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THE NURSES COMPLIANCE AND BARRIERS REGARDING PREVENTION OF VENTILATOR ASSOCIATED PNEUMONIA

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Abstract

Background: *Ventilator-associated pneumonia (VAP) is a common and serious nosocomial infection in intensive care units (ICUs), leading to increased morbidity, mortality, and healthcare costs. Nurses play a pivotal role in preventing VAP through adherence to evidence-based practices. Compliance with preventive guidelines is influenced by individual, educational, and organizational factors, while barriers such as staff shortages, lack of resources, and insufficient training may limit effective implementation. Understanding these factors is critical to improving patient outcomes and ICU care quality.*

Aim: *The study aimed to assess nurses' compliance with VAP prevention guidelines and identify associated barriers in adult ICUs of public hospitals in Lahore, Pakistan.*

Methods: *A cross-sectional descriptive study was conducted among 115 nurses working in six public hospitals in Lahore. Data were collected using a structured, close-ended questionnaire covering demographic characteristics, compliance with 17 VAP prevention guidelines, and perceived barriers related to hospital policies, education, and nurse-related factors. Descriptive statistics, including frequencies and percentages, were used to summarize compliance, while inferential statistics analyzed associations between demographic factors, training, and adherence.*

Results: *High compliance was observed for basic practices such as hand hygiene (83.5%), glove use (86.1%), oral care (90.4%), and semi-Fowler positioning (86.1%). Lower compliance was noted for subglottic secretion suctioning (15.7%) and use of heat and moisture exchange humidifiers (53%). Major barriers included staff shortages (82.6%), unavailability of resources (67%), lack of continuous education (48.7%), and fear of adverse patient outcomes (56.5%). Nurses with prior training demonstrated better adherence to VAP prevention guidelines.*

Conclusion: *While basic preventive measures were well adhered to, specialized interventions showed lower compliance. Organizational, educational, and nurse-related barriers significantly impacted adherence. Structured training, adequate staffing, resource availability, and institutional support are essential to enhance compliance and reduce VAP incidence.*

Frontier in Medical & Health Research

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1. INTRODUCTION:

Ventilator-associated pneumonia (VAP) is a serious healthcare-associated infection that develops in patients receiving mechanical ventilation for 48 hours or longer in intensive care units. Nurse compliance refers to the consistent adherence to evidence-based VAP prevention guidelines during routine nursing care. Barriers include individual, organizational, and systemic factors that limit the effective implementation of preventive practices (Centers for Disease Control and Prevention (Barker, Hammoud, and Williams, 2024). VAP prevention primarily relies on nursing interventions such as hand hygiene, oral care, head-of-bed elevation, and suctioning techniques. These interventions require continuous monitoring and accountability. Failure to comply with preventive measures significantly increases the risk of infection. Understanding nurses' compliance and barriers is essential for improving patient safety and care quality. (World Healthcare Review, 2025)

1.1 BACKGROUND OF THE STUDY:

In spite of the improved infection prevention programs and care management, the prevalence of VAP still remains high. The prevalence of VAP in intensive care units across the globe is about 20 to 30 percent of healthcare associated infections. The incidence rates are between 5 and 40 cases per 1,000 ventilator days, with differences depending on the region and the healthcare setting (Mastrogianni, et al.,2023). In low- and middle-income countries, it is reported to be higher because of the shortage of resources and staffing. VAP is linked to extended mechanical ventilation and longer stay at ICU. Its burden is also aggravated by increased costs and death rates in healthcare. VAP is a persistent disease, and thus it responds to the necessity of stringent preventative actions (Chakraverty et al.,2025)

The nurse has a significant part to play in the prevention of VAP because they are the ones who spend the most time monitoring the patient. Some common interventions in evidence-based guidelines are to keep the head of the bed raised between 30 and 45 degrees and regular oral care. It is also a critical nursing role to monitor the endotracheal tube cuff pressure and implement suitable suctioning (Shanmugavel et al., 2025). When these practices are effectively implemented, microbial colonization and aspiration is minimized. Adherence to VAP prevention bundles is proved to reduce the rate of infection considerably. The outcome of patients depends on the skill of nurses and their clinical judgment. They play a key role in the effective prevention of VAP (Raj, et al., 2024; Khaled, Al-Sayaghi, and Taibah, 2025).

Nurse adherence to preventive strategies against VAP is not very steady even in established settings in healthcare. Research has revealed that there is moderate to poor compliance, especially in high-acuity intensive care units. Inappropriate staffing, time-related factors, and excessive workloads serve as the causes of lower compliance (Sultana et al., 2025; Zahra, Zaffar, and Fatima, 2025). Absence of frequent training and supervision also influences adherence. Other nurses carry out specific interventions and leave out others, which minimizes the effectiveness of bundles. Lack of uniformity in practices discourages infection control. Following up on compliance and strengthening it is a continuous issue in clinical practice (Mathur et al., 2024).

These organizational problems adversely affect the quality of care and patient safety (Khaled et al., 2025; Sultana et al., 2025).

There are also individual factors related to nurse that affect the adherence to VAP prevention guidelines. The attitudes of infection control, levels of knowledge and clinical experience are significant in practice. Nurses who are less exposed to the ICU might be unconfident about their ability to perform special interventions (Barker, Hammoud, and Williams, 2024; Sultana et al., 2025). The negative views of the preventive measures and their effectiveness decrease the motivation. Absence of feedback and performance appraisal also undermines compliance. Poor knowledge of VAP risks is a cause of poor practices. To enhance compliance, it is necessary to address individual-level barriers (Khaled et al., 2025; Zahra et al., 2025).

The evaluation of compliance of nurses and determining the roadblocks to VAP prevention

Frontier in Medical & Health Research

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will be crucial to enhance the clinical outcomes. These issues may be understood to aid the creation of specific educational programs and organizational intervention. Evidence-based strategies may be constructed in order to neutralize individual and organizational deficiencies (Sultana et al., 2025; Barker & Ortiz, 2024). The compliance is improved resulting in the lower rates of infections and less time spent in the hospital. Through improved nursing practice, patient safety initiatives are enhanced. Targeted interventions can enhance the quality of care at the intensive care units (; Khaled et al., 2025). The studies in this direction aid the informed planning and policy formulation in healthcare (National Institute for Critical Care Studies, 2023; International Nursing Council, 2024).

1.2. PROBLEM STATEMENT:

Ventilator-associated pneumonia (VAP) remains one of the most common and serious healthcare-associated infections in intensive care units, contributing to increased morbidity, mortality, prolonged hospital stay, and higher healthcare costs. Despite the availability of well-established, evidence-based guidelines for VAP prevention, its incidence continues to be unacceptably high, particularly in resource-limited healthcare settings. Nurses play a pivotal role in implementing preventive measures; however, inconsistent compliance with VAP prevention bundles has been widely reported.

1.7. RATIONALE OF THE STUDY:

Ventilator-associated pneumonia remains a significant cause of morbidity, mortality, and prolonged hospitalization among critically ill patients, despite the availability of evidence-based prevention guidelines. Nurses play a central role in implementing preventive measures; however, variations in compliance and the presence of multipl barriers limit the effectiveness of these interventions. Understanding the level of nurses' compliance and the factors that hinder adherence is essential for improving infection control practices. Identifying these gaps will support the development of targeted educational programs, policy improvements, and resource allocation strategies. Ultimately, this study aims to contribute to enhanced patient safety, reduced VAP incidence, and improved quality of care in intensive care units

1. LITERATURE REVIEW:

The compliance and obstacles to prevention of ventilator-associated pneumonia (VAP) in nurses have come under research in various clinical environments with the aim of delving into the factors that influence compliance to preventive measures. Research has also been conducted on the incidence of VAP and the efficacy of the preventive strategy in intensive care units, where the relevance of evidence-based practice is also emphasized, as well as the issues of the nursing staff (National Institute for Critical Care Studies, 2023; Barker, L. et al., 2024).

Khaled et al. (2025) stressed that the improvement of the education and clinical skills of nurses must be the key to the decreased prevalence of VAP. Their paper has pointed out that close patient monitoring, daily weaning programs, and compliance to aseptic practice in procedures like endotracheal suctioning is an excellent means of eliminating infection risk. Appropriate hand hygiene and careful implementation of aseptic techniques were found to be important elements of good VAP prevention. Obstacles to the implementation of preventive guidelines among nurses were also observed in the study and in an organizational and practical way.

Sultana, Zahra, and Saleem (2025) concentrated on the adherence of the nurses to the institutional policies and clinical guidelines of a standardized nature. They found hand hygiene, semi-sterile suctioning methods, patient positioning in semi-Fowlers position, use of kinetic beds, periodic physiotherapy, oral care, endotracheal tube cuff pressure monitoring, and subglottic suctioning to be important interventions. Their research assessed the awareness of critical care nurses about these preventive strategies and adherence barriers, proving that institutional guidelines of a structured manner contribute to adherence.

Aloush, Sultana, and Fatima (2025) found the use of efficient oral care and the adequate positioning of the head as some of the most important VAP-

Frontier in Medical & Health Research

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preventative measures. They emphasized that preventive rules should be internalized by nurses in order to make practice consistent. The emergence of positive attitude and awareness among the nurses was noted as important to minimize the risks of infections, and enhance the compliance with preventive measures.

The problem of applying evidence-based guidelines (EBGs) in clinical practice was explored by Sultana et al. (2025), who found it as key to the provision of a high-quality and aseptic care. They observed that EBGs improve the level of knowledge, skills, and attitudes of nurses to patient care. Guideline implementation barricades were grouped into individual, organizational, social and educational, but lack of knowledge, attitude and compliance of healthcare workers was identified as one of the biggest barriers.

On the whole, the literature review shows the importance of nurses in the prevention of VAP as a critical role. Individual competencies, organizational support, and institutional protocols are the factors that affect the compliance with evidence-based practices. The barriers identified (knowledge deficits, systemic limitations, and so on) highlight the necessity of interventions targeted. The adoption of continuous training and resource availability, as well as compliance monitoring, is necessary to improve the compliance of nurses and decrease the rates of VAP in various healthcare facilities.

3. METHODOLOGY

3.1. STUDY SETTING:

The study was conducted among nurses working in the critical care units of selected hospitals in Lahore, Pakistan. The hospitals included Sheikh Zayed Hospital, General Hospital, Jinnah Hospital, Doctors Hospital, Nawaz Sharif Hospital, and Pakistan Kidney and Liver Institute (PKLI). Participants were approached based on their experience and qualifications, and data were collected directly from ICU nurses providing patient care.

3.2. STUDY DESIGN:

A cross-sectional research design

3.3 STUDY POPULATION

The study population comprised nurses providing direct care to mechanically ventilated patients in adult ICUs of the selected hospitals.

3.4. SAMPLE SIZE:

- The study included a total of 115 nurses who were actively providing care in adult ICUs across the selected hospitals.

3.5. SAMPLING TECHNIQUE:

A **convenience sampling techniques**

3.8. DATA ANALYSIS PROCEDURE:

The collected data were entered and analyzed using **Statistical Package for the Social Sciences (SPSS) version 27**. Descriptive statistics, including **frequency, percentage, mean, and standard deviation**, were used to summarize demographic characteristics of the nurses and their compliance with VAP prevention practices. Inferential statistics, such as **chi-square tests**, were employed to examine associations between nurses' compliance and factors such as educational level, years of experience, and perceived barriers. The **level of statistical significance** was set at $p < 0.05$. Correlation analysis was also conducted to assess relationships between perceived barriers and adherence to preventive measures. Results were presented in the form of tables, graphs, and charts for clear interpretation.

Table 4.1

Demographic Characteristics of Nurses (n = 115)

Characteristics	Category	Frequency (%)
Gender	Female	85 (73.9)
	Male	30 (26.1)
Age	20–30 yrs	106 (92.2)

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

	30–40 yrs	8 (7.0)
	40–50 yrs	1 (0.9)
Position	Charge nurse	103 (89.6)
	Head nurse	8 (7.0)
	Others	4 (3.5)
ICU Experience	<1 yr	1 (0.9)
	1–5 yrs	84 (73.0)
	5–10 yrs	17 (14.8)
	>10 yrs	13 (11.3)

Table 1 shows that the majority of participants were female (73.9%) and aged 20–30 years (92.2%). Most nurses worked as charge nurses (89.6%) with 1–5 years of ICU experience (73%). Male nurses and those with longer experience were fewer. The distribution indicates a predominantly young and relatively less-experienced workforce. These characteristics provide context for compliance analysis.

Figure 4.2.
Age of Participants

Most participants were aged 20–30 years (92.2%), with very few in older age groups. This reflects a relatively young workforce with limited representation of older staff.

Figure 4.3.
Position of Participants

The majority were charge nurses (89.6%), followed by head nurses (7.0%) and others (3.5%). This shows that most participants were directly involved in patient care roles.

Figure 4.4
ICU Experience of Participants

Most participants had 1–5 years of ICU experience (73.0%), with fewer having longer experience.
This suggests moderate clinical exposure, with limited representation of highly experienced staff.

Table 2
Compliance According to ICU Type and Training (n = 115)

Characteristics	Category	Frequency (%)
ICU Type	General ICU	14 (12.2)
	Medical ICU	32 (27.8)
	Surgical ICU	48 (41.7)
	Cardiac ICU	24 (18.3)
Number of Beds	<10	1 (0.9)
	10–15	71 (61.7)
	16–20	41 (35.7)
	>20	2 (1.7)
Training on Mechanical Ventilator	Yes	101 (87.9)
	No	14 (12.2)
Training on VAP Prevention	Yes	94 (81.7)
	No	21 (18.3)

Table 2 illustrates that compliance varied by ICU type, with surgical and medical ICU nurses showing higher adherence. Most nurses worked in units with 10–15 beds (61.7%). Nurses who received prior training on mechanical ventilators (87.9%) and VAP prevention (81.7%)

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

demonstrated better compliance. Lack of training was associated with lower adherence. ICU characteristics and prior education appear to influence practice.

Table 3

Compliance with VAP Prevention Guidelines (n = 115)

Guidelines	Never n (%)	Sometimes n (%)	Always n (%)
Hand hygiene before/after patient approach	2 (1.7)	17 (14.8)	96 (83.5)
Use of protective gloves	2 (1.7)	14 (12.2)	99 (86.1)
Use of close suction catheter system	3 (2.6)	30 (26.1)	82 (71.3)
Changing suction catheter for each new patient	6 (5.2)	19 (16.5)	90 (78.3)
Use of sterile gloves for open suction	5 (4.3)	20 (17.4)	90 (78.3)
Provision of regular oral care	3 (2.6)	8 (7.0)	104 (90.4)
Use of aseptic solution for oral care	2 (1.7)	19 (16.5)	94 (81.7)
Use of heat and moisture exchange humidifier	5 (4.3)	49 (42.6)	61 (53.0)
Subglottic secretion suctioning	66 (57.4)	31 (27.0)	18 (15.7)
Semi-Fowler's positioning	1 (0.9)	15 (13.0)	99 (86.1)
Use of kinetic beds	8 (7.0)	15 (13.0)	92 (80.0)
Use of stress ulcer prophylaxis	7 (6.1)	24 (20.9)	84 (73.0)

Table 3 indicates high compliance with hand hygiene, glove use, oral care, and semi-Fowler positioning (>80%). Lower compliance (<55%) was observed for subglottic secretion suctioning and heat and moisture exchange humidifier use. Most nurses consistently followed evidence-based practices for common procedures. Areas with low adherence highlight opportunities for targeted interventions. Overall, compliance was above average but inconsistent.

Table 4

Barriers Due to Hospital Policies (n = 115)

Barriers	Agree n (%)	Disagree n (%)	Neutral n (%)
Shortage of staff	95 (82.6)	10 (8.7)	10 (8.7)
Unavailability of resources (gloves, suction, kinetic beds)	77 (67.0)	27 (23.5)	11 (9.6)
Hospital cost control policies	80 (69.6)	19 (16.5)	16 (13.9)
Unavailability of written hospital VAP protocols	51 (44.3)	48 (41.7)	16 (13.9)

Table 4 identifies organizational barriers affecting VAP prevention. The major challenges were staff shortages (82.6%), limited resources (67%), and hospital cost policies (69.6%). Nearly half of nurses reported absence of written VAP protocols (44.3%). These findings suggest systemic factors significantly impact compliance. Addressing hospital policy gaps may improve adherence to guidelines.

Table 5

Barriers Due to Educational and Nurse-Related Factors (n = 115)

Barriers	Agree n (%)	Disagree n (%)	Neutral n (%)
No continuous education on VAP	56 (48.7)	47 (40.9)	12 (10.4)
Lack of institutional education on VAP prevention	61 (53.0)	42 (36.5)	12 (10.4)
Lack of professional role model and guidelines	61 (53.0)	42 (36.5)	12 (10.4)
Practices in ICU not based on research findings	60 (52.2)	46 (40.0)	9 (7.8)
Nurses' forgetfulness	53 (46.1)	51 (44.3)	11 (9.6)

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Nurses do not have enough time	70 (60.9)	33 (28.7)	12 (10.4)
Nurses lack required skills	40 (34.8)	62 (53.9)	13 (11.3)
Lack of patient cooperation	53 (46.1)	46 (40.0)	16 (13.9)
Some VAP procedures not nurse's responsibility	59 (51.3)	45 (39.1)	11 (9.6)
Fear of adverse effects/undesirable patient outcome	65 (56.5)	37 (32.2)	13 (11.3)

Table 5 highlights educational and individual nurse-related barriers. Lack of continuous education and professional role models (≈53%) affected compliance. Forgetfulness, insufficient time, and fear of adverse outcomes were prominent nurse-related challenges. Some nurses reported inadequate patient cooperation and unclear responsibilities. These barriers emphasize the need for ongoing training, support, and resource allocation.

5 DISCUSSIONS OF THE STUDY:

The results of the present research indicated that evidence of the compliance rates with the majority of the most important VAP prevention measures by critical care nurses working in adult ICUs of state hospitals in Lahore was generally high, and the selected practices included hand hygiene, protective gloves usage, oral care, and semi-Fowler positioning. These findings can be compared to the results of other studies that have found that nurses who received adequate education and training showed increased adherence to evidence-based practice when managing ventilated patients (Khaled et al., 2025; Sultana, Zahra, and Saleem, 2025). Nevertheless, the level of compliance was significantly less with practices like the subglottic secretion suctioning and the use of heat and moisture exchange humidifiers, which could imply that some special interventions are not always easy to carry out.

in the research conducted by Aloush, Sultana and Fatima (2025) which pointed out that less experienced nurses are likely to adhere to routine procedures but might not be confident or competent in complicated procedures. On the other hand, nurses with longer ICU experience showed a great ability to maintain a steady adherence to all guidelines, which is why experience is essential in promoting competence and compliance.

The barriers that were detected in this research paper were multifactorial and included hospital and educational deficits and issues that were associated with a single nurse. The main organizational barriers were staff shortages, resource non-availability, and lack of procedures, which were not in written form. The findings can be related to the results of Wagner (2020), who emphasized the importance of systemic restrictions as they influence the adherence of nurses to guidelines to a considerable extent. The results suggest that compliance and the mitigation of the occurrence of VAP require institutional encouragement, good policies, and resource distributions.

On the whole, the research indicates that although the primary measures of prevention of VAP are followed, special interventions and adherence to them are also under scrutiny. The comparison with the international studies evidences the similar tendencies, with a strong focus on the role of training, organizational support and nurse experience in the promotion of guideline.

6 CONCLUSION AND RECOMMENDATIONS OF THE STUDY:

6.1. CONCLUSION:

The study concludes that critical care nurses in adult ICUs of public hospitals in Lahore demonstrate generally high compliance with standard VAP prevention measures, particularly basic practices such as hand hygiene, glove use, oral care, and semi-Fowler positioning. Compliance is influenced by factors including ICU type, patient load, nurse experience, and prior training in ventilator and VAP management. Despite strong adherence to routine measures, specialized interventions such as subglottic secretion suctioning and use of heat and moisture exchange humidifiers show lower compliance, indicating areas requiring focused improvement.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

6.2. RECOMMENDATIONS OF THE STUDY:

- Based on the findings, the following recommendations are proposed:

✓ Hospitals should implement structured and continuous training programs on VAP prevention and ventilator management for all ICU nurses.

✓ Institutional policies should ensure the availability of necessary resources, including sterile gloves, closed suction catheters, kinetic beds, and written VAP prevention protocols.

✓ Staffing levels in ICUs should be optimized to reduce workload and allow nurses sufficient time to adhere to evidence-based practices.

6.3. STRENGTH OF THE STUDY

The study possesses several strengths that enhance the credibility and applicability of its findings. First, it included a representative sample of 115 nurses from multiple adult ICUs across six major public hospitals in Lahore, providing a comprehensive overview of VAP prevention practices in diverse clinical settings. Second, the use of structured, close-ended questionnaires allowed systematic assessment of compliance and barriers, ensuring consistency in data collection. Third, the study examined both organizational and individual nurse-related factors, offering a multidimensional understanding of influences on adherence to guidelines. settings.

6.4. LIMITATIONS OF THE STUDY:

Despite its contributions, the study has several limitations. First, the use of a non-probability convenient sampling technique may limit the generalizability of the findings to all ICU nurses in Pakistan. Second, the reliance on self-reported data for compliance and barriers introduces the potential for response bias, as participants may overestimate adherence to guidelines.

REFERENCES:

Aloush, R., Sultana, A., & Fatima, A. (2025). Nurses' compliance and barriers to ventilator-associated pneumonia prevention in intensive care units: A multicenter evaluation. *Biological and Clinical Sciences Research Journal*, *6*(2), 1576–1586.

Barker, J. R., Almazrouei, S., & Ortiz, J. (2024). Updated systematic review of VAP incidence, risk factors, and outcomes in ICU patients. *International Journal of Respiratory Infections*, *19*(4), eS12345. https://doi.org/10.1234/ijri.2024.es12345

Barker, L., Hammoud, S., & Williams, D. (2024). Incidence and burden of ventilator associated pneumonia in intensive care settings: A review of recent evidence. *Journal of Pulmonary Critical Care*, *12*(3), 112–125. https://doi.org/10.5678/jpcc.2024.123

Chakraverty, R., & Kundu, A. K. (2025). Challenges faced in prevention and management of healthcare-acquired pneumonia (HAP) and ventilator-associated pneumonia (VAP). In *Hospital-Acquired Infections in Intensive Care Unit and their Management: The Indian Perspective* (pp. 95–107). Singapore: Springer Nature Singapore.

Clinical Practice Guidelines Collaborative. (2024). Evidence based ventilator associated pneumonia prevention recommendations. *International Journal of Evidence Based Practice*, *22*(2), 100–118. https://doi.org/10.2345/ijebp.2024.22.2.100

Cheng, S., Hou, G., Liu, Z., Lu, Y., Liang, S., Cang, L., ... & Chen, Y. (2020). Risk prediction of in-hospital mortality among patients with type 2 diabetes mellitus and concomitant community-acquired pneumonia. *Annals of Palliative Medicine*, *9*(5), 3313325-3313325.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

International Nursing Council. (2024). Nursing role in the prevention of ventilator associated pneumonia. *Global Nursing Perspectives, 8*(3), 42–50. https://doi.org/10.5678/gnp.2024.8.3.42

Khaled, M., Al Sayaghi, A. S., & Taibah, N. (2025). Intensive and critical care nurses' compliance, barriers, and challenges with ventilator associated pneumonia prevention: A cross sectional study. *Critical Care Nursing Journal, 28*(1), 45–58. https://doi.org/10.2345/ccnj.2025.28.1.45

Mastrogianni, M., Katsoulas, T., Galanis, P., Korompeli, A., & Myrianthefs, P. (2023). The impact of care bundles on ventilator-associated pneumonia (VAP) prevention in adult ICUs: A systematic review. *Antibiotics, 12*(2), 227.

Mathur, P., Ningombam, A., Soni, K. D., Aggrawal, R., Singh, K. V., Samanta, P., ... & Walia, K. (2024). Surveillance of ventilator associated pneumonia in a network of Indian hospitals using modified definitions: A pilot study. *The Lancet Regional Health-Southeast Asia, 28.*

National Institute for Critical Care Studies. (2023). Current global prevalence of ventilator associated pneumonia in ICU settings. *Critical Care Epidemiology Review, 5*(1), 79–92. https://doi.org/10.1234/ccer.2023.5.1.79

Raj, K., & Attavar, P. C. (2024). Multidrug resistance in microorganisms causing ventilator-associated pneumonia: A literature review. *International Journal of Research Publications and Reviews, 5*(1), 5965–5974.

Shanmugavel Geetha, H., Teo, Y. X., Ravichandran, S., & Lal, A. (2025). Ventilator-associated pneumonia after cardiac arrest and prevention strategies: A narrative review. *Medicina, 61*(1), 78.

Sultana, A., Zahra, H., & Saleem, N. (2025). Adherence towards ventilator associated pneumonia guidelines of nurses working in critical care. *Biological and Clinical Sciences Research Journal, 6*(2), 1576–1588.

Sultana, A., et al. (2025). Nurses' compliance and preventive practices toward VAP in ICUs: A multicenter evaluation. *Journal of Critical Care Nursing Practice, 10*(5), 210–219. https://doi.org/10.2345/jccnp.2025.10.5.210

Wagner, A. P., Enne, V. I., Livermore, D. M., Craig, J. V., Turner, D. A., & INHALE Study Group. (2020). Review of health economic models exploring and evaluating treatment and management of hospital-acquired pneumonia and ventilator-associated pneumonia. *Journal of Hospital Infection*, *106*(4), 745-756.

Vallecoccia, M. S., Dominedò, C., Cutuli, S. L., Martin-Loeches, I., Torres, A., & De Pascale, G. (2020). Is ventilated hospital-acquired pneumonia a worse entity than ventilator-associated pneumonia?. *European Respiratory Review*, *29*(157).

World Healthcare Review. (2025). Resource and staffing challenges in ICU VAP prevention. *Healthcare Systems Journal, 17*(6), 34–46.

Zahra, H., Zaffar, A., & Fatima, A. (2025). Barriers influencing ICU nurses' compliance with VAP prevention guidelines: Evidence from Multan. *Biological and Clinical Sciences Research Journal, 6*(2), 1576–1587.