Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/dmqrkh48

ASSESSING ICU NURSES' KNOWLEDGE IN PREVENTION OF VENTILATOR-ASSOCIATED PNEUMONIA

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Abstract

Background: Ventilator-Associated Pneumonia (VAP) is a prevalent healthcare-associated infection in intensive care units (ICUs), significantly increasing patient morbidity, mortality, duration of hospitalization, and overall healthcare costs. ICU nurses are the frontline caregivers for ventilated patients and play a pivotal role in VAP prevention through the implementation of evidence-based protocols.

Aim: This study was conducted to assess the knowledge of ICU nurses regarding current VAP prevention practices and to identify specific knowledge gaps to facilitate targeted training.

Methods: A descriptive cross-sectional study was conducted among 56 ICU nurses at SSIMS and RC, Davangere. Data were collected using a validated 20-item structured questionnaire covering key aspects of VAP prevention. Statistical analysis was performed using descriptive statistics and Chi-square tests.

Results: The overall mean knowledge score was 70%, indicating moderate awareness. Specific deficiencies were noted in areas such as oral care frequency, suction system replacement, and humidifier management. Nurses with more experience and those who had undergone VAP prevention training demonstrated higher scores.

Conclusion: While a fair level of knowledge was observed, gaps remain in critical areas of practice. Regular training, incorporation of standardized VAP bundles, and periodic audits are recommended to enhance adherence to VAP prevention protocols and improve patient outcomes.

Introduction

Ventilator-associated pneumonia is a formidable challenge in modern ICUs, where the prevalence of invasive mechanical ventilation exposes patients to heightened risks of infection. VAP is associated with increased morbidity and mortality, leading to extended ICU stays and substantial financial burdens. Preventing VAP requires a multidisciplinary effort, with ICU nurses at the forefront due to their continual bedside presence and hands-on management of ventilated patients.

Over the past decade, evidence-based guidelines have been established for VAP prevention, including interventions such as strict hand hygiene, proper endotracheal tube management, appropriate oral care, and timely weaning. However, implementing these practices consistently remains a challenge. Numerous studies reveal that while general infection control knowledge among nurses is often

satisfactory, there are frequent gaps in awareness and execution of specific VAP prevention protocols, particularly regarding technical interventions like cuff pressure management and equipment handling. In this context, assessing baseline knowledge among ICU nurses serves as a foundation for identifying educational priorities, tailoring in-service training, and ultimately improving adherence to best practices. Understanding these knowledge gaps allows hospital administrators and educators to allocate resources more efficiently and track the impact of interventions over time.
This study was designed to systematically evaluate the knowledge levels of ICU nurses regarding VAP prevention, identify critical gaps, and examine the association of these gaps with factors such as clinical experience and prior exposure to formal VAP prevention training.

Aims and Objectives
- To assess the knowledge levels of ICU nurses regarding VAP prevention.
- To identify specific areas of deficient knowledge.
- To evaluate the relationship between knowledge scores and factors such as experience and training.

Inclusion and Exclusion Criteria
Inclusion Criteria:
- Registered nurses working in ICU for at least 6 months.
- Nurses involved in direct care of mechanically ventilated patients.
- Nurses who gave informed consent to participate.

Exclusion Criteria:
- Head nurses or administrative staff.
- Nurses in training or interns.
- Nurses on extended leave during the study period.

Materials and Methods
Study Design:
A descriptive, cross-sectional questionnaire-based study.

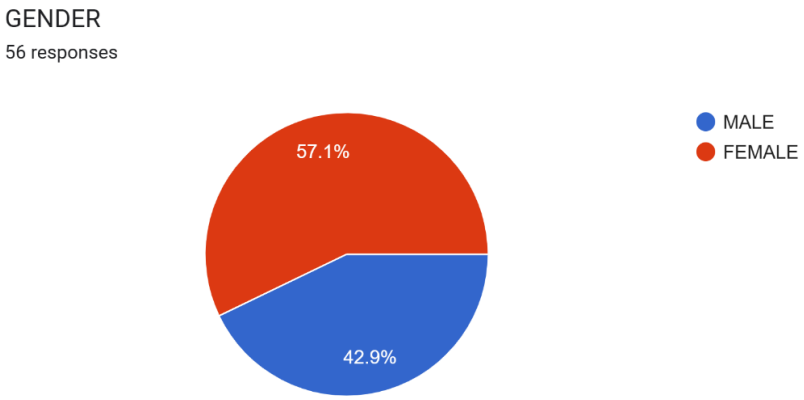
Setting and Sample:
The study was conducted at SSIMS and RC, Davangere, including a sample of 56 ICU nurses selected through convenience sampling.

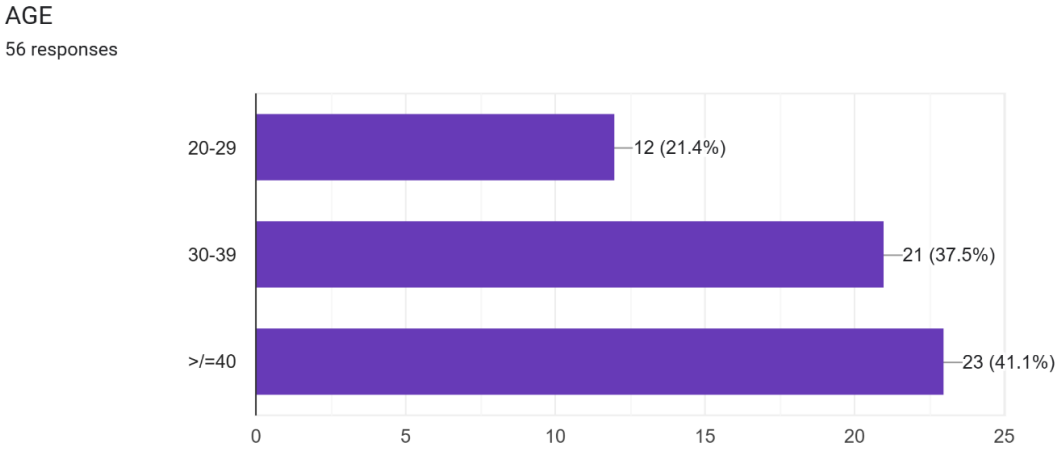
Tool for Data Collection:
A validated structured questionnaire consisting of 20 multiple-choice questions adapted from previous literature and guidelines (Labeau et al., Lin et al., Selamat et al.) covering various domains of VAP prevention.

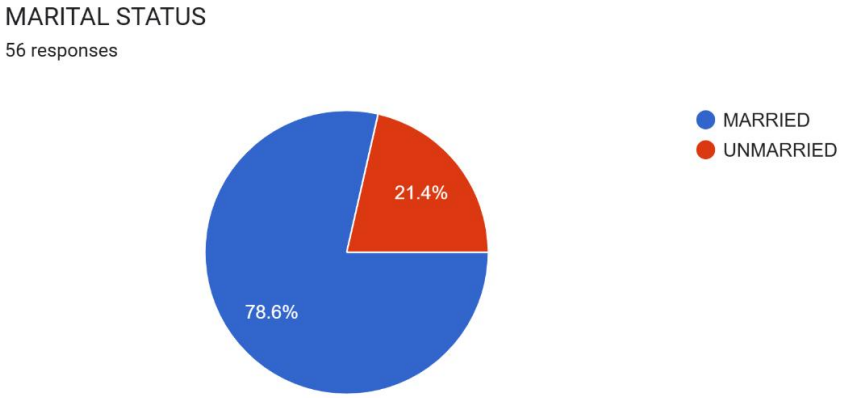
Data Collection Procedure:
Participants were briefed about the purpose of the study, and informed consent was obtained. Questionnaires were administered in person, ensuring anonymity and confidentiality.

Statistical Analysis
Data were entered and analyzed using SPSS version 25. Descriptive statistics were used to summarize demographic details and knowledge scores. Chi-square tests were applied to determine associations between demographic variables (e.g., years of experience, VAP training) and knowledge levels. A p-value < 0.05 was considered statistically significant.
Results
Demographics and Knowledge Overview
The study included 56 ICU nurses. Most had 1–5 years of ICU experience, and approximately half had not attended formal training on VAP prevention. The overall mean knowledge score was 70%,

indicating a fair level of awareness. Only 35% of participants demonstrated "good knowledge" (≥75%), while 65% had fair knowledge (<75%).

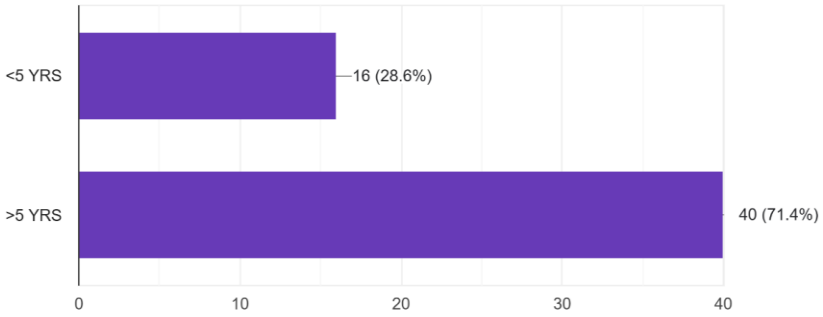






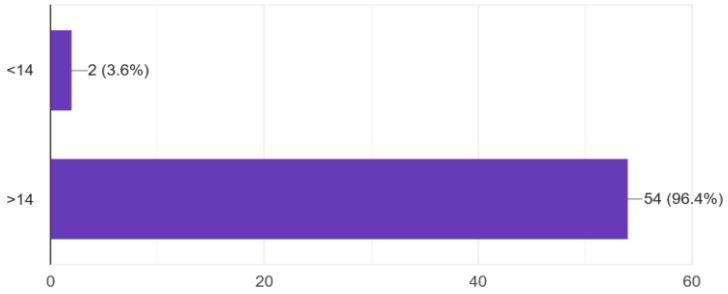
YEARS OF EXPERIENCE IN ICU

56 responses



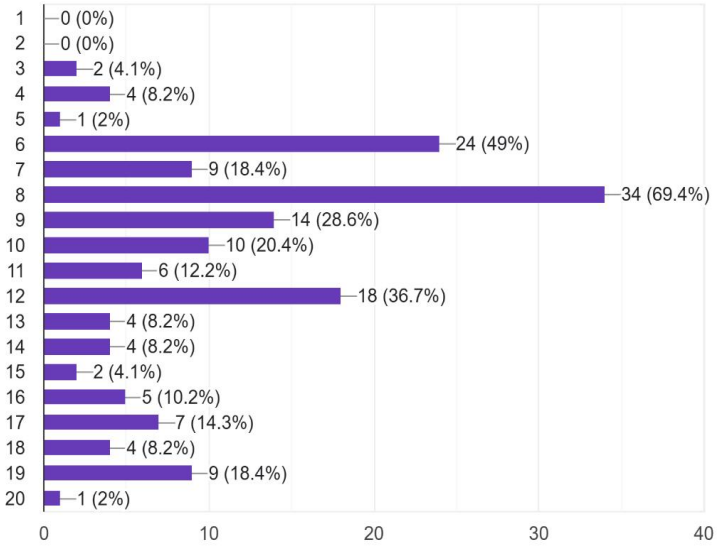
TOTAL SCORE

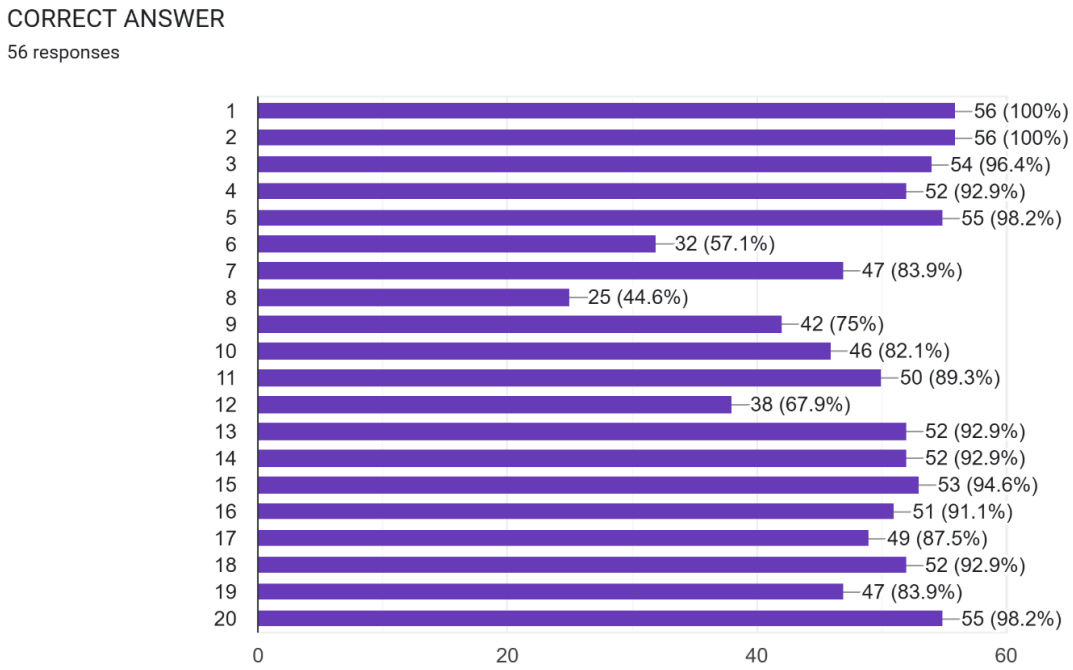
56 responses



WRONG ANSWER

49 responses





Detailed Questionnaire Results

The table below summarizes the percentage of correct responses for each item in the 20-question knowledge assessment questionnaire on VAP prevention.

Table 1: ICU Nurses' Responses to VAP Knowledge Questionnaire

No.	Questionnaire Item	% Correct
1	What is the single most important measure to prevent healthcare-associated infections?	92.8%
2	When should hand hygiene be performed while handling ventilated patients?	85.7%
3	Which PPE is essential when performing suctioning on a ventilated patient?	82.1%
4	Which disinfectant is most recommended for oral care in VAP prevention?	66.1%
5	Transmission of VAP most commonly occurs through:	78.5%
6	How often should ventilator circuits be changed?	73.2%
7	What should be the endotracheal cuff pressure to minimize aspiration?	53.6%
8	A closed suction system should be changed:	58.9%
9	Which humidification method is preferred in ventilated patients?	69.6%
10	Condensate in ventilator tubing should be:	76.8%
11	Head of bed elevation to reduce VAP should be:	85.7%
12	Preferred frequency of oral care with chlorhexidine:	55.3%
13	Subglottic suctioning is used to:	57.1%
14	To promote lung clearance in ventilated patients, which is recommended?	76.7%
15	Weaning from ventilation should start:	83.9%
16	Reintubation is associated with VAP because:	71.4%

17	Which of the following contributes to biofilm formation in ventilated patients?	62.5%
18	Which of these factors increases risk of VAP?	75.0%
19	Which of the following is not a risk factor for VAP?	60.7%
20	Before initiating oral care in a ventilated patient, the nurse should:	80.3%

Overall Mean Score: 70%
Good Knowledge (≥75% correct): 35.7%
Fair Knowledge (<75% correct): 64.3%

Observations:
- The **strongest responses** were noted in areas such as:
  - Hand hygiene (Q1, Q2): >85% correct
  - Head-of-bed elevation (Q11): 85.7%
  - Ventilator weaning (Q15): 83.9%
- **Knowledge deficits** were most evident in:
  - Cuff pressure management (Q7): 53.6%
  - Oral care frequency (Q12): 55.3%
  - Subglottic suctioning purpose (Q13): 57.1%
  - Suction system replacement (Q8): 58.9%

Discussion
This study aimed to evaluate ICU nurses' knowledge regarding VAP prevention, a crucial component of infection control in mechanically ventilated patients. The mean knowledge score among participants was **70%**, indicating **fair awareness** overall. These results are consistent with prior studies, including El-Kass et al. (2024), where the mean score was **72%**, reflecting widespread yet partial adherence to evidence-based VAP protocols.

Key Strengths and Gaps Identified
Participants demonstrated **strong knowledge** in basic infection control measures:
- **Hand hygiene** was well understood, with 92.8% and 85.7% answering Q1 and Q2 correctly.
- The importance of **head-of-bed elevation** (Q11, 85.7%) and **early weaning** (Q15, 83.9%) was widely recognized.
- **PPE use during suctioning** (Q3) and handling of **ventilator condensate** (Q10) also showed good awareness.

However, **knowledge gaps** were apparent in more technical and nuanced areas:
- Only **53.6%** correctly identified the **optimal cuff pressure** (20–30 cm H_2O), critical to minimizing microaspiration.
- Awareness regarding **oral care frequency with chlorhexidine** (Q12, 55.3%) and the **purpose of subglottic suctioning** (Q13, 57.1%) was limited.
- Less than 60% understood correct **replacement intervals** for closed suction systems (Q8) and **recognition of risk factors** such as reintubation and supine positioning.

These trends are similar to findings reported by Selamat et al. (2021) and Lin et al. (2014), who observed suboptimal knowledge of advanced airway management practices among ICU nurses.
In the Palestinian study by El-Kass et al., similar deficits were observed in understanding ventilator circuit changes and suction practices. In both studies, nurses had good foundational knowledge but inconsistent understanding of **protocol-specific** interventions (e.g., subglottic suctioning, humidification). However, our study showed **higher compliance in head-of-bed elevation and hand hygiene**, suggesting successful reinforcement of basic VAP bundle elements in your institution.
Factors Influencing Knowledge
In line with global literature:

- Nurses with **greater ICU experience** and those who had attended **VAP prevention programs** scored significantly higher.
- This supports findings from studies in Ethiopia, Taiwan, and Egypt, which concluded that **training interventions significantly improve knowledge and adherence to VAP protocols**.

Our findings echo the **pattern seen in developing countries**—strong awareness of general care principles but poor integration of **specific evidence-based strategies** unless reinforced through training.

Implications and Recommendations

- **In-service education** should target knowledge gaps identified (e.g., suction system maintenance, cuff pressure monitoring).
- Integration of **standardized VAP checklists** into daily ICU workflow is recommended.
- **Regular audits and re-evaluation** of staff knowledge can sustain improvements and track protocol adherence.
- Encouraging **interdisciplinary collaboration** (nursing, respiratory therapy, infection control) will further consolidate VAP prevention efforts.

Conclusion

Despite demonstrating a moderate overall awareness of ventilator-associated pneumonia (VAP) prevention measures, our findings highlight that ICU nurses continue to harbor significant knowledge gaps in key technical and procedural domains. These include, optimal strategies for oral care, suction system management, and maintenance of cuff pressures—all critical components in the effective prevention of VAP. Such deficits are particularly concerning as they can directly impact the reliability of prevention bundles and the overall standard of patient care delivered in intensive care settings.

This study reinforces the notion that periodic knowledge assessment is not only necessary but fundamental in the quest for continual quality improvement. Addressing these persistent deficits calls for a multipronged approach. The implementation of structured and evidence-based educational programs tailored to identified weaknesses is imperative. Competency-based workshops provide opportunities for hands-on learning and skill reinforcement, ensuring that theoretical knowledge is effectively translated into clinical practice. Furthermore, stringent policy enforcement, through regular audits and compliance tracking, is essential to cultivating accountability and adherence to established VAP prevention protocols.

Importantly, while the knowledge and skills of ICU nurses form the cornerstone of effective VAP prevention, the complexities of critical care demand a robust interdisciplinary approach. Real-time cooperation and communication among nurses, physicians, respiratory therapists, infection control personnel, and other members of the healthcare team are vital in translating knowledge into consistent bedside practice. Such collaboration ensures that prevention measures are not implemented in isolation, but integrated seamlessly into the patient's overall care plan, fostering a culture of shared responsibility and vigilance.

It is therefore essential to promote and facilitate interdisciplinary teamwork, with clear protocols and timely decision-making processes that empower frontline caregivers to act cohesively. Encouraging regular multidisciplinary rounds, joint training sessions, and open channels of communication enhances adherence to VAP prevention bundles and improves patient outcomes.

In addition to prevention, antibiotic stewardship plays a critical role in managing VAP. Judicious use of antibiotics, guided by local microbiology and resistance patterns, helps prevent the emergence of multidrug-resistant organisms and preserves antibiotic effectiveness. Therefore, combining robust infection prevention with responsible antibiotic use forms the cornerstone of reducing VAP incidence and improving patient outcomes.

Sustained commitment to education, interdisciplinary teamwork, and antibiotic stewardship is vital for advancing critical care practices and enhancing patient safety in intensive care units.

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