



# The Effect of Bed Head Elevation in Preventing Ventilator-Associated Pneumonia (VAP) in Patients on Ventilation

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## ABSTRACT

Ventilator Associated Pneumonia (VAP) is a common nosocomial infection in patients using ventilators. One recommended prevention method is head elevation of bed (HoB) at a 30-45 degree angle. The purpose of this study was to analyze the effect of head elevation on VAP prevention in patients on ventilators in the ICU of Dr. Iskak Tulungagung Regional Hospital. This study used a pre-experimental design. The sample consisted of 20 patients selected by consecutive sampling. Data were collected through Clinical Pulmonary Infection (CPIS) observations before and after the intervention for three days. The results showed that of the 20 patients who received the HoB intervention, 75% did not experience VAP, while 25% continued to experience VAP. The CPIS value increased significantly on the second and third days, indicating that this period is a critical phase for VAP development. Elevating the HoB position has an effect on reducing the risk of VAP, but does not completely prevent infection. Effective VAP prevention requires a comprehensive approach that combines HoB with other measures such as oral hygiene, endotracheal cuff pressure monitoring, and optimal ventilation management.

**Keywords:** Head elevation of Bed (HoB), pneumonia, ventilator

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## BACKGROUND

Ventilator-associated pneumonia, often referred to as VAP, is a Healthcare Associated Infection (HAIs) or nosocomial infection frequently found in hospitals due to infections that occur 48 hours after the use of a mechanical ventilator, either an endotracheal tube or tracheostomy (Ministry of Health of the Republic of Indonesia, 2017). Healthcare Associated Infections (HAIs) are infections acquired in the hospital, either in patients receiving care, healthcare workers working in the hospital, or hospital visitors (Hapsari et al., 2018). The risk of VAP in patients intubated on mechanical ventilators increases because the invasive endotracheal tube allows bacteria to enter the lower respiratory tract directly, as the tube is located in the trachea.

The primary indication for the use of a mechanical ventilator is to assist patients experiencing respiratory failure, hypercarbia, oxygen deprivation, or both. One chronic disease that can lead to the use of a ventilator is pneumonia. Pneumonia is an inflammation of the lung parenchyma caused by microorganisms such as bacteria, mycobacteria, fungi, and viruses. Symptoms experienced by pneumonia sufferers include shortness of breath and



coughing. However, in elderly cases, symptoms can include chest pain and hemoptysis. (Sai, et al., 2016). Yunita & Rondhianto, (2015) stated that further bacterial colonization of the respiratory tract occurs due to the absence of a cough reflex and excessive mucus secretion in patients on mechanical ventilation. The Centers for Disease Control and Prevention (2015) stated that 157,000 patients in the ICU experienced VAP during treatment. VAP is a complication in as many as 28% of patients on ventilation. In line with this, the International Nosocomial Infection Control Consortium (INICC) as an international organization that accommodates the problem of infection cases in hospitals stated that in 2015-2020 there were 7,635 VAP incidents in intensive care units spread across 45 countries (Rosenthal et al., 2025). Karina et al., (2025) also cited the results of a survey conducted by the World Health Organization (WHO) where approximately 8.7% of 55 hospitals in 14 countries in Europe, the Middle East, Southeast Asia, and the Pacific region had VAP cases. In line with other research conducted by Ni Luh Nyoman Adi Parwati (2014) at Sanglah General Hospital, Denpasar, showed that the incidence of VAP was very high, namely 10-25%.

Based on the phenomenon that the author knows, especially in the ICU of Dr. Iskak Tulungagung Regional Hospital, many VAP incidents arise due to the prolonged use of mechanical ventilators. According to the author's observations, the number of cases increases every month. The incidence of VAP in hospitals, especially in the ICU, can be minimized with a standard operating procedure (SOP) called the VAP bundle. The Institute for Healthcare Improvement (IHI) published a guideline for VAP prevention, namely the VAP bundle, which is stated to be able to reduce the incidence of VAP when implemented properly in patients on ventilators. The results of its implementation at Albany Hospital in New York City showed that the incidence of VAP decreased to 0 events because nurses complied and were able to apply the VAP bundle correctly (Avinnia et al., 2025).

One VAP bundle care strategy that can be implemented is head of bed (HOB) elevation. Head of bed (HOB) elevation involves raising the head of the bed to a semi-reclining position with a minimum incline of 30-40 degrees to reduce the occurrence of VAP (Göcze et al., 2022). This aims to prevent VAP by focusing on reducing bacterial colonization in the oropharynx and tracheobronchial tubes, as well as reducing the risk of aspiration (Sadli et al., 2017).

In the field, researchers observed that head-of-bed procedures were often neglected by healthcare workers, particularly those in the ICU at Dr. Iskak Hospital in Tulungagung. Based on the available data, healthcare workers focused solely on suctioning and oral hygiene. Researchers wanted to delve deeper into this topic to help prevent VAP in patients in the ICU at Dr. Iskak Hospital in Tulungagung.

## **METHODS**

This study used a pre-experimental design with a pre-post test approach. The population was all patients using ventilators at Iskak Tulungagung Regional Hospital. Samples were 20 patients using ventilators with the criteria of patients using ventilators for at least 3 days by excluding patients with ventilators with post-op esophagus, post-op laminectomy, patients with cervical trauma, hypotension, uncontrolled airways. The independent variable was the provision of head elevation of bed (HoB) and the dependent variable was the incidence of Ventilator-associated Pneumonia (VAP). VAP measurement used Clinical Pulmonary Infection Score (CPIS) observation both clinically (temperature, leukocytes, chest X-ray, tracheal secretions) and microbiologically (sputum culture).

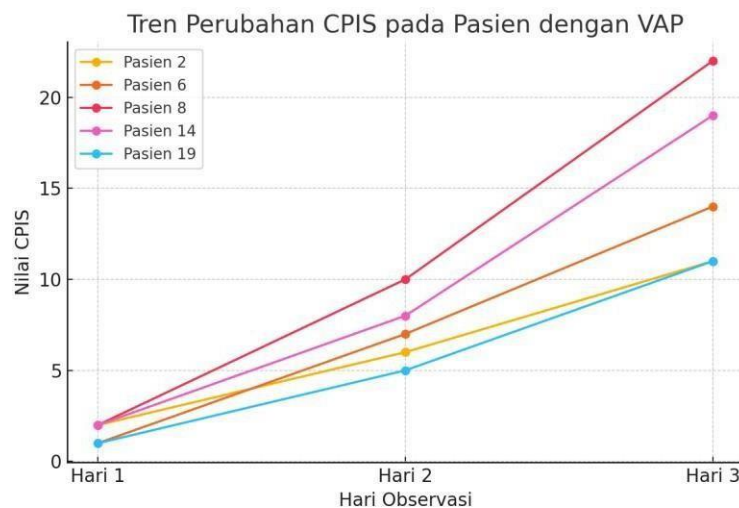
## RESULTS

**Table 1.** Characteristics of research respondents

| age          | amount | Persentase |
|--------------|--------|------------|
| < 20 year    | 4      | 20%        |
| 21 - 40 year | 6      | 30%        |
| 41 – 60 year | 8      | 40%        |
| > 60 year    | 2      | 10%        |
| <b>Total</b> | 20     | 100%       |
| gender       | amount | Persentase |
| female       | 12     | 60%        |
| male         | 8      | 40%        |
| <b>Total</b> | 20     | 100%       |

Based on table 1 above, the majority of respondents were aged 41-60 years, namely 8 respondents (40%), with the majority being female, namely 12 respondents (60%).

**Graph 1.** Graph of daily CPIS changes in patients with VAP



The results of the Wilcoxon statistical test show a sig. value, namely p-value = 0.000 < 0.005, so  $H_0$  is rejected, which means that there is an effect in HoB actions to prevent VAP in patients.

## DISCUSSION

Before receiving the head of bed (HoB) elevation intervention, patients using mechanical ventilators in the ICU of Dr. Iskak Tulungagung Regional Hospital showed a risk of Ventilator-Associated Pneumonia (VAP). Based on observations using the Clinical Pulmonary Infection Score (CPIS), the majority of patients had low CPIS scores on the first



day. However, some patients began to show early signs of improving CPIS on the second day.

This is consistent with research by Klompas et al. (2019), which found that patients on mechanical ventilators who are in the supine position (lying on their backs without elevation) are more susceptible to aspiration of secretions, a major contributing factor to VAP. A flat body position allows oropharyngeal fluid and gastric secretions to enter the lungs, increasing the risk of infection.

After the Head of Bed (HoB) elevation intervention at an angle of 30–45°, the study results showed that 75% of patients did not experience VAP, while 25% of patients continued to experience VAP despite receiving the HoB position intervention. This indicates that although the HoB is effective as a preventive strategy, this intervention cannot completely eliminate the risk of VAP. A significant increase in the Clinical Pulmonary Infection Score (CPIS) was seen on the second and third days, especially in patients who experienced VAP. This phase indicates a critical period for the development of nosocomial infections in the lower respiratory tract.

Research by Labeau et al. (2020) confirmed that the 30–45° HoB position can reduce the risk of microaspiration of oropharyngeal secretions, which is a major mechanism causing VAP. However, they also stated that the HoB is not sufficient as a sole preventive method and should be combined with other interventions.

The results of the Wilcoxon Signed-Rank Test statistical test showed a p-value = 0.000 (<0.05), which means there is a significant effect between the implementation of the HoB and the prevention of VAP in patients using mechanical ventilators. However, this study also found that HoB elevation alone is not enough to completely prevent the occurrence of VAP. According to research by Klompas et al. (2019), elevation of the HoB position by at least 30° to 45° can help reduce aspiration of oropharyngeal secretions containing pathogens, which is one of the main mechanisms causing VAP. This study also confirmed that a higher HoB position can reduce the risk of aspiration of gastric fluid in patients undergoing mechanical ventilation, which ultimately reduces the possibility of lung infection.

Another aspect that can influence the effectiveness of Hob elevation in preventing VAP is the duration of mechanical ventilation. According to research by Mumtaz, H et al. (2023), the longer a patient is on a ventilator, the higher their risk of developing VAP, even after various prevention protocols have been implemented. In the study, patients who were on a ventilator for more than 72 hours had a twofold higher risk of developing VAP compared to patients who were only on a ventilator for a short time. Therefore, although Hob elevation can help reduce the risk of VAP, the duration of ventilator use remains a key consideration in prevention efforts. The following is a graphical presentation of daily CPIS changes in patients with VAP.

In this study, observations were conducted on patients using mechanical ventilators in the ICU of Dr. Iskak Tulungagung Regional Hospital to evaluate the effectiveness of implementing Head Elevation of Bed (HoB) at an angle of 30–45° in preventing Ventilator-Associated Pneumonia (VAP). Observations were conducted for three days using the Clinical Pulmonary Infection Score (CPIS) method, which includes several parameters such as body temperature, leukocyte count, sputum characteristics, PaO<sub>2</sub>/FiO<sub>2</sub> ratio, chest X-ray results, and sputum culture. These parameters are used to determine whether a patient has VAP or not, with a CPIS score ≥6 categorized as VAP.

The results showed that of the 20 patients observed, 15 (75%) did not experience VAP, while 5 (25%) continued to experience VAP despite receiving HoB intervention. Daily observations revealed that the second and third days were the critical phase, with most patients experiencing VAP showing a more significant increase in their CPIS score. A



notable example is patient number 8, who experienced a drastic increase in her CPIS score from 2 on the first day to the third day, indicating a rapid progression of the infection. This could be influenced by several factors, such as longer duration of ventilator use, the patient's immune status, and adherence to other aspects of the VAP bundle, including oral hygiene and endotracheal cuff pressure management.

From these observations, it can be concluded that although head elevation has an effect on reducing the risk of VAP, there are other factors that must also be considered. The longer a patient uses a mechanical ventilator, the higher their risk of developing VAP. Research conducted by Mumtaz, H et al. (2023) showed that patients who use a ventilator for more than 72 hours have a two-fold higher risk of developing VAP compared to patients who use a ventilator for a shorter time. Furthermore, the implementation of HoB needs to be combined with other prevention strategies to be more effective. As explained in the study by Munro et al. (2020), optimal VAP prevention should include good oral hygiene, monitoring endotracheal cuff pressure, and appropriate ventilation management. Another factor that also plays a role is the patient's clinical condition. Patients with comorbidities such as diabetes mellitus, chronic obstructive pulmonary disease (COPD), or immune disorders have a higher risk of developing VAP, even with HoB intervention.

## CONCLUSION

Head of bed (HoB) elevation has an effect in reducing the risk of Ventilator-Associated Pneumonia (VAP), as shown by 75% of patients in this study who did not experience VAP after being given HoB intervention. Improvement in Clinical Pulmonary Infection Score (CPIS) scores in patients with VAP began to be seen significantly on days 2 and 3. This indicates that the first 48-72 hours is a critical phase in the development of VAP. Statistically, HoB significantly influences the prevention of VAP both clinically and by specimen culture examination.

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