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The Effect of Age and Length of Stay on the Incidence of Ventilator Associated Pneumonia (VAP) in the ICU of Royal Prima Ayahanda Hospital During the 2022-2024 Period

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Abstract: Ventilator-associated pneumonia (VAP) is the most common nosocomial infection affecting patients in intensive care units. Ventilator-associated pneumonia (VAP) is defined as pneumonia that occurs 48 hours or more after the initiation of mechanical ventilation. The aim of this study was determine the relationship between age and the incidence of VAP, as well as the relationship between the length of hospital stay and the incidence of VAP among ICU patients at Royal Prima Ayahanda Hospital during the 2022-2024 period who were using mechanical ventilators. This study employed a cross-sectional design. The sample consisted of 125 patients, selected using a consecutive sampling technique. The data used were secondary data obtained from medical records. The statistical test applied were Fisher's Exact. The result showed that 12 respondents (9.6%) developed VAP in the ICU of Royal Prima Ayahanda Hospital. Statistical analysis revealed a p-value of 0.342 between age and the incidence of VAP, and a p-value of 0.003 between the length of hospital stay and the incidence of VAP. The conclusion of this study is that there is a relationship between age and the incidence of VAP, as well as relationship between the length of hospital stay and the incidence of VAP.

Keywords: Age; Length of stay; Mechanical ventilation; VAP

Introduction

Ventilator-Associated Pneumonia (VAP) is defined as pneumonia that occurs 48 hours or more after mechanical ventilation is administered. Mechanical ventilation is a negative or positive pressure breathing aid that can maintain ventilation and oxygen delivery for a long time (Yuniandita & Hudiyawati, 2020; Bakhtiari et al., 2015; Wosti et al., 2017; Madhuvu et al., 2020). VAP is one of the most common infections in critically ill patients using ventilators, leading to increased mortality, morbidity, length of hospital stay, as well as economic and psychological burden for patients and their families (Mastrogianni et al., 2023; Azab et al., 2015; Cooper & Haut, 2013; Tricco et al., 2018; Speck et al., 2016). Ventilator-associated pneumonia (VAP) is the most common nosocomial infection affecting patients in intensive care units. Ventilator-Associated pneumonia (VAP) is a type of nosocomial pneumonia that develops >48 hours after intubation with mechanical ventilation, typically characterized by the onset of fever, tachycardia, leukocytosis, and pulmonary infiltrates (Priyahita, 2023; Buchler et al., 2025; Sadli et al., 2017). Infections like VAP are common in patients on long term ventilation due to use of invasive devices and impaired immune system after critical illness (Núñez et al., 2021; Puspa & Phalswal, 2025; Corrieto et al., 2025; Russo et al., 2022; Buston & Hariadi, 2020; Fitriani, 2018; Fatmawati et al., 2023; Parisi et al., 2019; Lawn et al., 2017).

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The incidence of VAP reaches 9-27% of all intubated patients, and the International Nosocomial Infection Control Consortium (INICC) reports the incidence of VAP to be 13.6 per 1,000 ventilators days (Chuandy et al., 2021; Essa et al., 2024; Apriyani et al., 2021; Madhuvu et al., 2020; Ismail & Zahran 2015). Based on research on conducted by Maria et al. (2022), two variables were found to have a statistically significant relationship with the occurrence of VAP: age and duration of ventilator use. Other risk factors associated with VAP, such as age, gender, trauma, chronic obstructive pulmonary disease (COPD), and duration of ventilation use, have been extensively studied. Most of these risk factors predispose to colonization of the gastrointestinal tract by pathogenic microorganism or aspiration (Maria & Syarif, 2022; Khan et al., 2016; Ismaeil et al., 2019; Amini et al., 2020; Hassan, 2021; Saodah, 2019; Ferreira et al., 2016; Khalifa & Eldin 2020; Modi & Kovacs, 2020; Fatmawati et al., 2023; Essa et al., 2024; Chuandy et al., 2021). The main risk factors for VAP include invasive mechanical ventilation, extreme age, decreased level of consciousness, chronic lung disease, severe trauma, malnutrition, and exposure to broad-spectrum antibiotics.

Some studies show that the longer patients are hospitalized, especially in the ICU, the higher their risk of contracting nosocomial infections such as VAP. This risk factor is associated with longer exposure to mechanical ventilation, decreased immunity, and potential bacterial colonization in the respiratory tract. The risk of VAP significantly increases in patients hospitalized for more than five days, especially those receiving mechanical ventilation (Yang et al., 2014; Modi & Kovacs, 2020; Akhter et al., 2025; Wip & Napolitano, 2009; Sutoyo et al., 2024; Atmaja, 2018; Abou & Mohammed, 2019). Based on the results of research on the prevalence of VAP in Indonesia, data were obtained showing that DKI Jakarta is the province with the highest incidence of VAP, AT 37.9%, and that several other cities also have a fairly high incidence of VAP, such as Central Java (15.9%), Yogyakarta (13.8%), and East Java (11.7%) (Syarif et al., 2024; Safdar et al., 2016; Samra et al., 2017; Oner & Kanan, 2019; Noorifard et al., 2020 Sadli et al., 2017; Ismaeil et al., 2019; Khan et al., 2016; Lawn et al., 2017; Madhuvu et al., 2020; Bakhtiari et al., 2015). To date, there continues to be an increase in the incidence of VAP. This is related to the above discussion regarding factors that influence the increase in VAP rates.

Despite extensive research, data on the relationship between age, length of stay, and the occurrence of VAP remains limited and varies across hospitals. This creates a research gap, especially in local hospitals that have different patient characteristics, infection prevention efforts, and ICU management systems, Therefore, this study aims to determine the relationship between age and length of stay with the incidence of Ventilator-Associated Pneumonia (VAP) in ICU patients at RS. Royal Prima Ayahanda from 2022-2024. The result of this study is expected to provide useful scientific evidence for improving ICU management and infection prevention strategies, particularly in identifying patients at high risk of developing VAP.

Method

This study applied an observational analytic research design using a cross-sectional approach. The research was conducted at the Intensive Care Unit (ICU) of Royal Prima Ayahanda Hospital. The study population consisted of all patients admitted to the ICU during the period of 2022-2024. The sample was obtained using a consecutive sampling technique, in which all patients who met the inclusion and exclusion criteria within the study period were included. The sample of this study consisted of 125 participants (n=125). The data collected were secondary data obtained from medical records at Royal Prima Ayahanda hospital, including name, gender, age, religion, marital status, length of stay, and duration of ventilator use. The collected data were processed, coded, and tabulated. Statistical analysis was conducted using the statistical product and service solution (SPSS) version 30.

Data analysis was presented as follows. Descriptive analysis was used to describe the characteristics of the samples. To determine the relationship between age and the incidence of Ventilator-Associated Pneumonia (VAP), the Fisher's test applied. The relationship between length of stay and the incidence of VAP was also analyzed using Fisher's Exact Test. Similarly, the relationship between the duration of ventilator used and the incidence of VAP was analyzed using Fisher's Exact. Furthermore, to determine the relationship between the length of hospital stay and the duration of ventilator use, a simple linear logistic test was conducted.

Result and Discussion

Results

Distribution Frequency of Characteristic Respondents

Based on Table 1, it is shown that most respondents were from the year 2024, totaling 68 individuals (54.4%), followed by 40 individuals (32.0%) from 2023 and 17 individuals (13.6%) from 2022. In terms of gender, the majority of respondents were male, comprising 69 individuals (55.2%), while females accounted for 56 individuals (44.8%). The highest number of respondents came from the Neurosurgery Department with 56 individuals (44.8%), followed by the Neurology

Department with 23 individuals (18.4%) and the Internal Medicine Department with 22 individuals (17.6%). Meanwhile, the pulmonology Department recorded 18 individuals (14.4%) and the lowest number was found in the General Surgery Department with 6 Individuals (4.8%).

Table 1. Distribution frequency of Characteristic Respondents

Characteristic	f	%
Year		
2022	17	13.6
2023	40	32
2024	68	54.4
Gender		
Male	69	55.2
Female	56	44.8
Departement		
Pulmonology	18	14.4
Neurosurgery	56	44.8
Neurology	23	18.4
General Surgery	6	4.8
Internal Medicine	22	17.6
Age		
<65 years	81	64.8
≥65 years	44	35.2
Length of Stay		
<10 days	83	66.4
≥10 days	42	33.6
Duration of Ventilator		
<5	83	66.4
≥5	42	33.6
VAP		
No	113	90.4
Yes	12	9.6

The table also shows that there were 125 subjects in total. Among them, 12 subjects (9.6%) developed Ventilator-Associated Pneumonia (VAP), while 113 subjects (90.4%) did not experience VAP. Of the 125 respondents, 18 subjects (64.8%) were aged <65 years, whereas 44 subjects (35.2%) were aged ≥65 years. The majority of respondents had a length of hospital stay of <10 days, amounting to 83 individuals (66.4%), while 42 individuals (33.6%) had a hospital stay of ≥10 days. Additionally, 83 individuals (66.4%) used a ventilator for <5 days, and 42 individuals (33.6%) used a ventilator for ≥5 days.

Relationship between Age and the Incidence of VAP

Based on the results of Fisher's Exact Test, a p-value of 0.342 was obtained, indicating no significant relationship between age and the incidence of VAP. Among respondents aged <65 years, 6 individuals developed VAP and 75 did not. In the ≥65 years age group, 6 Individuals developed VAP, while 38 did not.

Table 2. Relationship between Age and the Incidence of VAP

VAP	No	Yes	p-value
Age			0.342*
<65 years	75	6	
≥65 years	38	6	

*Fisher's Exact Test

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The analysis of the relationship between the length of hospital stay and the incidence of VAP using Fisher's Test Exact Test showed a p-value of 0.003, indicating a statistically significant relationship between the legth of hospital stay and the occurrence of VAP. Respondents with a hospital stay of <10 days mostly did not develop VAP, with 80 Individuals unaffected and only 3 experiencing VAP. In contrast among respondents with a hospital stay of ≥10 days, 9 individuals developed VAP, while 33 did not.

Table 3. Relationship Between Lenght of Stay and the Incidence of VAP

VAP	No	Yes	p-value
Lenght of Stay			0.003*
<10	80	3	
≥10	33	9	

*Fisher's Exact Test

Relationship Between Duration of Ventilator Use and the Incidence of VAP

According to Table 4, in the group with a ventilator duration of <5 days, 3 individuals developed VAP and 80 did not. In contrast, in the group with ventilator use ≥5 days, 9 patients developed VAP and 33 did not. The statistical test using Fisher's Exact yielded a p-value of 0.003, indicating a significant relationship between the duration of ventilator use and the incidence of VAP.

Table 4. Relationship Between Duration of Ventilator Use and the Incidence of VAP

VAP	No	Yes	p-value
Duration of Ventilators			0.003*
<5	80	3	
≥5	33	9	

*Fisher's Exact Test

Relationship Between Length of Hospital Stay and Length of Venous Use

Based on the results of the Simple Linear Logistic Test, the analysis produced an R^2 value of 0.0061 and a p-value of 0.005, indicating a positive but very weak relationship between the length of hospital stay and the duration of ventilator use. This means that the longer the hospital stay, the longer the ventilator use tends to be.

Table 5. Relationship Between Length of Hospital Stay and Duration of Ventilator Use

LOS	<10	≥10	R^2	p-value
Duration of Ventilators			0.061*	0.005*
<5	62	21		
≥5	21	21		

*Simple Linear Logistic Test

Discussion

Ventilator-Associated Pneumonia (VAP) is one of the most common types of nosocomial infections found in Intensive Care Units (ICU) among patients receiving mechanical ventilation. One of the essential pieces of equipment in the ICU is the mechanical ventilator, which functions to support respiration through an endotracheal tube (ETT) or tracheostomy. This device is used to assist or replace spontaneous breathing when patients are unable to breathe independently (Panjaitan, Sinatra, & Siahaan, 2021; Noorifard et al., 2020). The incidence rate of VAP in this study was 9.6% higher than that reported by Maria et al (2022), which was 6.7%. This difference may be attributed to several factors, such as the higher proportion of patients from the Neurosurgery Department (44.8%) and Neurology Department (18.4%), who typically have longer ventilation durations and hospital stays due to severe neurological conditions like stroke or head trauma. These factors increase the risk of bacterial colonization in the respiratory tract and subsequent VAP in infection.

Length of stay (LOS) refers to the duration of hospitalization, defined as the number of days a patient is hospitalized during a treatment period (Wulandari et al., 2021). In this study, a significant relationship was found between the length of stay and the incidence of VAP ($p = 0.003$). This finding is consistent with the study of Shuhua Li et al. (2022), which reported a significant relationship between length of stay and VAP incidence ($p < 0.001$). Patients with prolonged hospitalization are more likely to be exposed to nosocomial pathogens, undergo invasive producers, and experience bacterial colonization, all of which contribute to the development of VAP (Li et al., 2023).

Age is an important factor contributing to the occurrence of VAP among patients receiving mechanical ventilation. In this study, no significant association was found between age and the incidence of VAP ($p = 0.216$). This finding differs from that of Maria et al (2022). Theoretically, older patients have higher risk of developing VAP due to age related declines in anatomical, physiological, and immune functions, which make them more susceptible to infection (Saputra et al., 2022). However, in this study, no significant relationship was observed between age and the occurrence of VAP.

Patients receiving mechanical ventilation for more than 48 hours are at risk of developing pneumonia known as VAP, which is a form of lung infection resulting from the use of mechanical ventilation (Zhang et al., 2023; Zubair et al., 2018) The incidence of VAP ($p = 0.003$), which is consistent with the findings of Yesi Maria et al 2022, who reported a significant relationship between ventilator duration and VAP ($p = 0.007$).

This study also demonstrated a significant relationship between the length of hospital stay and the duration of ventilator use among ICU patients ($p = 0.005$). This indicated that patients with longer hospital stays tend to require prolonged mechanical ventilation. This may be due to more severe clinical conditions, a greater number of complications, or slower recovery processes. Such conditions often lead to extended dependence on mechanical ventilation to maintain adequate respiratory function. This finding is consistent with previous studies, which have shown that hospital stay duration has positive correlation with ventilator duration among ICU patients.

Conclusion

Based on the analysis of the data obtained in this study, it can be concluded that the incidence of Ventilator-Associated Pneumonia (VAP) among ICU patients was 9.6%. A significant association was found between the length of hospital stay and the incidence of VAP ($p = 0.003$), as well as between the duration of ventilator use and the incidence of VAP ($p = 0.003$). In contrast, age did not show a significant relationship with VAP occurrence ($p = 0.342$). Furthermore, a positive relationship was identified between the length of hospital stay and the duration of ventilator use ($R^2 = 0.061$; $p = 0.005$), indicating that longer hospitalization tends to result in prolonged mechanical ventilation. These findings suggest that extended hospital stays and prolonged mechanical ventilation. These findings suggest that extended hospital stays and prolonged ventilator use are key risk factors contributing to VAP in ICU patients. Future studies are recommended to include a larger sample size and a broader range of variables, such as comorbidities, disease severity scores (e.g., APACHE II or SOFA), and patient consciousness levels, to provide a more comprehensive understanding of VAP risk factors. Further research should also explore the characteristics of VAP patients based on the causative pathogens. Information on pathogen types and resistance patterns would be valuable in guiding appropriate empirical therapy and supporting infection prevention strategies in ICU settings.

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The authors declare no conflict of interest

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