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Association between Healthcare Providers' Knowledge and Adherence to Ventilator-Associated Pneumonia Prevention Guidelines

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ABSTRACT

Ventilator-associated pneumonia (VAP) represents a prevalent and serious healthcare-associated infection among mechanically ventilated ICU patients. While evidence-based preventive measures can substantially reduce VAP incidence, their effectiveness depends on healthcare providers' (HCPs) knowledge and compliance. This study evaluated the relationship between HCPs' knowledge and adherence to VAP prevention guidelines in ICUs of public sector tertiary care hospitals in Peshawar, Pakistan. A cross-sectional study was conducted with 140 healthcare professionals (HCPs), including nurses, respiratory therapists, and physicians, using convenience sampling. Data were collected through a structured questionnaire assessing demographics, knowledge, and self-reported practices, analyzed via SPSS v25 using descriptive and inferential statistics (chi-square, ANOVA). Participants were predominantly male (60%), respiratory therapists (46.4%), with 79.3% having 1 month to 5 years ICU experience. While 73.6% reported formal VAP training, significant knowledge-practice gaps emerged: 92.9% knew the correct head-of-bed elevation (30-45°), but only 78.6% consistently practiced it; 70.7% recognized ideal oral care frequency ("every shift"), yet 57.1% performed it twice daily. Although 75% identified chlorhexidine as the preferred antiseptic, application remained inconsistent. Significant profession-based variations were observed. Chi-square tests revealed associations between professional role and oral care frequency ($p=0.040$) and antiseptic selection ($p=0.041$). ANOVA showed differences in early mobility understanding across professions ($p=0.027$). Despite adequate knowledge, adherence to critical practices (sedation interruption, subglottic suctioning) varied substantially by role. The study demonstrates persistent gaps between VAP prevention knowledge and practice, influenced by professional background, training inconsistencies, and systemic factors. Findings underscore the need for role-specific training, clinical audits, and strengthened institutional protocols to bridge these gaps. A multidisciplinary approach combining education, monitoring, and system-level support is essential to reduce VAP incidence and promote evidence-based critical care.

INTRODUCTION

Ventilator-associated pneumonia (VAP) is a significant healthcare-associated infection (HAI) that occurs in patients receiving mechanical ventilation for more than 48 hours. Ventilator-associated pneumonia (VAP) significantly contributes to increased morbidity, mortality, prolonged hospital stays, and higher healthcare costs, particularly in intensive care units (ICUs). (1–3)The incidence of VAP in ventilator-dependent patients is 10% to 20%, with mortality between 20% and 50%.(4) Evidence-based preventive measures can substantially reduce VAP incidence; their effectiveness depends on healthcare providers' (HCPs) knowledge and compliance.(4) Klompas noted that misconceptions surrounding ventilator-associated events (VAEs) could produce uncertainty regarding the most efficacious preventive strategies, further undermining adherence rates.(2) Qualitative research by Madhuvu et al. clarified several systemic barriers to guideline implementation, including time constraints, high patient-to-staff ratios, limited access to updated protocols, and insufficient institutional support structures. These insights underscore the necessity of evaluating not only healthcare providers' knowledge but also the practical challenges they encounter within high-pressure ICU environments. (5) Respiratory therapists (RTs), nurses, and physicians, despite their specialized training, are not immune to these obstacles. The dynamic and evolving nature of evidence-

based guidelines necessitates ongoing professional development and regular competency assessments to ensure alignment with current best practices. (6) The majority of existing research on VAP prevention has been conducted within high-income healthcare systems, with a lack of data available from lower-middle-income countries such as Pakistan. Public-sector tertiary care hospitals in regions like Peshawar, Khyber Pakhtunkhwa, face distinct challenges, including resource constraints, irregular training programs, and understaffed ICUs. These systemic deficiencies may exacerbate the existing knowledge-practice gap, ultimately compromising patient safety and clinical outcomes. There exists an urgent need to investigate this issue within the local context, with particular emphasis on frontline healthcare providers such as RTs, nurses, and physicians. By concurrently assessing knowledge levels, real-world adherence patterns, and identifying gaps between knowledge and practices, this study seeks to identify the underlying factors contributing to suboptimal implementation of VAP prevention strategies within public-sector ICUs of public sector tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan.

METHODOLOGY

This descriptive cross-sectional research focused on evaluating the knowledge of healthcare professionals, particularly respiratory therapists, physicians, and nurses, regarding their adherence to evidence-based guidelines for the prevention of ventilator-associated pneumonia was conducted in public sector tertiary care hospitals of Peshawar, Khyber Pakhtunkhwa, including Lady Reading Hospital (LRH), Khyber Teaching Hospital (KTH), and Hayatabad Medical Complex (HMC). The samples were collected from the ICUs of these hospitals from March 2025 to June 2025. The sample was 140 while using Single population proportion formula: $n = Z^2 * p * (1 - p)/d^2 = 1.96^2 * 0.899 * 0.101/0.05^2 = 139.5 = 140$. A non-probability convenience sampling technique was used to recruit participants who met the inclusion criteria; Healthcare professionals directly involved in the care of ventilated patients having at least one month of experience in an ICU setting and willingness to participate and excluded those who's on extended leave, inexperience, and not directly involved in VAP prevention practices. Approval was obtained from the Institutional Review Board (IRB) before data collection. Written informed consent was obtained from all participants. A structured self-administered questionnaire was used, consisting of three sections: Demographic Information (age, gender, profession, experience, and training), Knowledge Assessment: Based on evidence-based VAP prevention guidelines, and Adherence Assessment: Practices related to VAP prevention such as hand hygiene, head-of-bed elevation, oral care, etc. The questionnaire was developed based on previously validated tools and adapted to the local context. Data were entered and analyzed using the Statistical Package for the Social Sciences SPSS. Descriptive statistics were used to summarize demographic data and responses. One-way ANOVA testing and the Chi-square test were used to assess the association between knowledge and adherence.

RESULTS

A total of 140 healthcare professionals took part in this study, which included 84 males (60%) and 56 females (40%). Among the participants, 65 were respiratory therapists (46.4%), 61 were nurses (43.6%), and 14 were physicians (10%). Most participants (111; 79.3%) had between 1 month and 5 years of experience, while 23 participants (16.4%) had 6 to 10 years of experience, and only 6 participants (4.3%) had more than 10 years of experience. Furthermore, 103 participants (73.6%) received training in VAP prevention, whereas 37 participants (26.4%) indicated they had not received such training.

Table 1

Demographic Information

Demographic Characteristic	Category	Frequency (N)	Percentage (%)
Gender	Male	84	60.0
	Female	56	40.0
Profession	Respiratory Therapist	65	46.4
	Physician	14	10.0
	Nurse	61	43.6
Years of Critical Care Experience	1 month to 5 years	111	79.3
	6 to 10 years	23	16.4
	More than 10 years	6	4.3
Received VAP Prevention Training	Yes	103	73.6
	No	37	26.4

Participants suggested elevating the head of the bed to minimize the risk of VAP. A large majority (130; 92.9%) recognized the ideal elevation range as 30–45 degrees, while a few indicated 15–30 degrees (3; 2.1%), 45–60 degrees (2; 1.4%), and "no specific angle" (5; 3.6%). When asked if they routinely elevate the head of the bed to the recommended 30–45 degrees for patients on ventilation, 110 participants (78.57%) replied "Always," 21 (15%) said "Often," and 9 (6.43%) answered "Sometimes." Ninety-nine participants (70.7%) correctly stated that oral care for ventilated patients should be provided "every shift." Other responses included "twice a day" (16; 11.4%), "once a day" (12; 8.6%), and "as needed" (13; 9.3%). In practice, 80 participants (57.1%) reported providing oral hygiene twice daily, while 19 (13.6%) did it once daily, 39 (27.9%) as needed, and 2 (1.4%) indicated they did not perform it routinely. A significant percentage of participants (105; 75%) accurately identified chlorhexidine gluconate as the preferred antiseptic for oral care, while others selected normal saline (24; 17.1%), betadine (6; 4.3%), and hydrogen peroxide (5; 3.6%). Regarding the rationale for daily sedation interruption, 75 participants (53.6%) understood its purpose as "to assess readiness for extubation." Alternative responses included "to prevent VAP" (46; 32.9%), "to improve patient comfort" (14; 10%), and "to reduce aspiration risk" (5; 3.6%). In practice, 102 participants (72.9%) reported that they "always implement daily sedation interruption", 36 (25.7%) indicated "occasionally", and 2 (1.4%) stated they "do not practice it at all." Participants were asked about their practices concerning the replacement of ventilator circuits. The predominant response was "when visibly soiled" (59; 42.14%), followed by "weekly" (23; 16.43%), "every 48 hours" (31; 22.14%), and "every 24 hours" (27; 19.29%). A majority of participants (83; 59.3%) reported

checking and emptying condensate from ventilator tubing as needed. Additionally, 27 participants (19.3%) conducted this process "once or twice daily," while 3 (2.1%) "did not do it routinely." When asked about methods to prevent secretion pooling, 76 participants (54.3%) chose subglottic suctioning through specialized endotracheal tubes. Other options included frequent suctioning (50; 35.7%), routine saline instillation (8; 5.7%), and daily changing of ventilator circuits (6; 4.3%). Regarding practice, 74 participants (52.86%) indicated they "Always" ensure subglottic suctioning for eligible patients, while 23 (16.43%) said "Often," 33 (23.57%) answered "Sometimes," and 10 (7.14%) responded "Rarely." 73.57% of respondents correctly identified that the primary purpose of subglottic suctioning is "to prevent secretion pooling above the endotracheal tube cuff." 13.57% believed its purpose was "to improve oxygenation", 7.14% answered "to reduce patient discomfort," and 5.71% selected "to remove sputum from the lungs." When asked about the routine use of saline instillation during suctioning, 108 participants (77.1%) responded "Yes," while 32 (22.9%) replied "No." A total of 100 participants (71.4%) accurately identified that handwashing or the use of alcohol-based hand rub is vital for infection control. Nevertheless, misconceptions were present, as 32 (22.9%) thought that handwashing is optional when wearing gloves, 7 (5%) chose "wear gloves without handwashing," and 1 (0.7%) stated "only wash hands if visibly soiled. A significant majority (116; 82.9%) acknowledged the main goal of the ventilator bundle as preventing VAP. Other beliefs included enhancing mobility (11; 7.9%), shortening hospital stays (10; 7.1%), or ensuring ventilator maintenance (3; 2.1%). Most participants (72; 51.4%) recognized "to reduce the duration of mechanical ventilation" as the primary aim of early mobility initiatives. Other answers included preventing pressure ulcers (52; 37.1%), improving physical fitness (14; 10%), and facilitating feeding (2; 1.4%).

In the Chi-square analysis, the relationship between profession and head-of-bed elevation did not show statistical significance ($\chi2 = 7.312$, df = 6, p = 0.293). A significant correlation was found between profession and the frequency of oral care ($\chi2 = 13.172$, df = 6, p = 0.040; Spearman ρ = 0.281, p = 0.001), suggesting that a professional's background affects their oral care habits. A marginally significant result was observed for profession and the selection of antiseptic ($\chi2 = 12.239$, p = 0.057), but the likelihood ratio (p = 0.041) and Spearman correlation (ρ = 0.217, p = 0.010) indicate a weak relationship between profession and antiseptic choice. No significant relationship was detected between profession and the purpose of sedation interruption ($\chi2 = 7.740$, df = 6, p = 0.258).

In the One-way ANOVA, a significant variation was found regarding the purpose of early mobility programs across different professions (F = 3.702, p = 0.027), highlighting different perceptions of the purpose of early mobility among healthcare roles. No significant difference was noted in the primary focus of the ventilator bundle (F = 0.087, p = 0.917), indicating agreement on its focus across various professions. No significant differences were observed in understanding hand hygiene protocols across professions (F = 0.699, p = 0.499), showing a consistent grasp of hand hygiene among providers. These results confirm a solid overall understanding of VAP prevention among healthcare professionals. Nevertheless, the highlighted practice gaps and variations among professionals indicate the need for focused training and reinforcement measures to improve compliance with VAP prevention best practices.

Table *2*

One-Way ANOVA (Profession and Groups)

ANOVA						
		Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
What is the purpose of early mobility programs in ventilated patients?	Between Groups	3.371	2	1.686	3.702	.027
	Within Groups	62.372	137	.455		
	Total	65.743	139			
What is the primary focus of the ventilator bundle?	Between Groups	.064	2	.032	.087	.917
	Within Groups	50.928	137	.372		
	Total	50.993	139			
What is the recommended protocol for hand hygiene before patient contact?	Between Groups	2.224	2	1.112	.699	.499
	Within Groups	218.026	137	1.591		
	Total	220.250	139			

DISCUSSION

The findings are examined in relation to existing literature, highlighting levels of knowledge, gaps in adherence, and variations among professions. The results reveal that, although the majority of healthcare professionals (HCPs) exhibited a strong theoretical understanding of guidelines for VAP prevention, their practical adherence significantly varied. The research showed that while 92.9% of participants accurately identified the recommended head-of-bed elevation (HOB) as 30–45 degrees, only 78.6% consistently applied this in practice. This inconsistency aligns with the observations made by Wami et al., and Klompas noted that such gaps frequently arise due to institutional workflow challenges, staffing constraints, or a lack of routine audits. (2,7) Likewise, 70.7% correctly acknowledged that oral care should be conducted every shift, yet merely 57.1% indicated they performed it twice daily. Although the guidelines recommend more frequent care, the behaviors observed suggest discrepancies and potential logistical hurdles, including workload pressures or inadequate supplies issues also reported by Madhuvu et al. (5) Chlorhexidine gluconate was correctly identified by

75% as the preferred antiseptic for oral care; however, its regular application remains insufficient. Ogdi et al. reported similar outcomes, attributing inconsistent supply and ambiguous protocols as hindrances to nurse-led prevention initiatives. (8) A statistically significant correlation was observed between profession and frequency of oral care ($\chi 2 = 13.172$, $p = 0.040$), as well as the choice of antiseptic (likelihood ratio $p = 0.041$). Nurses were more likely to vary their oral care frequency in comparison to respiratory therapists. Such inter-professional differences were also documented in studies by Blot et al. and Rahimi et al. (3,9) Subglottic suctioning, a vital practice in preventing VAP, was reported to be performed "Always" by only 52.9% of participants, despite 54.3% identifying it as the primary method for managing secretions. Torres et al. suggested that incorporating suctioning into bundle protocols with monitoring tools may enhance consistency. (6) Sedation interruption showed improved adherence, with 72.9% reporting consistent practice, which may reflect its integration into ICU protocols, while 27.1% practiced it less frequently or not at all. This inconsistency could be addressed by strengthening ICU rounds and promoting team-based monitoring, as advocated by Labeau et al. (10) A concerning observation was the reported use of saline instillation during suctioning by 77.1% of participants. This outdated practice is discouraged by modern guidelines due to the associated risk of infection and impaired oxygenation. Mohammed et al. also noted a high prevalence of this practice among neonatal ICU nurses. (11) Hand hygiene protocols were largely understood, with 71.4% correctly indicating that it is essential to use an alcohol-based rub or wash hands prior to patient contact. However, 22.9% believed this requirement to be optional when wearing gloves. This misunderstanding presents a significant infection risk, reinforcing the CDC's guidelines emphasizing hand hygiene regardless of glove usage. (12) Inferential analysis indicated statistically significant variations in knowledge and practices based on profession. Chi-square tests confirmed that profession affected both the frequency of oral care and antiseptic selection. One-way ANOVA revealed significant differences in knowledge related to early mobility programs ($F = 3.702$, $p = 0.027$). Nurses frequently associated mobility with the prevention of pressure ulcers, while respiratory therapists connected it to shorter ventilation durations. These findings support Klompas' claim that the translation of knowledge into practice is influenced by role-specific expectations. (2) No significant differences were identified concerning hand hygiene practices or awareness of the ventilator bundle's focus, suggesting a consistent baseline understanding across professions. Participants who had undergone formal training (73.6%) displayed higher adherence in crucial areas such as sedation interruption, oral hygiene, and ventilator circuit replacement. These results resonate with Blot et al., who concluded that structured education enhances both knowledge and compliance. (9) The majority of participants possessed less than 5 years of ICU experience, which may have influenced their confidence and consistency in applying the guidelines. Mohammed et al. discovered that although junior staff often have up-to-date theoretical knowledge, they may fall short in clinical autonomy and support mechanisms necessary for consistent application. (11)

The CDC guidelines (13) advocate for organized documentation and electronic monitoring tools to track compliance. Future research should concentrate on long-term follow-ups after training to evaluate changes in behavior. Mixed-methods approaches could examine the underlying reasons for ongoing knowledge-practice gaps. Extending the study to include private hospitals and rural ICUs would enhance the generalizability of the results. Moreover, the effect of simulation-based training on behavioral adherence warrants further exploration, as highlighted by Labeau et al. (9)

Limitations

The study has several limitations, such as relying on self-reported data, which might be affected by recall bias or social desirability bias. Utilizing a convenience sampling method restricts the generalizability of the findings. The study was restricted to public tertiary hospitals in Peshawar and did not encompass private or rural healthcare environments. The cross-sectional design collects data at a single time point, which limits the capability to determine causality or observe changes over time.

CONCLUSION

The findings indicated that, while most healthcare professionals showed sufficient knowledge of VAP prevention strategies, their actual compliance with these practices varied greatly. Respiratory therapists tended to demonstrate higher compliance, whereas nurses and physicians exhibited more significant knowledge-practice gaps. These disparities are affected by factors such as profession, training exposure, and institutional obstacles. Focused, role-specific education paired with systemic support and monitoring is vital for improving adherence to VAP prevention protocols. Notable correlations were identified between professional roles and practices including oral care frequency, antiseptic use, and comprehension of VAP bundle elements. The one-way ANOVA revealed variations in knowledge about early mobility based on profession. The study concludes that targeted interventions, continuous education, and organizational backing are crucial for improving adherence to evidence-based VAP prevention tactics.

REFERENCES

1. Safdar N, Musuuza JS, Xie A, Hundt AS, Hall M, Wood K, et al. Management of ventilator-associated pneumonia in intensive care units: A mixed methods study assessing barriers and facilitators to guideline adherence. BMC Infect Dis. 2016 Jul 22;16(1). https://doi.org/10.1186/s12879-016-1665-1
2. Klompas M. Ventilator-associated events: What they are and what they are not. Respir Care. 2019;64(8):953–61. https://doi.org/10.4187/respcare.07059
3. Rahimi S, Abdi A, Salari N, Shohaimi S, Naghibeiranvand M. Factors associated with long-term mechanical ventilation in patients undergoing cardiovascular surgery. BMC Cardiovasc Disord [Internet]. 2023;23(1):1–9. https://doi.org/10.1186/s12872-023-03315-7
4. Fauerbach LL, Cic ; Sandra MS, Fitzler L. Association for

Professionals of Infection Control and Epidemiology, Inc., Shands Hospital at University of Florida. American Healthcare Association. https://doi.org/10.1016/s0196-6553(09)00620-8
5. Madhuvu A, Endacott R, Plummer V, Morphet J. Healthcare professional views on barriers to implementation of evidence-based practice in prevention of ventilator-associated events: A qualitative descriptive study. Intensive Crit Care Nurs. 2022 Feb 1;68. https://doi.org/10.1016/j.iccn.2021.103133
6. Torres A, Niederman MS, Chastre J, Ewig S, Fernandez-Vandellos P, Hanberger H, et al. Guidelines for the management of hospital-acquired pneumonia and ventilator-associated pneumonia. European Respiratory Journal [Internet]. 2017;50(3):1–22. http://dx.doi.org/10.1183/13993003.00582-2017
7. Wami GA, Mengistu D, Gudisa GG. To cite this article: Girma AlemuWami, Daniel Mengistu, Gebre Gelana Gudisa. Knowledge, Practice and Associated Factors of Adult Intensive Care Nurses' on Prevention of Ventilator Associated Pneumonia in Addis Ababa Public Hospitals. International Journal of Clinical Dermatology [Internet]. 2018;1(1):15–21. http://www.sciencepublishinggroup.com/j/ijcd
8. Ogdi FS, Hmoud N, Hothan Z. A Comprehensive Review of Ventilator-Associated Pneumonia: The Nurses' Role in Prevention and Management. 2024;7:1615–29.
9. Blot S, Koulenti D, Labeau S. Optimizing educational initiatives to prevent ventilator-associated complications. Am J Infect Control [Internet]. 2017;45(1):102–3. http://dx.doi.org/10.1016/j.ajic.2016.05.035
10. Blot SI, Labeau S, Vandijck D, Van Aken P, Claes B. Evidence-based guidelines for the prevention of ventilator-associated pneumonia: Results of a knowledge test among intensive care nurses. Intensive Care Med. 2007;33(8):1463–7. https://doi.org/10.1007/s00134-007-0705-0
11. Mohammed A, Ahmed S, Reyad A, Mohamed S. Nurses' Knowledge and Practices Regarding Care of High-Risk Neonates Connected with Mechanical Ventilator. Minia Scientific Nursing Journal. 2023;014(1):32–41. https://doi.org/10.21608/msnj.2023.234525.1078
12. Paula V, Gomes R. Knowledge of Intensive Care Nurses on Evidence Based Guidelines for Prevention of Ventilator Associated Pneumonia. 2010.
13. Kumar Mehta R. Knowledge, Adherence and Barriers towards the Prevention of Ventilator Associated Pneumonia among Nurses. International Journal of Science and Research (IJSR) Index Copernicus Value [Internet]. 2016;7–296. www.ijsr.net