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# Data on Germs Patterns and Sensitivity to Antibiotics in Late Onset Ventilator Associated Pneumonia at ICU Haji Adam Malik Hospital Medan 2024

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**Abstract**
Ventilator-associated pneumonia (VAP) is a lung infection that occurs in patients using mechanical ventilators for more than 48 hours, with late-onset VAP posing a high risk of multidrug-resistant pathogens. Data on bacterial patterns and antibiotic sensitivity are crucial for empirical treatment and resistance control. This research aims to identify bacterial patterns and antibiotic sensitivity in late-onset VAP cases at the ICU of Haji Adam Malik Hospital, Medan, in 2024. A cross-sectional study was conducted involving 76 samples. Demographic data, bacterial cultures, and antibiotic sensitivity results, obtained from medical records, were analyzed using SPSS 22.0. Among 75 patients with late-onset VAP, the majority were over 50 years old (63.2%) and male (57.9%). Acinetobacter baumannii (44.7%) and Pseudomonas aeruginosa (15.8%) were the most common pathogens. High resistance to cephalosporins was noted, while colistin, polymyxin B, amikacin, and norfloxacin remained effective. A significant association was found between VAP incidence and the duration of ventilator use ($p < 0.001$). Acinetobacter baumannii is the dominant pathogen in late-onset VAP, with significant antibiotic resistance. Continuous surveillance of bacterial profiles and resistance patterns is essential to guide effective empirical therapy and infection control.

## INTRODUCTION

Pneumonia is the most common infection in hospitals, with a prevalence of around 22%. VAP is the most common nosocomial infection, occurring in approximately 5–40% of patients on ventilators. The International Nosocomial Infection Control Consortium (INICC) collected summary data from 50 countries, including those in Southeast Asia, during 2010–2015, which indicated a VAP rate of 13.1 per 1,000 days of mechanical ventilator (MV) use in medical and surgical intensive care units. A 2025 global meta-analysis reported a pooled incidence rate of approximately 30% (95% CI: 24–37%) among ventilated ICU patients, with male gender, smoking history, and higher APACHE II scores identified as major risk factors (Arayasukawat et al., 2021; Ochoa et al., 2025).

Early-onset ventilator-associated pneumonia (VAP), characterized by its manifestation within the initial four days of hospitalization, generally exhibits a more favorable prognosis and is predominantly attributed to antibiotic-sensitive bacterial strains. Conversely, late-onset VAP, which occurs five days post-hospitalization or later, is more frequently linked to multidrug-resistant (MDR) pathogens, thereby correlating with elevated rates of patient mortality and morbidity. The prevalence of hospital-acquired pneumonia (HAP) extends the average duration of hospitalization by approximately seven to nine days per patient, concurrently imposing substantial financial strains on healthcare institutions (Kalil et al., 2016;

Kartikeswar et al., 2019; Wu et al., 2019). In Indonesia, local research has highlighted that comorbidities, malnutrition, high SOFA scores, and infections with multidrug-resistant (MDR) pathogens are key contributors to poor outcomes among VAP patients (Golia et al., 2013; Indriasari et al., 2024).

The incidence of Ventilator-Associated Pneumonia (VAP) is observed to be most pronounced during the initial phase of hospitalization, with an estimated occurrence rate of 3% per day during the first five days of mechanical ventilation, 2% per day from days five to ten of ventilation, and diminishing to 1% per day thereafter. In a study conducted by Wahyuni et al. (2017) within the Intensive Care Unit (ICU) of Haji Adam Malik Hospital, it was determined that the predominant pathogen responsible for VAP was Acinetobacter baumannii (39.3%), succeeded by Pseudomonas aeruginosa (21.4%) and Escherichia coli (14.8%) (Wahyuni et al., 2020).

Several previous studies have examined bacterial patterns and antibiotic resistance in VAP, but most have focused on populations outside Indonesia or were conducted in a past period. Research at Haji Adam Malik Hospital in Medan itself is still limited and was last conducted in 2017, so it has not reflected the changes in resistance patterns that have occurred over time. In addition, previous studies have not specifically analyzed the relationship between the duration of ventilator use and the late-onset incidence of VAP, as well as the current pattern of antibiotic sensitivity, in this regional referral hospital. The novelty of this study lies in the provision of up-to-date data on germ patterns and antibiotic sensitivity in late-onset VAP in the ICU of Haji Adam Malik Hospital Medan in 2024, reflecting the current situation after almost a decade, as well as the analysis of the risk factors that affect it, thus providing a more current epidemiological picture to support clinical decision-making.

The high level of resistance in the ICU raises awareness of being effective in the use of antibiotics, namely selecting the right antibiotic. The choice of initial antibiotic is critical in determining outcomes in patients with VAP, and it is a major factor contributing to the development of antibiotic resistance. The availability of germ and bacterial patterns for antibiotic sensitivity is very important as a consideration in guidelines for the empirical antibiotic treatment of VAP in patients undergoing treatment in the ICU. Because sensitivity patterns change at certain periodic intervals, it is necessary to provide data and patterns of bacterial sensitivity to antibiotics in the ICU (Blot et al., 2014). The aim of this study was to determine data on germ patterns and sensitivity to antibiotics in late-onset VAP in the ICU at Haji Adam Malik Hospital Medan in 2024. This research provides theoretical benefits to enrich clinical microbiology and intensive care knowledge on bacterial patterns and antibiotic resistance in late-onset VAP, as well as a reference for further research on infection management in the ICU, and the results of this study serve as a reference for health professionals in determining the appropriate empirical antibiotic therapy in VAP patients. This research also provides important data for the hospital's antibiotic resistance control committee to develop a rational antibiotic use policy and becomes the basis for the development of local guidelines for VAP management at Haji Adam Malik Hospital Medan. For educational institutions, the results of this study can be used as teaching material on nosocomial infections and ICU management, as well as contribute to national efforts to control antibiotic resistance through the provision of accurate and up-to-date local epidemiological data.

## METHOD

This research is a prospective case study design *cross sectional.* This research was conducted to look at data on germ patterns and sensitivity to antibiotics in late onset VAP at IPI Haji Adam Malik Hospital Medan. The research was carried out at the Haji Adam Malik Hospital in Medan from June to September starting from the time the proposal was approved

and received a letter of approval from the Health Research Ethics Commission, Faculty of Medicine, University of North Sumatra until the results were presented. The research variables are age, gender, length of use of the ventilator, and length of time treatment at ICU Haji Adam Malik Hospital Medan. Research subjects were taken from the patient population in the ICU room with ventilators at Haji Adam Malik Hospital. The sampling method for selecting research subjects was carried out according to the consistent sampling method in the form of demographic and clinical characteristics from patient medical records.

The total number of samples was 72 samples with inclusion criteria in the form of patients aged 18-70 years, using a ventilator for > 72 hours, having BAL culture performed, patients with VAP who had complete medical record data, and were willing to sign a consent form to be included as research subjects. VAP was defined according to the Centers for Disease Control and Prevention (CDC) / National Healthcare Safety Network (NHSN) criteria and the 2016 IDSA/ATS clinical practice guidelines for hospital-acquired and ventilator-associated pneumonia. [20] The diagnostic criteria included:

1. The presence of a new or progressive pulmonary infiltrate on chest radiography occurring ≥48 hours after endotracheal intubation.
2. At least two of the following clinical features:
   Fever (>38°C) or hypothermia (<36°C)
   Leukocytosis (>12,000/mm³) or leukopenia (<4,000/mm³)
   Purulent tracheal secretions
3. Microbiological confirmation by positive BAL or endotracheal aspirate culture, with significant bacterial growth (≥$10^4$ CFU/mL for BAL or ≥$10^5$ CFU/mL for ETA).

Meanwhile, the exclusion criteria were patients who were not on a ventilator at the time of data collection.

The research data will be analyzed statistically with the help of the Windows computer program, Statistical Product and Science Service (SPSS) version 22.0. Data analysis and presentation was carried out using univariate analysis stages to analyze the characteristics of research subjects and bivariate analysis to analyze the relationship between risk factors and the incidence of VAP.

## RESULTS AND DISCUSSION

In this study, 75 patients experienced it *late onset* VAP, with an average patient age distribution of 53.59 years. In addition, based on the age distribution of patients, it is known that the majority of patients are >50 years old (63.2%). These results are known to be similar to other studies in India which show the average age of patients diagnosed with *late-onset* VAP is 43.9 $\pm$ 16.1 years. Incident *late-onset* VAP in older patients is also associated with a higher incidence of mortality, as well as lower endurance.

### Demographic Characteristics

**Table 1. Research Characteristics**

| Variable | Sample (n=76) | *Late onset VAP* (n=75) | Not *late onset VAP* (n=1) |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | Mean ± SD |
| Age (Years) | 53,59 ± 15,32 | 53,36 ± 15,29 | 71 |
| Variabel | Median (Min-Max) | Median (Min-Max) | Median (Min-Max) |

| | | | |
|---|---|---|---|
| Treatment time (hours) | 432 (96–1608) | 432 (96–1608) | 48 |
| Variable | N (%) | N (%) | N (%) |
| Age | | | |
| <30 years | 6 (7,9) | 6 (8) | 0 (0) |
| 30-50 years | 22 (28,9) | 22 (29.3) | 0 (0) |
| >50 years | 48 (63,2) | 47 (62.7) | 1 (100) |
| Sex | | | |
| Male | 44 (57,9) | 43 (57.3) | 1 (100) |
| Female | 32 (42,1) | 32 (42.7) | 0 (0) |
| Lengh of Use | | 6 (8) | |
| <72 hours | 1 (1,3) | 0 (0) | 1 (100) |
| >72 hours | 75 (98,7) | 75 (100) | 0 (0) |
| Length of Treatment | | | |
| <72 jam | 0 (0) | 0 (0) | 1 (100) |

Source: Primary Research Data, 2024 (Medical Records of ICU Patients at Haji Adam Malik Hospital Medan

**Relationship of Variables to Events *Late Onset* VAP**

**Table 2. Relationship of Variables to Events *Late Onset* VAP**

| Variable | Chi-square | p-value |
|---|---|---|
| Age group | 0,591 | 0,744 |
| Sex | 0,737 | 0,391 |
| Length of Ventilator Use | 76,0 | <0,001* |
| Length of Treatment Use | n/a | n/a |

Source: Results of Data Analysis, 2024 (Processed Using SPSS Version 22.0)

**Bacterial patterns in patients with Late-Onset VAP**

**Tabel 3. Bacterial patterns in patients with Late-Onset VAP (n = 76)**

| Microorganisms | N | % |
|---|---|---|
| Acinetobacter baumannii | 34 | 44,74 |
| Pseudomonas aeruginosa | 12 | 15,79 |
| Escherichia coli | 8 | 10,53 |
| Klebsiella pneumoniae | 7 | 9,21 |
| Stenotrophomonas maltophilia | 4 | 5,28 |
| Citrobacter freundii | 2 | 2,64 |
| Aeromonas punctata (caviae) | 1 | 1,32 |
| Enterobacter cloacae | 1 | 1,32 |
| Proteus mirabilis | 1 | 1,32 |

| | | |
|---|---|---|
| Achromobacter xylosoxidans | 1 | 1,32 |
| Pseudomonas putida | 1 | 1,32 |
| Tidak diperiksa | 4 | 5,28 |

Source: Primary Research Data, 2024 (BAL Culture Results of ICU Patients at Haji Adam Malik Hospital Medan)

The findings of this study highlight important epidemiological and microbiological characteristics of late-onset ventilator-associated pneumonia (VAP) in the ICU of Haji Adam Malik Hospital. Based on demographic data (Table 1), most patients were male (57.9%) and over 50 years old (63.2%), with a mean age of 53.59 ± 15.32 years. A previous study by Gunalan et al. reported similar results, with males (66.7%) experiencing more incidents of late-onset VAP compared with women. Another study conducted by Sharpe et al. also showed similar results; however, no correlation was found between mortality rate and patient gender. The high rate of VAP in men can be thought to be due to the relationship between male gender and the risk of post-traumatic infections and ventilator installation (Goel et al., 2012; Gunalan et al., 2023).

From the bivariate analysis (Table 2), it was found that only the length of ventilator use had a statistically significant association with the incidence of late-onset VAP ($p < 0.001$). This finding aligns with global data indicating that the risk of VAP increases with each additional day of mechanical ventilation—approximately 3% per day during the first 5 days, and 2% per day from days 5–10 (Torres et al., 2017).

Germ pattern analysis was carried out in patients with a diagnosis of late-onset VAP. The microbiological analysis (Table 3) demonstrated that Acinetobacter baumannii (44.7%) was the predominant pathogen, followed by Pseudomonas aeruginosa (15.8%) and Escherichia coli (10.5%). The study by Lakhal et al. reported similar results, with the most common types of bacteria found being A. baumannii (53%), P. aeruginosa (37%), and the Enterobacteriales (28%). This research shows that these bacteria have high resistance to antibiotics. Another study by Chastre and Fagon also reported similar results, with the bacteria P. aeruginosa, S. aureus, and Enterobacterales being the group of pathogens that most frequently cause late-onset VAP. Other studies also report similar results in various countries. A study conducted in Surabaya reported P. aeruginosa as the most common pathogen in patients with VAP. Studies conducted in Iran and Poland reported A. baumannii as the most frequent pathogen in late-onset VAP (Mustikaningtyas et al., 2022).

Another study conducted in Thailand showed that the most common cause of late-onset VAP is gram-negative bacteria, with the most common organisms being A. baumannii, Klebsiella pneumoniae, and P. aeruginosa. Another different finding in this study is the presence of S. maltophilia bacteria, which tend to occur in patients with late-onset VAP. These results confirm that bacteria with resistance to various antibiotics can have a high probability of occurrence in late-onset VAP, as well as the need for microbiological confirmation before starting antibiotic therapy (Lakhal et al., 2021).

A sensitivity test was carried out between the late-onset and early-onset groups in patients with VAP, using antibiotics such as ceftriaxone, amikacin, amoxicillin, meropenem, ampicillin, nitrofurantoin, aztreonam, cefazolin, cefepime, ceftazidime, tobramycin, ciprofloxacin, chloramphenicol, ertapenem, and other types of antibiotic drugs. Antibiotic susceptibility testing in this study revealed marked resistance to most cephalosporins and carbapenems, while amikacin and norfloxacin retained good sensitivity (Caggiano et al., 2021). These results are consistent with international surveillance data showing that aminoglycosides and polymyxins (e.g., colistin, polymyxin B) remain among the few effective treatments

against MDR Acinetobacter (Bassetti et al., 2022). A study conducted by Golia et al. showed that the antibiotics that have sensitivity to bacteria in the incidence of VAP include linezolid, vancomycin, and gentamicin. These results also show that there is high meropenem resistance in the Pseudomonas and Acinetobacter groups. Another study conducted in Surabaya showed that antibiotic sensitivity in patients with late-onset VAP occurs most often in the cefoperazone-sulbactam, amikacin, and meropenem group. The cefoperazone group is known to have the highest sensitivity compared to other antibiotics (Mustikaningtyas et al., 2022). Other studies also reported similar results, where late-onset VAP is often associated with infection by MDR bacteria, such as P. aeruginosa, A. baumannii, and MRSA. This can be explained by the antibiotics used in patients with VAP (Mergulhão et al., 2024; Post et al., 2024).

This study tested the risk factors for the occurrence of late-onset VAP (LOVAP) using several factors, including age group, gender, length of ventilator use, and length of treatment. In this study, it was discovered that only the length of ventilator use had a significant result ($p < 0.05$). Late-onset VAP itself can be explained as VAP that occurs after 96 hours of mechanical ventilation. A study by Gunalan et al. reported that the use of mechanical ventilation after 5 days caused the occurrence of VAP in 82.7% of patients, with a p-value that is not significant. In contrast to these studies, the study by Khan et al. reported that the use of mechanical ventilation had a significant correlation with the incidence of late-onset VAP ($p < 0.001$) (Caggiano et al., 2021).

The use of mechanical ventilation is a major factor in the occurrence of late-onset VAP, due to the colonization of the respiratory tract by pathogenic bacteria disturbing mucociliary clearance. A study by Busl et al. reported that patients who used mechanical ventilation for more than 48 hours tended to experience VAP. The risk of the occurrence of late-onset VAP also increases with the daily use of mechanical ventilation. In addition, the type of suction system used is also able to predict the incidence of VAP. Closed suction systems can reduce bacterial colonization compared to open systems, which reduces the risk of VAP (Debora et al., 2012; Khan et al., 2015).

## CONCLUSION

This study shows that the majority of patients with late onset VAP are older of 50 years (63.2%) with an average age of 53.59 years. This is consistent with previous studies showing that advanced age increases susceptibility to VAP infection, and is associated with higher mortality and lower survival. Apart from that, the male gender is more dominant in the incident *Late Onset* VAP (66.7%), which is in line with the results of previous studies showing that men have a higher risk of experiencing post-traumatic infections or being placed on a ventilator. In this study, the germ pattern found in patients with late onset VAP was dominated by bacteria *Acinetobacter baumannii* (44,74%), *Pseudomonas aeruginosa* (15.79%), and *Escherichia coli* (10.53%). These results are in line with previous studies which showed the dominance of Acinetobacter baumannii and Pseudomonas aeruginosa bacteria in late onset VAP patients in various countries. This study also emphasizes the importance of microbiological confirmation before starting antibiotic therapy, considering the high resistance to various antibiotics of this pathogen.

The antibiotic sensitivity test carried out showed that the antibiotics Amikacin and Norfloxacin had significant results against bacteria that cause late onset VAP. This study confirms the findings of previous studies showing high resistance to antibiotics such as Meropenem in Pseudomonas and Acinetobacter. This indicates that late onset VAP is often caused by multi-resistant (MDR) bacteria, which require a more careful and antibiotic sensitivity-based treatment approach. The main risk factor found in this study was the length

of use of a mechanical ventilator. Using a ventilator for more than 96 hours increases the risk of this occurring *Late Onset* VAP significantly. This study shows that use of a mechanical ventilator for more than five days is associated with an increased incidence of VAP in patients, with statistically significant results. The use of a closed suction system has also been proven to be more effective in reducing bacterial colonization in the respiratory tract, which in turn can reduce the risk of VAP.

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