

# The Effectiveness of Respiratory Therapists in Implementing Protocolized Ventilator-Associated Pneumonia (VAP) Bundles

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## Abstract

**Background:** Ventilator-associated pneumonia (VAP) is a significant complication in mechanically ventilated patients, leading to increased morbidity, length of ICU stay, and healthcare costs. This study assesses the impact of enhanced involvement of respiratory therapists in implementing VAP prevention bundles within a tertiary hospital's intensive care unit.

**Methods:** A retrospective cohort study was conducted involving 950 adult patients who were mechanically ventilated for more than 48 hours. The study compared VAP incidence and compliance with prevention protocols before and after enhancing respiratory therapist involvement in VAP bundle implementation.

**Results:** The intervention led to a 34% reduction in VAP incidence rates (22.4 to 14.7 cases per 1,000 ventilator days). Compliance with VAP bundle components improved significantly, notably in head of bed elevation (80% to 94%), daily sedation interruptions (75% to 89%), and oral care with chlorhexidine (70% to 88%). There were also reductions in the average duration of mechanical ventilation and ICU stays.

**Conclusion:** Enhanced involvement of respiratory therapists in VAP prevention significantly reduces VAP incidence and improves compliance with preventive measures. These findings suggest that respiratory therapists play a crucial role in the effective management of VAP prevention strategies, leading to improved patient outcomes in ICU settings.

**Keywords:** Ventilator-associated pneumonia, respiratory therapists, VAP prevention, ICU, mechanical ventilation, healthcare outcomes

## Introduction

Ventilator-associated pneumonia (VAP) is a serious nosocomial infection that develops in patients receiving mechanical ventilation, typically after 48 hours of intubation. It remains one of the leading causes of morbidity and mortality in intensive care units (ICUs), with reported mortality rates ranging from 20% to 50% among affected patients (Arabi et al., 2008). The occurrence of VAP is associated with prolonged ICU stays, extended durations of mechanical ventilation, and increased healthcare costs, making it a critical focus for infection control efforts (Kalanuria, Zai, & Mirski, 2014).

To address the significant burden of VAP, evidence-based prevention strategies have been developed, often referred to as VAP prevention bundles. These bundles typically include a combination of interventions, such as elevating the head of the bed, daily sedation interruptions, peptic ulcer prophylaxis, deep vein thrombosis prophylaxis, and oral care with chlorhexidine (Institute for Healthcare Improvement, 2012). When consistently adhered to, these bundles have been shown to significantly reduce the incidence of VAP (Chastre & Fagon, 2002).

Respiratory therapists (RTs) play a crucial role in managing mechanically ventilated patients and implementing VAP prevention strategies. As key members of the ICU team, RTs are responsible for ventilator management, airway clearance, and ensuring adherence to evidence-based protocols to minimize the risk of

VAP (Hess, 2011). However, while VAP bundles are widely implemented, the specific contribution of respiratory therapists to the success of these interventions remains underexplored.

This study aims to address this gap by investigating the effectiveness of respiratory therapists in implementing VAP prevention bundles across multiple centers. By analyzing data from a multicenter cohort of ICUs, this study will assess the impact of RT-led VAP prevention efforts on reducing the incidence of VAP. The findings of this research have the potential to highlight the critical role of RTs in infection control and improve the overall quality of care for mechanically ventilated patients.

## Literature Review

**Ventilator-Associated Pneumonia: Prevalence and Impact:** Ventilator-associated pneumonia (VAP) is a well-documented and serious complication of mechanical ventilation in critically ill patients. VAP develops after 48 hours or more of endotracheal intubation and is one of the most common healthcare-associated infections in ICUs (Arabi et al., 2008). According to a review by Kalanuria, Zai, and Mirski (2014), the incidence of VAP varies widely, with rates ranging from 10% to 25% of ventilated patients, depending on ICU practices and patient populations. The development of VAP leads to increased ICU stays, prolonged mechanical ventilation, and significantly elevated healthcare costs. Moreover, the mortality rate for VAP is reported to range between 20% and 50%, underscoring the severity of this condition (Chastre & Fagon, 2002).

**Evidence-Based VAP Prevention Strategies:** To reduce the incidence of VAP, various evidence-based prevention strategies, often bundled into protocols, have been developed. These VAP prevention bundles typically involve a set of interventions, including elevating the head of the bed to 30-45 degrees, daily sedation interruptions, peptic ulcer prophylaxis, deep vein thrombosis prophylaxis, and oral hygiene with chlorhexidine (Institute for Healthcare Improvement, 2012). The effectiveness of these bundles in reducing VAP incidence has been demonstrated in numerous studies. For instance, Bassi, Ferrer, and Marti (2014) reported that the consistent application of VAP bundles could reduce the incidence of VAP by as much as 40%.

VAP bundles represent a shift from focusing on individual interventions to an integrated approach that requires consistent, multidisciplinary teamwork. The success of VAP bundles depends not only on the adoption of evidence-based interventions but also on the adherence to protocols by the entire ICU team, including nurses, physicians, and respiratory therapists (RTs) (Klompas, Branson, & Eichenwald, 2014).

**The Role of Respiratory Therapists in VAP Prevention:** Respiratory therapists are integral to the care of mechanically ventilated patients and play a crucial role in the implementation of VAP prevention strategies. RTs are responsible for ensuring appropriate ventilator settings, performing airway clearance techniques, and conducting regular assessments of the patient's respiratory status (Hess, 2011). They are uniquely positioned to influence the prevention of VAP through their direct involvement in ventilator management and adherence to VAP prevention protocols.

A study by Genet et al. (2015) highlighted the impact of RT involvement in VAP prevention, demonstrating that hospitals with dedicated RT teams experienced lower rates of VAP compared to those relying on general ICU staff. The study emphasized the importance of RT-led interventions, particularly in maintaining ventilator care protocols, suctioning, and positioning, which are critical elements of VAP bundles.

However, despite their key role, there is limited research that specifically examines the effectiveness of RTs in leading VAP prevention efforts. Most existing studies focus on multidisciplinary teams without isolating the contributions of individual healthcare professionals. This gap in the literature suggests a need for more targeted research on the impact of RT-led VAP prevention initiatives, particularly in multicenter settings where practices may vary.

**Multicenter Studies on VAP Prevention:** Multicenter studies provide a broader perspective on the effectiveness of VAP prevention strategies across different healthcare settings. These studies are valuable because they allow for the comparison of outcomes across various ICUs, enabling researchers to identify best practices and potential areas for improvement. A multicenter study by Muscedere et al. (2008) found that the implementation of VAP bundles across multiple hospitals significantly reduced VAP rates, but also highlighted the variability in adherence to bundle components. This variability underscores the importance of consistent protocol implementation and the potential role of RTs in standardizing VAP prevention efforts across different ICUs.

In a similar vein, the study by Klompas et al. (2014) explored the impact of VAP bundle adherence on patient outcomes across several institutions, revealing that adherence to bundle elements was associated with a reduction in both VAP incidence and related mortality. These findings suggest that focusing on specific healthcare professionals, such as RTs, who are directly involved in the implementation of these bundles, could further enhance patient outcomes.

The current literature highlights the significance of VAP prevention bundles in reducing the incidence of ventilator-associated pneumonia in ICU patients. While respiratory therapists play a critical role in the implementation of these bundles, there remains a gap in the literature regarding their specific contributions to VAP prevention efforts. Given the potential impact of RT-led interventions, particularly in maintaining ventilator care protocols and adherence to VAP bundles, further research is warranted. A multicenter study that evaluates the effectiveness of RTs in implementing VAP prevention strategies could provide valuable insights into optimizing care for mechanically ventilated patients.

### Methodology

This study assessed the effectiveness of respiratory therapists (RTs) in implementing protocolized ventilator-associated pneumonia (VAP) bundles within a large tertiary hospital's intensive care unit (ICU). The study utilized a retrospective cohort design to evaluate the impact of RT-led VAP prevention protocols on the incidence of VAP.

**Study Design and Setting:** A retrospective cohort design was employed at a single, large tertiary hospital known for its comprehensive ICU facilities. This setting provided a controlled environment to study diverse ICU practices and patient demographics under one roof. The study period covered data from January 2015 to December 2015.

**Participants:** The study included adult patients (aged 18 years and older) who were mechanically ventilated for more than 48 hours during the study period. Exclusion criteria included patients who had a pre-existing pneumonia at the time of intubation. A total of 950 patients met the inclusion criteria and were included in the analysis.

### Data Collection

Patient data were extracted from the hospital's electronic medical records (EMRs). The following variables were collected for each patient:

- Demographic information (age, sex, comorbidities)
- ICU admission and discharge dates
- Duration of mechanical ventilation
- Diagnosis of VAP, based on microbiological data and radiographic findings
- Detailed documentation of compliance with VAP prevention bundle components
- Specific contributions and interventions performed by respiratory therapists
- Outcome data (ICU and hospital mortality rates)

The VAP prevention bundle focused on several evidence-based interventions:

1. Elevation of the head of the bed to 30-45 degrees
2. Daily sedation interruptions and assessments of readiness for extubation
3. Peptic ulcer disease prophylaxis
4. Deep vein thrombosis prophylaxis
5. Oral care with chlorhexidine

Compliance with each component was recorded daily, and adherence rates were calculated based on the percentage of days each intervention was implemented.

**Role of Respiratory Therapists:** The involvement of respiratory therapists was a primary focus of this study. RTs were responsible for ventilator settings management, performing airway clearance techniques, and

enforcing adherence to the VAP prevention bundle. The frequency and specifics of RT interventions were gathered from EMR documentation and corroborated by ICU supervisory staff.

The effectiveness of RT involvement was quantified by comparing VAP incidence rates in the ICU before and after enhancing RT roles in VAP prevention.

### Outcome Measures

The primary outcome was the incidence of VAP, defined by the Centers for Disease Control and Prevention (CDC) criteria, which includes clinical, radiological, and microbiological parameters indicative of pneumonia. Secondary outcomes included:

- Duration of mechanical ventilation
- Length of ICU stay
- ICU and hospital mortality rates
- Adherence to VAP prevention bundle components

### Statistical Analysis

Statistical analyses were conducted using SPSS software (version 26.0). Continuous variables were compared using t-tests or Mann-Whitney U tests as appropriate, while categorical variables were analyzed using the chi-square test. Logistic regression was used to adjust for confounders such as patient age, severity of illness, and ICU characteristics.

Pre-intervention and post-intervention phases were compared to assess the impact of enhanced RT involvement on VAP incidence rates and other outcomes. Kaplan-Meier curves were used to analyze survival data, and a p-value of less than 0.05 was considered statistically significant.

### Ethical Considerations

The study was approved by the ethics committee, ensuring adherence to ethical standards in retrospective data handling. Patient confidentiality was maintained by anonymizing all personal identifiers before data analysis.

### Findings

The study evaluated the effectiveness of respiratory therapists in implementing VAP prevention bundles within a large tertiary hospital's ICU over a two-year period. The findings highlight significant improvements in VAP prevention and associated patient outcomes following enhanced involvement of respiratory therapists in the VAP bundle protocols.

**Overview of Patient Demographics and Baseline Characteristics:** The study included a total of 950 mechanically ventilated patients. The baseline characteristics of the patient population are summarized in Table 1.

**Table 1: Baseline Characteristics of Study Population**

Characteristic	Pre-intervention (N=475)	Post-intervention (N=475)
Age (years), mean (SD)	62.3 (15.4)	61.8 (15.7)
Male, n (%)	290 (61.1%)	287 (60.4%)
Comorbidities:		
- Diabetes, n (%)	142 (29.9%)	138 (29.1%)
- Chronic Respiratory Disease, n (%)	115 (24.2%)	118 (24.8%)
- Cardiovascular Disease, n (%)	190 (40%)	185 (38.9%)
ICU Stay (days), mean (SD)	18.4 (6.2)	16.9 (5.8)
Duration of Ventilation (days), mean (SD)	9.5 (3.1)	8.2 (2.9)

**Incidence of Ventilator-Associated Pneumonia:** The incidence of VAP showed a marked decrease following the enhanced RT involvement in the VAP prevention protocols. The rates of VAP per 1,000 ventilator days are presented in Table 2.

**Table 2: Incidence of VAP per 1,000 Ventilator Days**

Period	VAP Incidence Rate
Pre-intervention	22.4
Post-intervention	14.7

This represents a 34% reduction in the VAP incidence rate following the intervention.

**Compliance with VAP Prevention Bundle Components:** Significant improvements were observed in the compliance rates for each component of the VAP prevention bundle. The data are summarized in Table 3.

**Table 3: Compliance with VAP Prevention Bundle Components**

Bundle Component	Pre-intervention Compliance (%)	Post-intervention Compliance (%)
Head of Bed Elevation	80%	94%
Daily Sedation Interruptions	75%	89%
Peptic Ulcer Disease Prophylaxis	77%	92%
Deep Vein Thrombosis Prophylaxis	78%	91%
Oral Care with Chlorhexidine	70%	88%

**Duration of Mechanical Ventilation and ICU Stay:** The average duration of mechanical ventilation and ICU stay decreased in the post-intervention group. These outcomes are detailed in Table 4.

**Table 4: Duration of Mechanical Ventilation and ICU Stay**

Outcome	Pre-intervention (days)	Post-intervention (days)
Mechanical Ventilation Duration	9.5	8.2
ICU Stay	18.4	16.9

**ICU and Hospital Mortality Rates:** There was a slight but not statistically significant reduction in both ICU and hospital mortality rates in the post-intervention group. Mortality data are shown in Table 5.

**Table 5: ICU and Hospital Mortality Rates**

Mortality Rate	Pre-intervention (%)	Post-intervention (%)
ICU Mortality	18.9	17.6
Hospital Mortality	24.2	22.9

## Discussion

The findings of this study provide substantial evidence that enhanced involvement of respiratory therapists in VAP prevention strategies leads to significant improvements in patient outcomes in a tertiary hospital ICU setting. The discussion explores the implications of these findings, compares them with existing literature, and considers the broader impacts on clinical practice.

**Impact of Respiratory Therapist Involvement on VAP Incidence:** Our study demonstrated a 34% reduction in VAP incidence rates following the implementation of a protocolized intervention led by

respiratory therapists. This reduction is notable and aligns with previous research which has highlighted the effectiveness of multidisciplinary approaches to VAP prevention. For example, a study by Klompas et al. (2014) reported similar reductions in VAP incidence through bundle approaches, although their study did not isolate the specific contributions of respiratory therapists as our study has done.

**Compliance with VAP Prevention Bundle Components:** Significant improvements in compliance with all components of the VAP prevention bundle were observed. The involvement of respiratory therapists was instrumental in achieving high compliance rates, particularly in the areas of head of bed elevation, daily sedation interruptions, and oral care with chlorhexidine. These findings corroborate those of Hess (2011), who argued that respiratory therapists are ideally positioned to ensure consistent application of these interventions due to their continuous presence at the bedside and their expertise in airway management.

**Role of Education and Training:** The success observed in this study may also be attributed to the enhanced training and education provided to respiratory therapists as part of the intervention. Prior studies have suggested that ongoing education and training are critical to maintaining high compliance rates with VAP prevention protocols (Bassi et al., 2014). Our findings underscore the importance of continuous professional development for respiratory therapists, particularly in complex clinical areas like ICU ventilation management.

**Reduction in Ventilation Duration and ICU Stay:** The reduction in the duration of mechanical ventilation and ICU stays are among the most clinically significant findings of this study. Shorter ventilation times are associated with lower risks of VAP and other complications, which in turn can lead to shorter ICU stays. These results are consistent with those of Genet et al. (2015), who found that proactive respiratory therapy interventions can reduce the duration of mechanical ventilation and enhance overall patient outcomes.

### Limitations

While the results are promising, this study is not without limitations. The retrospective design and the single-center setting may limit the generalizability of the findings. Additionally, the reliance on historical controls rather than a randomized control group may introduce biases related to temporal changes in ICU practices or patient populations. Future studies could address these limitations by employing a prospective, multicenter design to validate our findings across diverse healthcare settings.

### Implications for Practice

The findings from this study have significant implications for ICU management practices. They suggest that hospitals should consider enhancing the role of respiratory therapists in the management of mechanically ventilated patients, particularly in the implementation of VAP prevention bundles. By leveraging the specialized skills of respiratory therapists, hospitals can improve adherence to prevention protocols, thereby reducing the incidence of VAP and improving overall patient outcomes.

### Future Research

Future research should focus on prospective studies to confirm these findings and explore the impact of respiratory therapist-led interventions in different settings, such as in non-tertiary hospitals or across various geographical regions. Additionally, investigating the cost-effectiveness of enhancing respiratory therapist involvement could provide compelling evidence for policy changes in ICU management practices.

### Conclusion

This study highlights the critical role of respiratory therapists in reducing the incidence of VAP through enhanced compliance with prevention protocols. The improvements in patient outcomes, including reduced VAP rates, shorter duration of mechanical ventilation, and decreased ICU stays, underscore the value of specialized respiratory therapy interventions in critical care. By continuing to foster the skills and responsibilities of respiratory therapists, healthcare systems can enhance the quality of care provided to mechanically ventilated patients and achieve better overall health outcomes.

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