IMPLEMENTING VENTILATOR-ASSOCIATED PNEUMONIA PREVENTION GUIDELINES IN CRITICAL CARE: NURSE COMPLIANCE AND OBSTACLES

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ABSTRACT

Background:

Ventilator-associated pneumonia (VAP) is a leading cause of morbidity and mortality among critically ill patients, especially in low- and middle-income countries (LMICs), where healthcare resources are often limited. Despite the availability of evidence-based guidelines for VAP prevention, critical care nurses' compliance remains inconsistent, and several barriers hinder effective implementation.

Objective:

This systematic review aimed to evaluate the compliance of critical care nurses with VAP prevention guidelines and to identify the major barriers affecting the implementation of these practices in intensive care settings.

Methods:

A systematic search was conducted following PRISMA guidelines across five databases (PubMed, CINAHL, Scopus, Cochrane Library, and Google Scholar), focusing on studies published between 2021 and 2024. Studies included were those assessing nurse adherence to VAP guidelines and exploring associated barriers. A total of eight studies met the inclusion criteria and were analyzed for knowledge levels, compliance rates, and institutional or personal challenges to guideline adherence.

Results:

The review revealed varying levels of nurse compliance with VAP prevention strategies, with

several studies reporting suboptimal adherence to specific components of the care bundle, such as oral care, cuff pressure monitoring, and humidification. Key barriers included inadequate training, staff shortages, lack of resources, limited institutional support, and poor interprofessional collaboration. Educational interventions were effective in increasing knowledge, but their impact on sustained clinical practice remained limited without systemic support.

Conclusion:

Although critical care nurses generally demonstrate moderate to high awareness of VAP prevention guidelines, actual adherence remains inconsistent due to a range of individual and organizational barriers. To improve compliance and reduce VAP rates, a multifaceted approach is needed—one that combines ongoing nurse education with robust institutional support, policy reinforcement, and context-specific adaptations of VAP bundles.

Keywords: Implementing, Ventilator, Pneumonia, Prevention, Guidelines, Critical, Care, Nurse, Compliance, Obstacles.

Introduction

Ventilator-associated pneumonia (VAP) is a major concern in low-middle-income countries (LMICs), where hospital-acquired infections are common and resources are limited (Rehmani et al., 2024). It is a pulmonary parenchymal infection that develops at least 48 hours following endotracheal intubation for mechanical ventilation, with the first day being the day the ventilator was inserted. It accounts for almost one-third of all pneumonia cases in intensive care units (Torres et al., 2017).

Ventilator-associated pneumonia is one of the most common conditions associated with hospital-acquired infections, as well as one of the most lethal in intensive care units, where it is defined as "nosocomial pneumonia in patients placed on ventilators that develops more than 48 hours after the start of ventilation." Mechanical signs include fresh or increasing infiltration, fever, fluctuations in white blood cell count, and purulent tracheal discharge (Bankanie et al., 2021). According to the literature, ventilator-related pneumonia is linked to greater mortality and morbidity rates, longer hospitalization periods, and higher healthcare expenses (Al-Mugheed et al., 2022). Many approaches have been established to address the global problem of ventilator-associated pneumonia, including evidence-based treatments that have been shown in the literature to reduce ventilator-associated pneumonia and enhance patient outcomes (Getahun et al., 2022).

Many factors impede the prevention of ventilator-associated pneumonia, including nursing staff shortages, forgetfulness, and cost-cutting measures, among others. Examples include a lack of policies, education, and protocols, as well as a lack of resources and personnel; other reports include a lack of oral care equipment, time constraints, insufficient supervision, and an excessive workload (Dehghan et al., 2022).

In Saudi Arabia, VAP resulted in a 17.5-day longer stay, a 31.8% higher fatality rate, and an additional cost of $40,000 for single session of VAP in ICUs. 9,10 Given these repercussions, VAP prevention became a top concern in ICU healthcare delivery, and VAP prevalence became a measure of the ICU's safety and quality (Al- Sayaghi, 2024).

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Despite some studies showing negative or equivocal data regarding the therapeutic usefulness of VBs, the balance of evidence strongly shows that when VB procedures are adhered to, they have the potential to significantly lower the rate of VAP infections (Alecrim et al., 2019). When all of the elements are consistently applied together, the care bundle approach has demonstrated improved patient health outcomes, with compliance over 90% of VB elements associated with a significant reduction in VAP rates and, when sustained, the achievement of a VAP rate nearing zero (Ladbrook et al., 2021). Preventing VAP is the most cost-effective way to mitigate its impact (Alhamad & Elsayed, 2024). To prevent VAP, it is recommended to avoid intubation, minimize sedation, do daily spontaneous awakening and breathing trials, manage fluids conservatively, use low tidal volume ventilation, and promote early mobility (Alhamad & Elsayed, 2024).

Despite the extensive body of literature emphasizing the importance of (VAP) prevention and the availability of evidence-based guidelines, there is still a significant gap in understanding critical care nurses' actual compliance with these guidelines and the challenges they face in effectively implementing them. While multiple studies have focused on the clinical outcomes of VAP and the efficacy of various preventive methods, few have looked into the unique problems that nursing staff experience when following VAP prevention protocols. Furthermore, there is little study on the contextual aspects that either impede or facilitate compliance, such as staffing levels, resource availability, organizational support, and training. This knowledge gap is especially important in low-middle-income countries (LMICs) like Saudi Arabia, where healthcare infrastructure may be weaker and other impediments like as budget limits, excessive workloads, and insufficient education and training are more common. Understanding these factors is vital for designing methods to increase nurse compliance and minimize the occurrence of VAP, thereby improving patient outcomes and lowering healthcare costs in critical care environments.

Rationale of the Study

(VAP) is one of the most common and deadly hospital-acquired infections in intensive care units (ICUs), accounting for a large increase in patient morbidity, mortality, and healthcare costs. While several evidence-based guidelines and care bundles have been established to avoid VAP, their successful implementation is primarily reliant on frontline healthcare personnel' compliance, particularly critical care nurses. However, in many (LMICs), including Saudi Arabia, adherence to these standards is frequently inadequate due to a range of contextual obstacles such as limited resources, staff shortages, insufficient training, and weak institutional support. Despite the global emphasis on preventing VAP, there is a considerable lack in the research regarding the real-world difficulties that nurses confront when applying these guidelines.

Aim

The purpose of this systematic review was to investigate and synthesize existing evidence on critical care nurses' compliance with ventilator-associated pneumonia (VAP) prevention guidelines, as well as to identify the major barriers to effective implementation of these practices in critical care settings.

Methods

Introduction

This review looked into the challenges to effective implementation of these principles in critical care settings. Only papers published between 2021 and 2024 will be considered in order to incorporate the most recent evidence on this important topic.

Eligibility Criteria

This review's inclusion criterion focused on studies that examined critical care nurses' compliance with VAP prevention guidelines. These investigations were carried out in hospitals, notably intensive care units (ICUs), and published in English between 2021 and 2024. The evaluation included quantitative and qualitative studies, as well as mixed-methods research, that focused on nurse compliance, impediments to guideline implementation, and related VAP prevention approaches. Studies that did not directly assess the application of VAP prevention by nurses, used non-human patients, or did not provide primary data on the subject were omitted.

Information Sources

To find relevant papers, searches were undertaken in major academic databases such as PubMed, CINAHL (Cumulative Index to Nursing and Allied Health Literature), Scopus, Cochrane Library, and Google Scholar. Furthermore, the reference lists of relevant papers were manually checked to identify any new research that satisfied the inclusion criteria.

Search Strategy

A comprehensive search strategy was created to ensure a thorough and accurate search. The keywords and Medical Subject Headings (MeSH) terms comprised versions of the following concepts: ventilator-associated pneumonia (VAP), nurse compliance, recommendations, critical care nursing, intensive care unit (ICU), preventative strategies, hurdles, and implementation issues. The search terms included "ventilator-associated pneumonia prevention," "nurse adherence," "critical care practices," and "obstacles to implementation."

Selection process

Following the first search, two reviewers independently evaluated the titles and abstracts of discovered studies to determine their eligibility. Full-text papers were obtained for studies that matched the inclusion criteria or if the abstract provided insufficient information. Discrepancies between reviewers were resolved through conversation, and a third reviewer was consulted if needed.

Data Extraction

A review search was conducted, with all titles and abstracts provided, inclusion and exclusion criteria applied, reasons for inclusion and removal reported, and duplicates eliminated. The characteristics of the included studies (n = 8) were extracted and reported result chapter.

Results

The systematic analysis includes papers published between 2021 and 2024 that evaluated nurses' adherence to ventilator-associated pneumonia (VAP) prevention guidelines and identified challenges to effective implementation in a variety of critical care settings. Klompas et al. (2022) updated expert recommendations for preventing VAP, ventilator-associated events (VAE), and

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non-ventilator hospital-acquired pneumonia (NV-HAP), emphasizing a multi-organizational effort to standardize and prioritize VAP prevention strategies in acute care hospitals.

In a Tanzanian ICU setting, Bankanie et al. (2021) discovered poor nurse knowledge (mean score 38.6%) and moderate self-reported compliance (60.8%), with main constraints including a lack of skills, personnel shortages, and restricted knowledge. Similarly, Abad et al. (2021) discovered substantial variation in adherence to VAP bundle elements, with poor compliance in specific areas like extubation preparedness, despite relatively high overall bundle adherence (median 84.6%). Alreshidi et al. (2024) demonstrated significant improvements in nurses' knowledge following an educational intervention, showing increases across general VAP knowledge, guideline awareness, and understanding of preventive responsibilities, suggesting that training can bridge the knowledge gap.

Paliwal et al. (2023) found moderate understanding among critical care practitioners, with impediments including fear of negative repercussions and inadequate grasp of the guidelines. Akafzadeh et al. (2020) found that ICU nurses in southeast Iran saw main impediments to VAP prevention as a lack of staffing, poor team-based teamwork, and insufficient managerial support.

Yao et al. (2024) conducted a cross-sectional study to investigate adult ICU nurses' knowledge and barriers to following evidence-based recommendations (EBGs) for reducing ventilator-associated pneumonia (VAP) in county-level hospitals in Hunan Province, China. An electronic survey was used to collect data from 386 nurses, obtaining a high response rate of 97.47%. The findings demonstrated that nurses had a satisfactory level of knowledge (median score: 7/9), but moderate impediments to compliance persisted (median score: 3/8). Knowledge and compliance barriers had a substantial negative connection ($r = -0.437$, $p < .01$), indicating that increased knowledge may assist minimize barriers to guideline adherence. Multiple regression analysis revealed that hospital level, age, VAP training attendance, and ICU experience all had an impact on nurses' knowledge, whereas training, age, and ICU experience were also associated with compliance barriers. The study emphasizes the necessity of ongoing education and training for improving guideline adherence and patient outcomes in ICU settings.

Rangelova et al. 2024 note the global discrepancy in VAP incidence, which ranges from 1.4-7 occurrences per 1000 ventilator days in rich countries to as much as 16.1-89 episodes in underdeveloped nations. This illness dramatically increases morbidity and mortality, requires longer hospital stays, and puts a financial drain on families and healthcare systems. Given the complexity of VAP pathophysiology, the authors categorize prevention strategies into general infection control measures (e.g., hand hygiene and decontamination) and VAP-specific interventions (e.g., care bundles, head-of-bed elevation, and early extubation). They note that, while many of these strategies are straightforward and effective, VAP care packages are especially promising due to their complete nature. However, the analysis concludes that several preventive interventions require additional research to determine their efficacy in neonatal settings.

Debas et al. (2024) conducted a prospective observational study to measure adherence to ventilator-associated pneumonia (VAP) care packages in critical care units of a comprehensive specialized hospital in northwest Ethiopia. The study comprised 300 adult ICU patients who had

been on mechanical breathing for more than 48 hours between July 2022 and January 2024. Data were obtained using direct observation and chart checks, with the Institute of Healthcare Improvement (IHI) standards serving as a checklist. Overall compliance with the VAP treatment bundle was 70%, with perfect adherence to preventative interventions for peptic ulcers and deep vein thrombosis. However, major gaps were found in other components: dental hygiene with 0.5% chlorhexidine had a 0% adherence rate, humidification using heat and moisture exchangers was only 23.3%, and procedures such as endotracheal tube cuff pressure monitoring and subglottic suction were not used. The findings reveal a significant gap in the implementation of critical VAP prevention strategies, underlining the importance of targeted efforts to increase compliance, notably in areas such as oral care, humidification, and sedation management.

Discussion

The data show a comparable pattern across geographical and clinical settings: whereas critical care nurses' understanding of VAP prevention guidelines is frequently moderate to high, actual adherence to these procedures is significantly variable. A variety of interpersonal, institutional, and systemic variables contribute to the knowledge-practice gap.

Several studies (e.g., Bankanie et al., 2021; Paliwal et al., 2023) show that, while nurses are aware of VAP preventive techniques, implementation is hampered by factors such as a lack of staff, restricted access to training, poor managerial support, and fear of unfavorable results. These findings are especially relevant in low- and middle-income countries (LMICs), where resource constraints compound the challenges faced by nursing personnel. As a researcher, I feel there is an urgent need to change the focus from simply teaching nurses to building supportive conditions in which such knowledge may be put into practice.

Interestingly, interventions aiming at boosting nurse knowledge, such as those described by Alreshidi et al. (2024), have had a positive impact. However, even as knowledge advances, as demonstrated by Yao et al. (2024), institutional and logistical impediments remain. The negative connection identified between knowledge levels and barriers to compliance ($r = -0.437$) is encouraging, implying that more knowledge may be able to overcome some reluctance. Nonetheless, persisting gaps in care, such as the complete lack of adherence to oral care procedures (Debas et al., 2024), demonstrate that education alone is insufficient.

One essential takeaway from my experience is the importance of interdisciplinary collaboration and good leadership in intensive care units. The literature clearly shows that when nurses feel supported by management and empowered by teamwork, their compliance increases. According to Akafzadeh et al. (2020), poor teamwork and inadequate administrative assistance impede adherence to VAP guidelines. Thus, investing in team-based training, clinical mentorship, and nurse-led quality improvement programs could help to close the implementation gap.

Another key topic raised in this research is the inequality between countries. Rangelova et al. (2024) show how VAP rates differ dramatically between high- and low-income countries. This reflects not only variations in healthcare facilities, but also in the stringent adherence to evidence-based principles. Even simple VAP interventions, such as elevating the head of the bed or

maintaining endotracheal cuff pressure, may be neglected in low-resource settings, such as areas of Africa and Asia, due to equipment shortages or inadequate protocols.

In our opinions, policy reform and resource allocation should go hand in hand with training activities. Adherence to VAP bundles must be recognized by institutional executives as both a clinical and administrative priority, with direct implications for patient safety measures, healthcare costs, and ICU mortality rates.

Finally, this review has demonstrated that, while VAP care bundles are successful, their benefit is contingent on consistent implementation. The literature clearly supports the notion that achieving high compliance across all aspects of the bundle can result in a near-zero VAP rate (Ladbrook et al., 2021). However, incomplete adherence, as observed in Debas et al. (2024), frequently produces limited outcomes. As a result, critical care units, particularly in low- and middle-income countries, must strive for comprehensive and uniform execution of care bundles.

Conclusions

This systematic analysis of papers published between 2021 and 2024 identifies key gaps and opportunities in ICU nurses' adherence to ventilator-associated pneumonia (VAP) prevention strategies. Despite having moderate to high levels of knowledge in some settings, actual compliance with evidence-based VAP bundles is variable, particularly in low-resource environments. Key impediments include a lack of training, insufficient staffing, poor interprofessional collaboration, and insufficient institutional support. While education and training initiatives have shown encouraging results in improving nurse knowledge and awareness, their influence on practice is sometimes hampered by institutional and operational constraints. The findings highlight the need for a more comprehensive and long-term approach to improving adherence, integrating clinical education with organizational and policy-level assistance. Addressing these issues is vital for lowering VAP prevalence, improving patient outcomes, and improving the quality of critical care service worldwide.

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