The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 12, 2025

EFFECT OF EDUCATIONAL GUIDELINES ON NURSES KNOWLEDGE AND PRACTICES REGARDING VENTILATOR ASSOCIATED PNEUMONIA IN A TERTIARY CARE HOSPITAL LAHORE

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DOI: https://doi.org/10.5281/zenodo.17986686

Keywords
Ventilator-Associated Pneumonia, Knowledge, Practices, Nurses, Educational Intervention.

Article History
Received: 19 October 2025
Accepted: 30 November 2025
Published: 19 December 2025

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Abstract

Background:
Ventilator-Associated Pneumonia (VAP) is a significant nosocomial infection occurring in patients after 48 hours of mechanical ventilation. It contributes to increased morbidity and mortality among intensive care unit (ICU) patients. Given the pivotal role of ICU nurses in implementing preventive measures, enhancing their knowledge and skills is essential to reduce the incidence of VAP.

Objective:
This study aimed to assess ICU nurses' knowledge and practices regarding VAP prevention before and after a structured educational intervention.

Method:
A quasi-experimental study was conducted from October 2024 to February 2025 among 35 ICU nurses. Data were collected using a structured questionnaire through pre-test and post-test assessments. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS), and paired t-tests were applied to compare mean knowledge and practice scores before and after the intervention.

Results:
The findings revealed a statistically significant improvement in nurses' knowledge and practice scores following the educational intervention. The mean knowledge score increased from 12.46 ± 3.33 to 15.49 ± 2.39 ($p < 0.001$), while the mean practice score rose from 14.63 ± 3.00 to 16.54 ± 2.29 ($p < 0.001$).

Conclusion:
The study concludes that a structured educational program effectively enhances ICU nurses' knowledge and practices regarding VAP prevention. Regular educational sessions are recommended to sustain improved clinical competence and promote better patient outcomes.

Introduction

Ventilator-associated pneumonia (VAP) is a lung infection that develops in patients after 48 hours of mechanical ventilation (Alvina et al., 2023). It is one of the most frequent hospital-acquired infections among intubated patients in intensive care units (ICUs) (Mathai et al., 2015). Based on the time of onset, VAP is classified as early or

late. Early-onset VAP occurs within the first four days of ventilation and is usually caused by antibiotic-sensitive bacteria, while late-onset VAP develops after five or more days and is commonly associated with multidrug-resistant (MDR) organisms (Mathai et al., 2015).

Common pathogens in early-onset VAP include *Streptococcus pneumoniae* (15–30%), *Haemophilus influenzae* (10–20%), and methicillin-sensitive *Staphylococcus aureus* (10–15%) (Rehman et al., 2024). In contrast, late-onset VAP is often caused by hospital-acquired, MDR organisms such as *Pseudomonas aeruginosa* (20–30%), *Acinetobacter baumannii* (10–20%), methicillin-resistant *Staphylococcus aureus* (MRSA), and extended-spectrum beta-lactamase (ESBL)-producing *Enterobacteriaceae* (15–25%) (Rehman et al., 2024).

The pathogenesis of VAP is complex and involves changes in normal airway defenses, alterations in microbial flora, and impaired immune responses (Howroyd et al., 2024). Several risk factors increase the likelihood of developing VAP, including older age, prolonged mechanical ventilation, aspiration of secretions, and COVID-19 infection (Zhao et al., 2020). Male patients have been reported to have a 1.6 times higher risk of developing VAP than female patients (Wu et al., 2019). The risk also varies across ICU types and between high- and middle-income countries (Papazian et al., 2020). Chronic diseases such as diabetes, coronary heart disease, and renal failure further increase vulnerability (Wu et al., 2019).

The ventilator delivers oxygen through an endotracheal tube, which provides a direct pathway for bacteria to enter the lower respiratory tract (Mannava et al., 2020). Mechanically ventilated patients often lack an effective cough reflex and accumulate mucus, which facilitates bacterial growth. Within 48 hours of ICU admission, the oral flora often shifts toward gram-negative organisms (Mannava et al., 2020). Dental plaque also serves as a reservoir for respiratory pathogens, including MRSA and *Pseudomonas aeruginosa* (Mannava et al., 2020).

Most VAP cases occur in patients aged 50 years or older, with age being a strong predictor of infection and mortality (Gunalan et al., 2023). In ICUs, VAP remains the most common hospital-acquired infection, affecting 20–36% of critically ill patients. Intubation is the primary risk factor, accounting for over 95% of pneumonia cases in ICUs (Wu et al., 2019). Other contributing factors include decreased consciousness, trauma, and severe illness.

The global incidence of VAP varies widely, ranging from 2 to 16 episodes per 1,000 ventilator days, depending on diagnostic criteria, preventive practices, and patient populations (Barbier et al., 2013; Timsit et al., 2017). It affects approximately 5–40% of patients who receive mechanical ventilation for more than two days (Papazian et al., 2020). A systematic review found that VAP rates ranged from 6.3% to 66.9% across low-, middle-, and high-income countries (Mumtaz et al., 2023).

Despite advances in medical care, VAP continues to have a high mortality rate, ranging from 30% to 35% within 90 to 180 days (Luo et al., 2021). Mortality varies depending on whether pneumonia was the reason for ICU admission or developed later during hospitalization (Costa et al., 2019).

ICU nurses play a vital role in preventing VAP because they provide continuous bedside care and can implement evidence-based interventions (Allen Furr et al., 2004). Assessing nurses' knowledge about VAP prevention helps identify gaps and improve clinical practices (Getahun et al., 2022). Effective education and adherence to prevention guidelines have been shown to reduce infection rates significantly.

VAP prevention requires consistent application of evidence-based strategies such as proper hand hygiene, elevating the head of the bed, maintaining oral hygiene with antiseptics, minimizing ventilation duration, and monitoring endotracheal tube cuff pressure. Implementing standardized prevention bundles in ICUs has led to a marked reduction in infection rates and improved patient outcomes (Gutiérrez et al., 2019).

In conclusion, ventilator-associated pneumonia remains a major concern in critical care worldwide. It leads to prolonged ventilation,

extended hospital stays, increased antibiotic use, and higher healthcare costs. ICU nurses are at the forefront of prevention, and their ongoing education and compliance with evidence-based guidelines are essential to reducing the incidence, morbidity, and mortality associated with VAP.

Methodology

A quasi-experimental design with pre-test and post-test assessments was used to evaluate changes in nurses' knowledge and practices before and after an educational intervention. By comparing baseline and post-intervention results, the study measured the effectiveness of the program without random assignment. This design was chosen for its practicality in a real clinical setting while addressing possible confounding factors.Thestudy was conducted in all Intensive Care Units (ICUs) of Avicenna Hospital, Lahore, Punjab. Data were collected and analyzed from all ICUs to provide a comprehensive overview of current nursing practices. The total duration of the study was five months, from October 2024 to February 2025.

The target population included all Registered Nurses (RNs) and Bachelor of Science in Nursing (BSN) intern nurses currently working in the ICUs. Participants were directly involved in bedside patient care, including monitoring, medication administration, and critical interventions. Nurses who were willing to participate and working in the ICUs were included, while those who had recently attended training sessions on the prevention of ventilator-associated pneumonia (VAP) were excluded. This ensured that participants had similar baseline knowledge and experience regarding VAP prevention. Anon-random convenience sampling technique was used to select participants based on their availability and willingness to participate. The total sample size was 35 nurses, representing all ICUs of Avicenna Hospital.

Data were collected using a structured questionnaire developed according to the Centers for Disease Control and Prevention (CDC) guidelines on VAP prevention. The questionnaire consisted of three parts: demographic information, knowledge-based questions, and a practice checklist. The total knowledge score was 20, with one point given for each correct answer and zero for incorrect responses. Higher scores indicated greater knowledge. The content validity of the tool was reviewed by two experts—an Associate Professor of Pulmonology and an Assistant Professor of Nursing—and revised based on theirfeedback.Theresearch was carried out in four stages: preparatory, planning, action, and outcome. Data collection occurred in two phases: the preparatory stage for baseline (pre-test) data and the evaluation stage for post-intervention data.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 30. Descriptive statistics such as frequency, percentage, and standard deviation were used to describe demographic variables. The Shapiro–Wilk test was applied to test data normality. Since the data were normally distributed, paired *t*-tests were used to compare pre- and post-test mean scores for nurses' knowledge and practices regarding VAP prevention.

Results

Out of 35 participants, 31(88.6%) participants were 15-25 years old and 4(11.1%) participants were in the range of 26-35 years,31(88.6%) were BSN and 4(11.4%) were Registered nurses,30(85.7%) were Muslims and 5(14.3%) were Christians,31(88.6%) participants had work experience of less than 1 year and only 4(11.4%) participants had 1-2 years of experience.19(54.3%) nurses deal with more than 4 patients,7(20.0%) nurses deal with 3 patients,8(22.9%) nurses deal with 2 patients and 1(2.9%) nurse deals with 1 patient.20(57%) was aware of organizational policy on VAP,13(37%) was not aware and 2(6%) were not sure about policy(Table 1).

Variable	F(%)
Age (years)	
15–25	31 (88.6%)
26–35	4 (11.4%)
Qualification	
BSN	31 (88.6%)
Registered Nurse	4 (11.4%)
Religion	
Muslim	30 (85.7%)
Christian	5 (14.3%)
Work Experience	
< 1 year	31 (88.6%)
1–2 years	4 (11.4%)
Patient Load	
1 patient	1 (2.9%)
2 patients	8 (22.9%)
3 patients	7 (20.0%)
>4 patients	19 (54.3%)
Awareness of Organizational Policy on VAP	
Aware	20 (57%)
Not aware	13 (37%)
Not sure	2 (6%)

Table 1: DemographicVariables of study sample

Table 2 shows that, mean knowledge scores of participantsbefore intervention was 12.46 and standard deviation was 3.33. After intervention and taking the post-test mean knowledge score was increased to 15.49 and standard deviation to 2.39. This indicate that there was significant increase in knowledge level of participants after teaching guidelines with the mean difference of 3.029, t-statistics 12.23 and *p*-value of <0.001.

Knowledge Score	Mean± SD	Mean Difference	t-statistics	*p*-Value
Pre-intervention	12.46± 3.33	3.029	12.23	<0.001
Post-Intervention	15.49±2.39			

Table 2: Pre and post intervention knowledge scores of nurses regarding ventilator associated pneumonia.

Table# 4.3Detailed practice checklist of participants in pre and post-test.					
Sr#	Items	Pre-Test		Post-Test	
		Yes	No	Yes	No
		f (%)	f (%)	f (%)	f (%)
1	Head end elevation for ventilator patient	30(85.70%)	5(14.30%)	32(91.40%)	3(8.60%)
2	Changes resuscitation bags for ventilator patient	21(60%)	14(40%)	32(91.40%)	3(8.60%)
3	Decontamination of respiratory equipment	27(77.10%)	8(22.90%)	30(85.70%)	5(14.30%)
4	Drain tubing condensation away from the patient.	28(80%)	7(20%)	32(91.40%)	3(8.60%)
5	Routinely provides (developmentally appropriate) oral care	29(82.80%)	6(17.20%)	31(88.50%)	4(11.50%)
6	Follows tongue cues and avoids gagging infants during oral care.	29(82.80%)	6(17.20%)	28(80%)	7(20%)
7	Meticulous hand hygiene before and after oral care, after contact with any source of microorganisms and after removing gloves.	29(82.80%)	6(17.20%)	24(68.50%)	11(31.50%)
8	Single use of products such as sponge applicator or gauze for every swab into the mouth.	25(71.40%)	10(28.60%)	32(91.40%)	3(8.60%)
9	Meticulous hand hygiene before and after suctioning the ETT and after touching potentially contaminated objects.	30(85.70%)	5(14.30%)	29(82.80%)	6(17.20%)
10	Does not perform saline lavage prior to suctioning.	13(37.10%)	22(62.90%)	30(85.70%)	5(14.30%)
11	Suction as clinically needed and oral cavity after oral care and mouth before nose.	26(74.20%)	9(36.80%)	32(91.40%)	3(8.60%)
12	Suctioning performed using pressure of <100 mm of Hg	21(60%)	14(40%)	32(91.40%)	3(8.60%)
13	Recognizes and informs physicians of infant readiness to trial off the Ventilator.	31(88.50%)	4(11.50%)	27(77.10%)	8(22.90%)
14	Enhances use of minimally invasive ventilator support techniques.	30(85.70%)	5(14.30%)	30(85.70%)	5(14.30%)
15	Assess feeding tube placement before each feed or after every two feeds	29(82.80%)	6(17.20%)	33(94.20%)	2(5.80%)
16	Checks for aspirates and documents the same with date and time.	33(94.20%)	2(5.80%)	33(94.20%)	2(5.80%)
17	Provides tube feeding with head of bed elevated between 15-30 degree	28(80%)	7(20%)	32(91.40%)	3(8.60%)
18	Adequate amount of sterile water is used in humidifiers	27(77.10%)	8(22.90%)	33(94.20%)	2(5.80%)
19	Washes hands before and after contact with the neonate	28(80%)	7(20%)	32(91.40%)	3(8.60%)

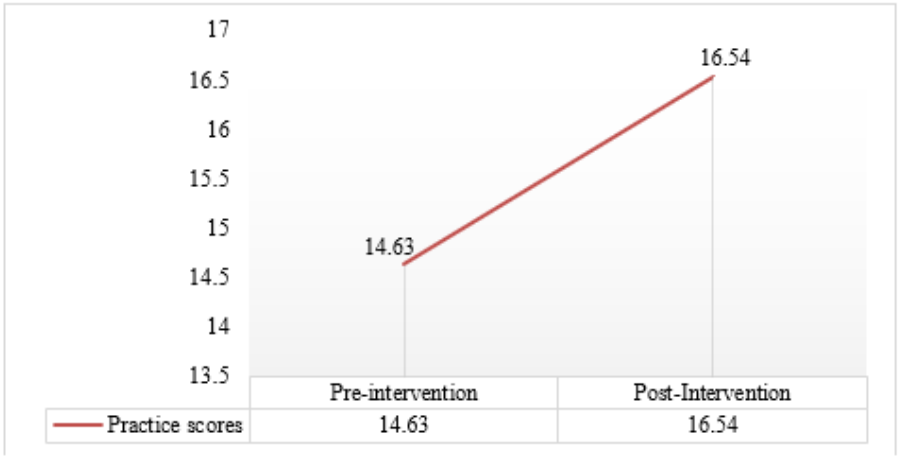

Figure 2: Comparison of Pre-and Post-Intervention practices Scores of Nurses Regarding Ventilator Associated Pneumonia.

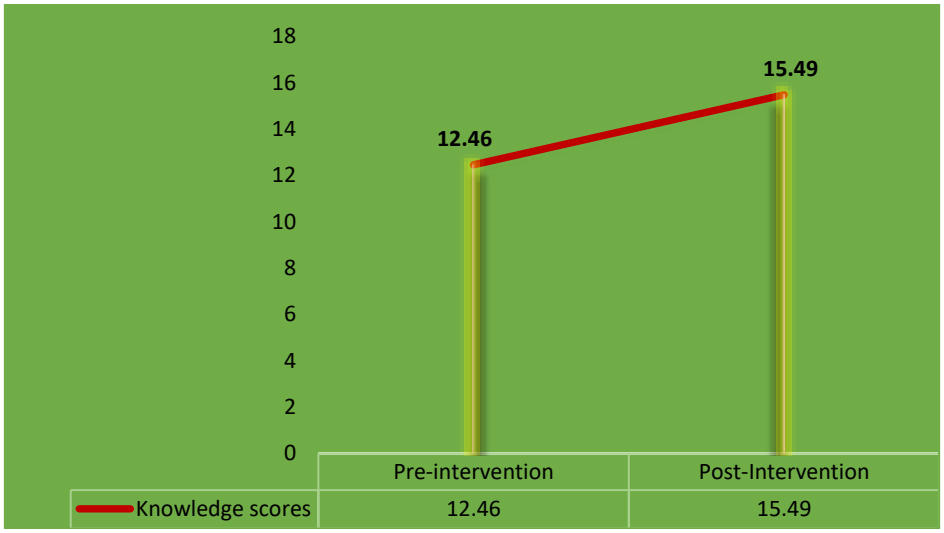

Figure 1: Comparison of Pre- and Post-Intervention Knowledge Scores of Nurses Regarding Ventilator Associated Pneumonia.

Table 3 Indicates that among the total sample of 35, mean score of practices of participants before intervention was 14.63 and standard deviation was 3.00. After intervention and taking of post-test the mean score of practices was increased to 16.54 and standard deviation to 2.29. This shows that there was significant improvement of practices of nurses by teaching prevention guidelines on ventilator associated pneumonia with the mean difference of1.914, t-statistics 10.10 and p-value of <0.001.

Practice Score	Mean± SD	Mean Difference	t-statistics	*p*-Value

Pre-intervention	14.63± 3.00	1.914	10.10	<0.001
Post-Intervention	16.54±2.29			

Table 3: Pre and post intervention practices scores of nurses regarding ventilator associated pneumonia.

Discussion

A quasi-experimental study was conducted to evaluate the effectiveness of an educational intervention in preventing Ventilator-Associated Pneumonia (VAP). A pre-test was administered to assess nurses' baseline knowledge and practices in managing patients on mechanical ventilation. Following structured teaching sessions based on evidence-based VAP prevention guidelines, a post-test was conducted to evaluate changes in knowledge and practice. The primary objective was to determine whether such educational interventions could enhance nurses' knowledge and practices to help reduce the incidence of VAP.

The study included 35 participants, of whom 31 (88.6%) were aged 15–25 years and 4 (11.4%) were between 26–35 years. In comparison, Alvina, Afzal et al. reported that 36.1% of participants in their study were aged 30–34 years. Regarding professional qualifications, 31 (88.6%) were BSN internees and 4 (11.4%) were BSN registered nurses, whereas Nahla S. Khalil and Hala et al. included diploma and technical institute nurses in their sample.

In terms of religion, 30 (85.7%) participants were Muslims and 5 (14.3%) were Christians, while Dipanjali and Shivananda et al. reported 66% Hindus and 34% Christians in their study. Most participants (31; 88.6%) had less than one year of professional experience, and 4 (11.4%) had one to two years, whereas Hassan and Wahsheh (2017) found that over half of their respondents had one to three years of experience.

Regarding workload, 19 (54.3%) nurses cared for more than four patients per shift, 7 (20%) managed three, 8 (22.9%) handled two, and 1 (2.9%) was responsible for one patient. In contrast, Dipanjali and Shivananda et al. reported that 94% of nurses were assigned three patients per shift. Awareness of institutional VAP prevention policies varied, with 20 (57%) nurses reporting awareness, 13 (37%) unaware, and 2 (6%) uncertain. Their study revealed comparable findings, with 44% aware, 32% unaware, and 24% unsure about existing policies.

In the current study, the mean knowledge score before the intervention was 12.46 (SD = 3.33), which increased to 15.49 (SD = 2.39) after the intervention, demonstrating a statistically significant improvement (mean difference = 3.029; $t = 12.23$; $p < 0.001$). This indicates that educational interventions effectively enhanced participants' knowledge of VAP prevention.

However, Aloush (2017) conducted a study in Jordan using a two-group post-test-only design and found no significant difference ($p = 0.15$) in compliance between nurses who received VAP education and those who did not, emphasizing the need to address workload and other contextual factors for effective outcomes. Conversely, several studies support the positive impact of education. At a tertiary hospital in Lahore, mean knowledge scores increased significantly from 7.78 ± 1.22 to 15.86 ± 1.22 ($p = 0.001$) after an intervention (Alvina, Afzal et al., 2023). Similarly, Dipanjali and Shivananda (2020) found a rise from 21.44 ± 3.06 to 30.26 ± 2.46 ($p < 0.001$), and Alamery, Yacoub et al. (2023) also reported significant improvement ($p < 0.05$) across 20 ICUs in Jordan.

In the present study, the mean practice score improved from 14.63 (SD = 3.00) to 16.54 (SD = 2.29) post-intervention, a statistically significant increase (mean difference = 1.914; $t = 10.10$; $p < 0.001$). Comparable results were reported by Abou Zed and Mohammed (2019), who observed

significant improvement in nurses' knowledge and performance following educational sessions in neonatal ICUs.

Overall, the findings confirm that structured educational programs significantly enhance nurses' knowledge and practices related to VAP prevention. Regular, evidence-based training and reinforcement of guidelines are essential for sustaining these improvements. Ongoing education not only strengthens nurses' competencies but also contributes to reducing VAP incidence, improving patient outcomes, and lowering healthcare costs. Therefore, integrating such educational interventions into routine intensive care practice is strongly recommended to promote adherence to VAP prevention standards.

Conclusion

The study found that educational programs on VAP prevention improved nurses' knowledge and practices. These types of training are helpful in increasing nurses' awareness and skills in preventing VAP.

Limitations

- The small sample size limits the generalizability of the findings.
- As the study was conducted in a single hospital, the results may not be applicable to other settings.
- The study did not evaluate the long-term retention of nurses' knowledge due to the absence of follow-up.

Recommendations:

- Future studies should be conducted on a larger scale with an increased sample size to enhance the generalizability of the findings.
- Continuous education and simulation-based training programs are recommended to help nurses retain and apply their knowledge effectively.

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