverse clinical outcomes, including prolonged duration of mechanical ventilation, extended length of stay in intensive care units and hospitals, increased utilization of healthcare resources, and substantially elevated mortality rates, particularly among critically ill and immunocompromised patients.

Ventilator-associated pneumonia was recognized as the most frequently acquired form of pneumonia within intensive care units worldwide. Epidemiological evidence indicated that VAP incidence rates ranged from 7 to 43 episodes per 1,000 ventilator days, while reported mortality rates demonstrated wide variation, extending from 6.3% to as high as 66.9%, depending on patient population, healthcare setting, and preventive practices employed (Zimlichman et al., 2019). The substantial burden of VAP underscored its significance as a major patient safety concern and a critical indicator of the quality of care provided in intensive care settings.

Extensive research had demonstrated that the implementation of evidence-based preventive strategies significantly reduced the incidence of ventilator-associated pneumonia. These strategies included maintaining appropriate head-of-bed elevation between 30° and 45° to minimize aspiration risk, conducting daily sedation interruption and assessment for early weaning from mechanical ventilation, providing regular oral care using antiseptic solutions such as chlorhexidine, and ensuring strict adherence to aseptic techniques during endotracheal suctioning and ventilator circuit management (Mumtaz et al., 2023). Despite the proven effectiveness of these interventions, their consistent application in clinical practice remained suboptimal in many healthcare settings. Although international guidelines and standardized VAP prevention bundles were widely available, compliance with these recommendations was frequently reported to be inadequate. This gap was largely attributed to insufficient knowledge among healthcare providers, limited access to continuing professional education, high patient-to-nurse ratios, and resource constraints, particularly in low- and middle-income countries. Studies conducted in South Asian regions, including India, documented significant variability in ICU nurses' knowledge levels and preventive practices related to VAP, highlighting persistent deficiencies in training and institutional support systems (John & Srivastava, 2022).

As frontline caregivers in intensive care units, nurses were primarily responsible for the implementation and day-to-day execution of VAP prevention measures. Their knowledge, skills, and adherence to evidence-based protocols played a pivotal role in determining the effectiveness of infection prevention efforts. Consequently, assessing the knowledge level of ICU nurses was considered essential for identifying existing gaps that could hinder the consistent application of preventive strategies. In resource-limited healthcare settings such as Mardan Medical Complex, a comprehensive understanding of nurses' knowledge regarding VAP prevention was particularly important, as it could inform the development of targeted educational

interventions, strengthen institutional policies, and enhance patient safety initiatives. Ultimately, improving nurses' knowledge and competency was viewed as a key strategy for reducing the incidence of ventilator-associated pneumonia and improving clinical outcomes among mechanically ventilated patients.

Objectives

- To assess the level of knowledge of ICU nurses working at MMC regarding evidence-based guidelines for preventing Ventilator-Associated Pneumonia (VAP).
- To explore the educational needs of ICU nurses regarding VAP prevention strategies and identify areas for improvement in training and resources.

Research Question

What is the level of knowledge among ICU nurses at Mardan Medical Complex regarding the prevention of ventilator-associated pneumonia (VAP)?

Methodology

Study Design

A descriptive cross-sectional study design was employed to assess the level of knowledge among intensive care unit (ICU) nurses regarding the prevention of ventilator-associated pneumonia (VAP). This design was considered appropriate as it allowed for the systematic assessment of nurses' knowledge at a single point in time without manipulating study variables. The approach facilitated the identification of existing knowledge levels and gaps related to evidence-based VAP prevention strategies within the clinical setting.

Study Setting

The study was conducted in the Intensive Care Unit of Mardan Medical Complex (MMC), a tertiary care teaching hospital located in Khyber Pakhtunkhwa, Pakistan. Mardan Medical Complex provides advanced critical care services to a large catchment population and accommodates a diverse group of critically ill patients requiring mechanical ventilation, making it an appropriate setting for assessing ICU nurses' knowledge related to VAP prevention.

Study Population

The study population comprised registered nurses working in the ICU at Mardan Medical Complex who were directly involved in the care and management of mechanically ventilated patients. These nurses were responsible for implementing preventive measures such as airway care, infection control practices, and adherence to ventilator-associated pneumonia prevention bundles.

Study Duration

The study was conducted over a period of six months. This duration allowed sufficient time for ethical approval, participant recruitment, data collection, and completion of data analysis in an organized and systematic manner.

Inclusion and Exclusion Criteria

Inclusion Criteria

The study included ICU nurses who were actively employed at Mardan Medical Complex and provided direct bedside care to mechanically ventilated patients. Nurses who were able to read and write in either Urdu or English were included to ensure proper understanding and accurate completion of the questionnaire. Additionally, only those nurses who willingly agreed to participate and provided written informed consent were enrolled in the study.

Exclusion Criteria

Nurses who were on extended leave during the data collection period were excluded from the study. Furthermore, nurses assigned to administrative or managerial roles without direct involvement in patient care were also excluded, as their responsibilities did not involve routine implementation of VAP prevention strategies.

Sample Size Determination

A total of 71 ICU nurses were included in the study. The sample size was calculated using OpenEpi software, considering a total population

of 80 ICU nurses at Mardan Medical Complex, a confidence level of 95%, and an expected proportion of 73%, based on findings from a previous study conducted by Abad et al. (2021). The initial calculated sample size was 64 participants. To compensate for potential non-response or incomplete questionnaires, a 10% attrition rate was added, resulting in a final sample size of 71 nurses.

Sampling Technique

Universal sampling technique was utilized, whereby all eligible ICU nurses working at Mardan Medical Complex during the study period were invited to participate. This technique was selected to maximize sample representation and minimize selection bias within the relatively small ICU nursing population.

Data Collection Tool

Data were collected using a structured questionnaire adopted from a previously published study and modified to align with the objectives of the present research. The questionnaire primarily focused on assessing nurses' knowledge related to ventilator-associated pneumonia, including risk factors, preventive strategies, and evidence-based guidelines. To ensure the validity of the instrument, content validity was established by calculating the Content Validity Index (CVI) with input from subject experts. For this study, only the educational and knowledge-related components of the tool were utilized.

Data Collection Procedure

Following approval from the Institutional Review Board, data collection was initiated. Written informed consent was obtained from all participants prior to questionnaire distribution. Participants were provided with clear instructions regarding the purpose of the study and the voluntary nature of their participation. The questionnaires were distributed individually and completed by the nurses during their available time to minimize disruption of clinical duties. Upon completion, the questionnaires were collected by the researcher. Each questionnaire was assigned a unique identification code to ensure anonymity and maintain confidentiality. Completed questionnaires were securely stored and accessed only by the research team.

Data Analysis

The collected data were coded and entered into Statistical Package for Social Sciences (SPSS) version 24 for analysis. Descriptive statistical methods were employed to analyze the data. Frequencies and percentages were used to describe categorical variables such as demographic characteristics and knowledge items, while means and standard deviations were calculated for continuous variables where applicable. The results were presented in the form of tables, figures, and graphical representations to enhance clarity and interpretation.

Ethical Considerations

Ethical approval for the study was obtained from the Institutional Review Board of Mardan Medical Complex prior to data collection. Written informed consent was obtained from all participants after providing a detailed explanation of the study objectives, procedures, potential risks, and benefits. Confidentiality and anonymity were strictly maintained throughout the research process by removing personal identifiers and using coded data. Participants were assured of their right to withdraw from the study at any time without any penalty or impact on their professional responsibilities.

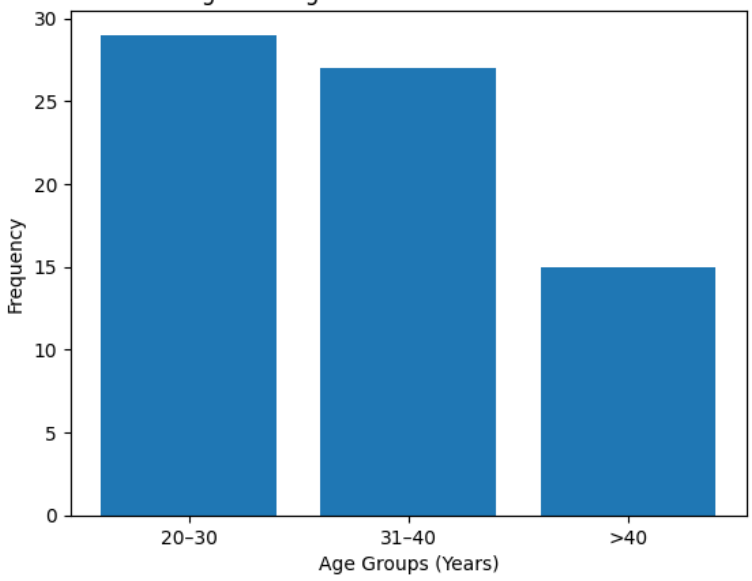
RESULTS

Table 1: Demographic Characteristics of ICU Nurses (N = 71)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	38	53.5
	Female	33	46.5

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	20–30	29	40.8
	31–40	27	38.0
	>40	15	21.1
Educational Qualification	Generic BSN	45	63.4
	Post-RN BSN	26	36.6
ICU Experience	< 2 years	22	31.0
	2–5 years	30	42.3
	> 5 years	19	26.8

Figure 1: Age Distribution of ICU Nurses



Description:
A bar graph illustrating the age-wise distribution of ICU nurses, showing that the majority (78.8%) fall between 20 and 40 years, indicating a predominantly young to middle-aged workforce.

Figure 2 Gender Distribution of Nurses:

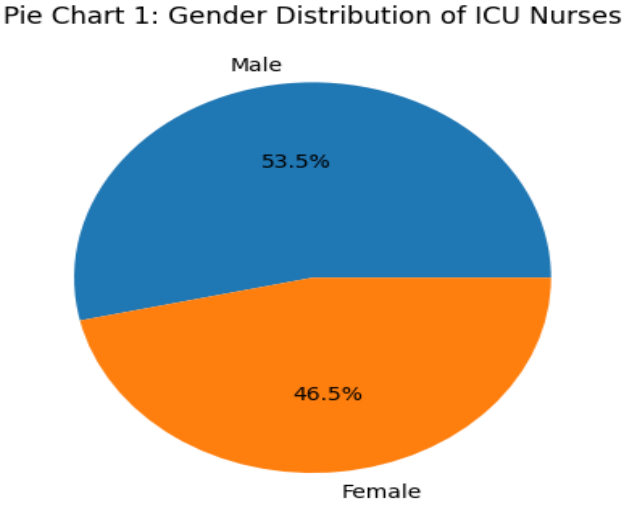
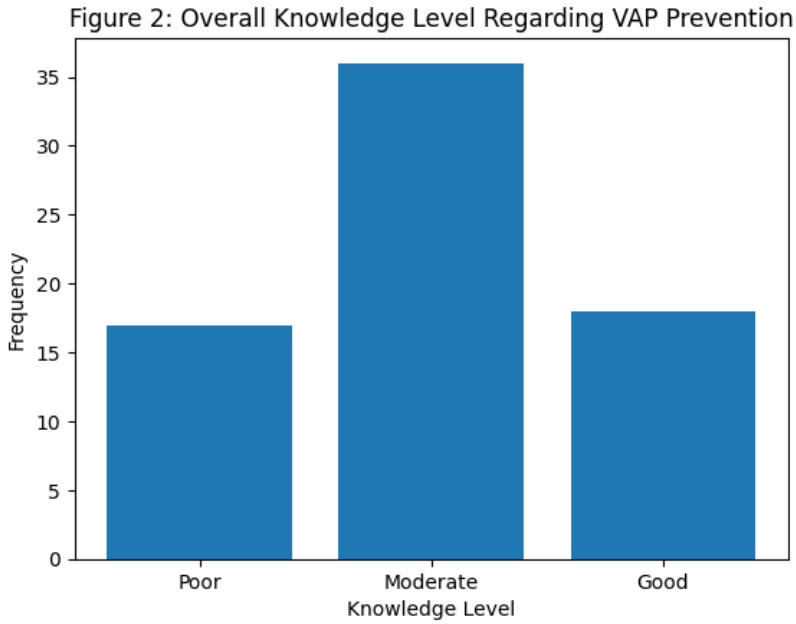
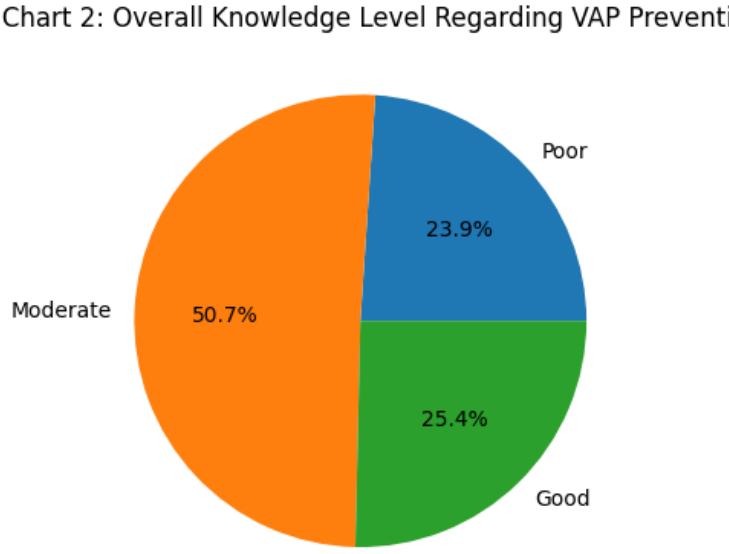


Table 2: Overall Knowledge Level Regarding VAP Prevention (N = 71)

Knowledge Level	Score Range	Frequency (n)	Percentage (%)
Good Knowledge	≥ 75%	18	25.4
Moderate Knowledge	50–74%	36	50.7
Poor Knowledge	< 50%	17	23.9





Description:
A pie chart demonstrating that more than half of ICU nurses (50.7%) had moderate knowledge, while only one-quarter (25.4%) exhibited good knowledge of VAP prevention.

Table 3: Item-Wise Knowledge Regarding VAP Prevention (N = 71)

Knowledge Item	Correct (n)	Correct (%)	Incorrect (n)	Incorrect (%)
Head-of-bed elevation (30–45°)	59	83.1	12	16.9
Oral care with antiseptics	55	77.5	16	22.5

Knowledge Item	Correct (n)	Correct (%)	Incorrect (n)	Incorrect (%)
Aseptic suctioning technique	38	53.5	33	46.5
Sedation interruption	32	45.1	39	54.9
Ventilator circuit management	29	40.8	42	59.2

Description:
Table showing higher knowledge scores in basic preventive measures such as head-of-bed elevation and oral care, while lower scores were observed in advanced interventions including sedation interruption and ventilator circuit management.

Table 4: Knowledge Level According to ICU Experience (N = 71)

ICU Experience	Poor n (%)	Moderate n (%)	Good n (%)
< 2 years	9 (40.9%)	10 (45.5%)	3 (13.6%)
2–5 years	6 (20.0%)	16 (53.3%)	8 (26.7%)
> 5 years	2 (10.5%)	10 (52.6%)	7 (36.9%)

Interpretation:
Nurses with greater ICU experience demonstrated higher proportions of good knowledge, indicating a positive trend between experience and understanding of VAP prevention.

Discussion
This study assessed the level of knowledge among intensive care unit nurses regarding the prevention of ventilator-associated pneumonia at Mardan Medical Complex. The findings demonstrated that the majority of nurses possessed a moderate level of knowledge; however, considerable deficiencies were identified in several critical components of evidence-based VAP prevention. These gaps suggest that although nurses were generally aware of basic preventive measures, their understanding of more complex and protocol-driven interventions remained suboptimal.

The proportion of nurses who demonstrated good knowledge in the present study was 25.4%, which is consistent with findings reported in national studies conducted in Pakistan. Previous research has indicated that moderate knowledge levels among ICU nurses commonly range between 40% and 60%, with limited proportions achieving high competency in VAP prevention practices (Mumtaz et al., 2023). Furthermore, a study conducted in tertiary care hospitals in Lahore reported inadequate awareness among nurses regarding sedation interruption and ventilator circuit management, findings that closely align with the results of the current study. These similarities may reflect common challenges within the national healthcare system, including limited access to continuous professional development programs and inconsistent implementation of standardized ICU protocols.

When compared with regional studies, particularly those conducted in India, the findings of the present study revealed comparatively lower levels of good knowledge. Indian studies have reported good knowledge levels ranging from 35% to 45% among ICU nurses, especially in institutions where structured training programs and routine in-service education were implemented (John & Srivastava, 2022). The higher knowledge levels observed in these studies may be attributed to regular educational interventions, stronger institutional emphasis on infection control policies, and systematic monitoring of guideline adherence.

In contrast, international studies conducted in high-income countries, including the United States and various European nations, have reported substantially higher levels of knowledge and compliance with VAP prevention bundles. More than 70% of ICU nurses in these settings demonstrated good knowledge and consistent adherence to evidence-based practices (Papazian

et al., 2020). The marked difference between these findings and those of the present study underscores disparities in healthcare infrastructure, nurse-to-patient ratios, availability of resources, and institutional support for ongoing education between developed and resource-limited settings.

The implications of these findings for clinical practice are significant. The identified knowledge gaps in suctioning techniques, daily sedation interruption, and ventilator circuit management may adversely affect the consistent implementation of VAP prevention bundles, thereby increasing the risk of VAP development among mechanically ventilated patients. Strengthening continuous nursing education through regular workshops, refresher courses, and competency-based training programs is essential. Additionally, institutional strategies such as routine audits, protocol reinforcement, and supportive supervision may enhance adherence to evidence-based guidelines and ultimately improve patient safety outcomes in intensive care units.

Conclusion:

The study revealed that ICU nurses at Mardan Medical Complex possess predominantly moderate knowledge regarding ventilator-associated pneumonia prevention. While awareness of basic preventive measures was satisfactory, deficiencies were evident in advanced and protocol-driven components of VAP prevention. These findings underscore the need for structured educational interventions, regular training workshops, and institutional support to enhance nurses' knowledge and improve adherence to evidence-based VAP prevention guidelines.

Conflict of Interest

The authors declare no conflict of interest.

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