

Neutrophil Lymphocyte Ratio and Its Association with Consciousness Level and Mortality among Pneumonia Patients in the Intensive Care Unit

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Abstract:

Pneumonia causes an intense inflammatory response involving neutrophils and lymphocytes, and the neutrophil to lymphocyte ratio (NLR) is increasingly recognized as a marker of disease severity. Such inflammatory processes, together with hypoxia, may impair consciousness and increase the risk of death. This study aimed to examine the association between NLR, level of consciousness, and mortality in pneumonia patients admitted to the intensive care unit. A cross-sectional analytical study with a retrospective approach was conducted using medical records of patients admitted to the intensive care unit between November 2023 and June 2024. Of the 432 patients assessed for eligibility, 248 were included using a census sampling approach. Data were analyzed using Spearman's rho correlation and Fisher's Exact Test. A of 248 patients hospitalized. The results showed a significant negative correlation between NLR and level of consciousness ($p < 0.001$, $r = -0.663$). Furthermore, NLR was significantly associated with mortality ($p\text{-value} < 0.001$). In conclusion, higher NLR is associated with impaired consciousness and increased mortality in pneumonia patients, suggesting its potential as a predictor of poor outcomes in critical care. These findings highlight the importance of nurses in early monitoring of NLR values to support timely interventions, improve surveillance, and reduce adverse outcomes in pneumonia patients.

Keywords: Intensive Care Units, Lymphocytes, Neutrophils, Patient Acuity, Pneumonia

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INTRODUCTION

Indonesia is a developing country where pneumonia remains a significant public health problem ([Ministry of Health, Republic of Indonesia, 2018](#)). Pneumonia is an infection of the lower respiratory tract, involving the bronchi and alveoli, leading to impaired gas exchange ([Crame et al., 2021](#)). The causative factors include microorganisms such as bacteria, fungi, and viruses ([Ministry of Health Republik Indonesia, 2018](#)).

Based on the 2019 Global Burden of Diseases (GBD) study, lower respiratory tract infections affected around 487 million people worldwide. In Indonesia, pneumonia cases increased significantly by 34.8% with a reported mortality of 1,017,290 cases ([Ministry of Health Republik Indonesia, 2018](#)). Hospital-acquired pneumonia has been identified as the leading cause of death in 70% of critically ill patients ([Lim, 2021](#)). According to data from the Central Statistics Agency (BPS) updated on July 24, 2023, there were 3,314 pneumonia cases in the Jember area. Furthermore, a preliminary study at Jember Pulmonary Hospital, a referral center for respiratory diseases, reported 1,152 patients with various subtypes of pneumonia between early 2022 and November 2023.

During inflammation, the primary cells involved in the immune response increase. Persistent

systemic inflammation initiates a physiological reaction associated with an increased number of neutrophils (neutrophilia), which occurs due to neutrophil release from blood vessels into circulation (demargination) and prolonged apoptosis. On the other hand, T lymphocytes are also immobilized on blood vessel walls (margination), and redistribution and apoptosis in both the thymus and spleen result in low numbers of lymphocytes (lymphopenia) ([Ayu et al., 2022](#)). Accordingly, there was enrichment in the neutrophil pathway and depletion of lymphocyte number as phenotypes associated with pneumonia ([Russell et al., 2019](#)).

Several studies have shown that the progression of pneumonia is closely associated with excessive inflammation ([Alzoubi & Khanfar, 2022](#)). Therefore, reliable predictors or biomarkers are needed to assess the degree of inflammation in patients with pneumonia. The neutrophil to lymphocyte ratio (NLR) is one such biomarker, reflecting the two conditions of systemic inflammation and immune status ([Torres & Cillo, 2021](#)). Damage to inflammatory cells, including neutrophils and lymphocytes, may decrease blood oxygen levels, leading to hypoxia. It can cause damage to brain cells and impair consciousness due to a lack of oxygen ([Wełnicka-Wesołowska & Gołab-Janowska, 2026](#)). Additionally, excessive inflammation may promote immune responses and lead to tissue damage, which in turn increases the risk of secondary infections or complications that also contribute to fatality ([Wang et al., 2025](#)).

Understanding the neutrophil to lymphocyte ratio (NLR) in pneumonia patients is essential for health professionals, as it provides valuable information for identifying patients who require intensive monitoring and treatment, as well as offering insights into worsening conditions and potential mortality ([Wu et al., 2021](#)). In clinical settings, these simple and inexpensive indices may help early risk stratification by helping clinicians identify patients who could benefit from supportive care ([Turbawaty et al., 2026](#)). Recent evidence has shown that the neutrophil-to-lymphocyte ratio (NLR) is a simple, inexpensive, and readily available biomarker associated with disease severity and mortality in patients with pneumonia and other critical illnesses ([Altas & Kizilkaya, 2021](#)). However, previous studies have primarily focused on mortality prediction, while evidence regarding the association between NLR, level of consciousness, and mortality in critically ill pneumonia patients remains limited. Therefore, further investigation is needed to clarify these relationships and support early risk stratification in intensive care settings. Nurses, in particular, play a crucial role by monitoring laboratory parameters, interpreting results in relation to the patient's clinical condition, collecting blood samples, and collaborating with physicians to optimize patient management ([TIM Pokja PPNL, 2018](#)). Given the importance of NLR in clinical decision-making and the pivotal role of nurses in patient care, this study was conducted to analyze the relationship between NLR, level of consciousness, and mortality among pneumonia patients in the intensive care unit of Jember Pulmonary Hospital.

METHODS

This study employed a quantitative correlational approach using a cross-sectional analytical design with a retrospective approach. The study was conducted in the Intensive Care Unit at Jember Pulmonary Hospital, Indonesia, using secondary data obtained from electronic medical records of patient admitted between November 2023 and June 2024, totaling 432 patients. The data included laboratory blood test results, Glasgow Coma Scale (GCS) scores, and in-hospital mortality.

The source population consisted of 432 patients who were assessed for eligibility during the study period. The participant selection process is presented in [Figure 1](#). A total population (census) sampling approach was applied based on predefined inclusion and exclusion criteria. Initially, 86 patients were excluded because their primary diagnosis was not pneumonia, resulting in 346 eligible participants. Subsequently, 20 patients were excluded because of incomplete blood test results, and 78 patients were excluded because the first blood test after ICU admission was unavailable. Consequently, 248 patients met the eligibility criteria and were included in the final analysis. The inclusion criteria were: (1) patients aged ≥ 18 years; (2) patients diagnosed with pneumonia; (3) patients with complete blood test results; and (4) patients whose first blood test was performed after ICU admission. The exclusion criteria were: (1) patients whose primary diagnosis was not pneumonia; (2) patients whose

blood test results were unavailable because of an ICU stay of less than 24 hours; (3) patients who had received corticosteroids before ICU admission or before the first blood test; (4) patients with autoimmune comorbidities; (5) patients with a history of chemotherapy; and (6) patients who received sedation.

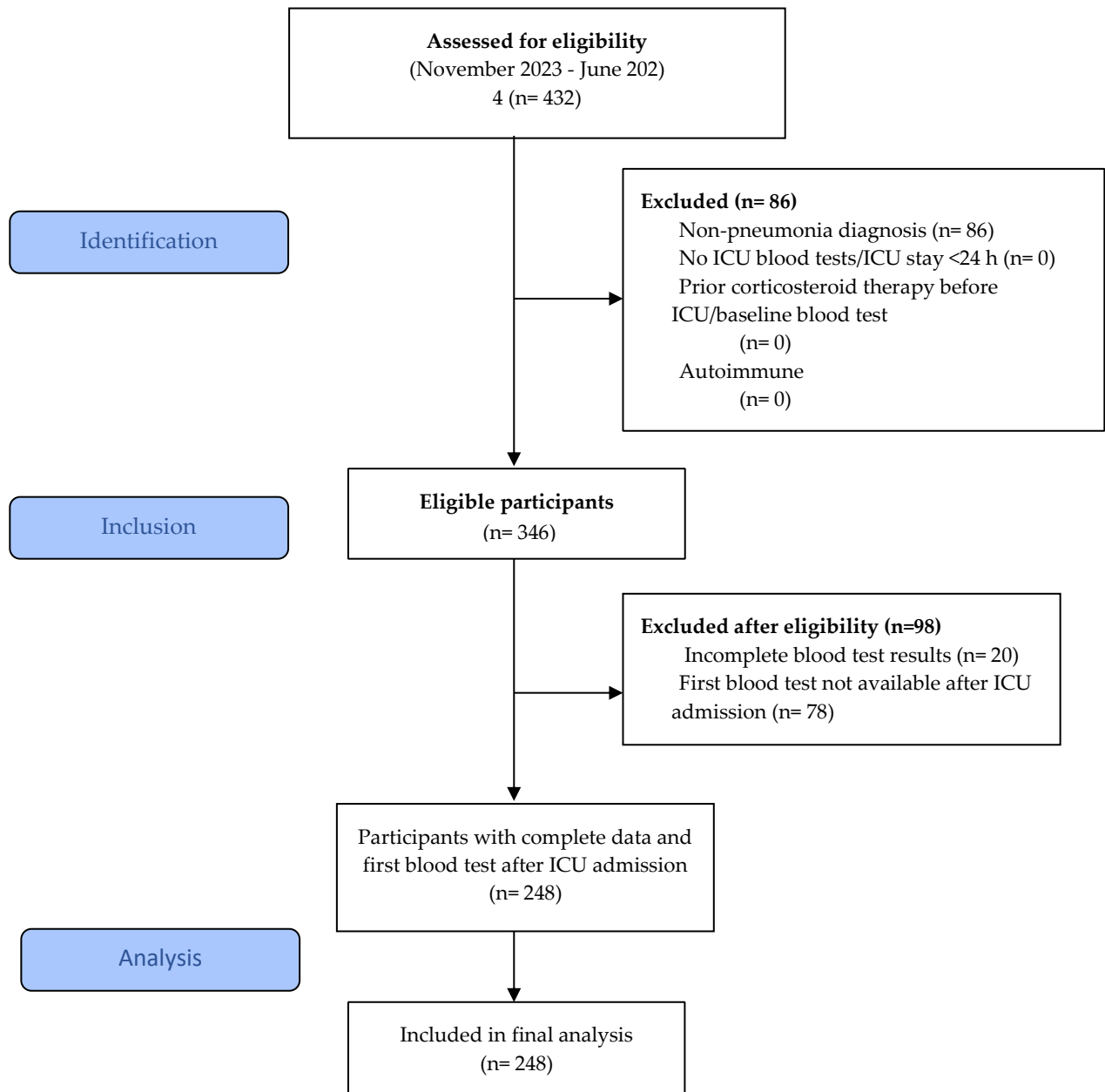


Figure 1. The flow diagram of participants' selection ([Hopewell et al., 2025](#))

To reduce potential bias, all eligible pneumonia patients during the study period were included using total sampling. Standardized medical record data from the hospital's electronic system were used to ensure consistent laboratory results and GCS assessments recorded by ICU nurses.

Research analysis uses univariate and bivariate analysis. Univariate analysis in the study was used for categorical variables, including patient characteristics such as age, gender, and comorbidities, NLR values, GCS values, and patient mortality data, which were analyzed using percentages and frequency distribution. The level of consciousness was assessed using the Glasgow Coma Scale (GCS), which was recorded in the patients' medical records. For the purpose of this study, the following

operational categories were applied: Compos mentis (GCS 15–14), Apathy (13–12), Delirium (11–10), Somnolence (9–7), Sopor (6–5), Soporosis Coma (4), and Coma (3). These categories were consistently used to classify the patients' level of consciousness in the analysis. NLR was categorized into two groups based on the clinical standard applied at Jember Pulmonary Hospital: high NLR (>3.13) and normal NLR (≤ 3.13).

All data that has been obtained is analyzed using bivariate analysis to determine the relationship between variables. This research used bivariate analysis using Spearman's rho correlation test and Fisher's exact test. The Spearman's rho correlation test is used to test the relationship between NLR and level of consciousness, while the Fisher's exact test is used to test the relationship between NLR and mortality.

RESULTS

A total of 248 pneumonia patients met the inclusion criteria and were included in the analysis. Patient characteristics, including age, sex, and comorbidities, as well as clinical outcomes such as neutrophil to lymphocyte ratio (NLR), level of consciousness, and mortality, were summarized. The detailed distribution of patient characteristics is presented in [Table 1](#).

Table 1. Distribution of Respondent Characteristics, Comorbidities, NLR, Consciousness, and Mortality Rates

Variable	n (%) or M $\pm$ SD
Age	54.55 $\pm$ 14.719
Sex	
Male	177 (71.4%)
Female	71 (28.6%)
Comorbidities	
Diabetes mellitus	86 (34.7%)
Cardiovascular	44 (17.7%)
Anemia	30 (12.1%)
COPD	28 (11.3%)
Tuberculosis	22 (8.9%)
Hypertension	16 (6.5%)
Bronchitis	12 (4.8%)
Kidney failure	10 (4%)
NLR value	Frequency
High (>3.13)	202 (81.5%)
Normal (≤ 3.13)	46 (18.5%)
Level of Consciousness	Frequency
Compos Mentis (15-14)	18 (7.3%)
Apathy (13-12)	22 (8.9%)
Delirium (11-10)	15 (6.0%)
Somnolence (9-7)	14 (5.6%)
Sopor (6-5)	40 (16.1%)
Soporosis Comatus (4)	56 (22.6%)
Coma (3)	83 (33.5%)
Mortality	
Died	193 (77.8%)
Survived/Recharged/Transferred	55 (22.2%)

Source: *Research Secondary Data (July 2024)*

[Table 1](#) of the study showed the respondents had an average age of 54 years. Based on gender distribution, 177 respondents (71.4%) were male and 71 respondents (28.6%) were female. The most

common comorbidities were diabetes mellitus, reported by 86 respondents (34.7%), and cardiovascular disease, reported by 44 respondents (17.7%).

The distribution of the neutrophil-to-lymphocyte ratio (NLR) showed that 202 respondents (81.5%) had $NLR > 3.13$, while 46 respondents (18.5%) had $NLR \leq 3.13$. For the level of consciousness, the highest proportions were coma with 83 respondents (33.5%) and soporous coma with 56 respondents (22.6%). The lowest proportions were delirium, with 15 respondents (6.0%), and Somnolence, with 14 respondents (5.6%). Finally, the distribution of mortality incidence indicated that most respondents (193 respondents, 77.8%) died within < 48 hours of ICU admission, while 55 respondents (22.2%) survived or were referred.

[Table 2](#) presents the cross-tabulation between levels of consciousness based on the Glasgow Coma Scale (GCS) and the Neutrophil-to-Lymphocyte Ratio (NLR). The analysis aims to examine the relationship between patients' level of consciousness and their NLR values using Spearman's rho correlation test.

Table 2. Cross Tabulation and Spearman's rho Test between the Neutrophil to Lymphocyte Ratio (NLR) and Level of Consciousness

Level of Consciousness based on Glasgow Coma Scale (GCS)	Neutrophil to Lymphocyte Ratio (NLR)		Total	p-value	r
	>3.13	≤3.13			
Compos Mentis (15-14)	4 (1.6%)	14 (5.6%)	18 (7.3%)	<0.001*	-0.663
Apathy (13-12)	1 (0.4%)	21(8.5%)	22 (8.9%)		
Delirium (11-10)	4 (1.6%)	11(4.4%)	15 (6%)		
Somnolence (9-7)	14 (5.6%)	0	14 (5.6%)		
Sopor (6-5)	40 (16.1%)	0	40 16.1%)		
Sopor Comatus (4)	56 (22.6%)	0	56 (22.6%)		
Coma (3)	83 (33.5%)	0	83 (33.5%)		
Total	202 (81.5%)	46 (18.5%)	248 (100%)		

*Spearman's rho test

Based on [Table 2](#), respondents with an $NLR > 3.13$ most frequently experienced a decreased level of consciousness in the form of coma, with 83 respondents (33.5%), while the lowest proportion was found in the apathy group, with only one respondent (0.4%). The relationship between NLR and the level of consciousness was analyzed using Spearman's rho correlation test. The results showed a statistically significant association ($p < 0.001$, $p < 0.05$). The strength of the correlation was $r = -0.663$, indicating a strong negative relationship. This suggests that higher NLR values are associated with lower levels of consciousness among pneumonia patients.

To further explore the relationship between the neutrophil to lymphocyte ratio (NLR) and mortality among pneumonia patients, a cross-tabulation and Fisher's Exact Test were conducted. The unadjusted relative risk (RR) with its 95% confidence interval (CI) was calculated to estimate the magnitude of the association. As this study was limited to bivariate analysis, no confounder-adjusted estimates were calculated. The results are presented in [Table 3](#).

Table 3. Cross Tabulation and Fisher's Exact Test between the Neutrophil to Lymphocyte Ratio (NLR) and Mortality

NLR	Mortality		Total	p-value	Risk Ratio (95% CI)
	Died	Survived/Recharged/Transferred			
>3.13	193 (77.8%)	9 (3.6%)	202 (81.5%)	<0.001*	0.045 (0.024-0.084)
≤3.13	0 (0%)	46 (18.5%)	46 (18.5%)		
Total	193 (77.8%)	55 (22.2%)	248 (100%)		

*Fisher's Exact Test

[Table 3](#) presents the relationship between the Neutrophil to Lymphocyte Ratio (NLR) and mortality outcomes among pneumonia patients admitted to the ICU. The majority of patients who died had $\text{NLR} > 3.13$, accounting for 193 respondents (77.8%), while none of the deceased patients were in the $\text{NLR} \leq 3.13$ group. Conversely, among patients who survived, were discharged, or transferred, the proportion was higher in the $\text{NLR} \leq 3.13$ group (46 respondents, 18.5%) compared to those with $\text{NLR} > 3.13$ (9 respondents, 3.6%).

The statistical analysis using Fisher's Exact test demonstrated a significant association between NLR and mortality ($p < 0.001$; $p < 0.05$). The risk estimate (risk ratio = 0.045; 95% CI: 0.024–0.084) indicates that patients with high NLR had markedly lower survival probability compared to those with normal NLR.

DISCUSSION

This study aimed to investigate the association between the neutrophil-to-lymphocyte ratio (NLR), level of consciousness, and in-hospital mortality among pneumonia patients admitted to the intensive care unit. The findings demonstrated that a higher NLR was significantly associated with lower Glasgow Coma Scale (GCS) scores and increased in-hospital mortality.

The results demonstrated a significant negative correlation between the neutrophil-to-lymphocyte ratio (NLR) and the level of consciousness among pneumonia patients admitted to the ICU (Spearman's rho, $r = -0.663$, $p < 0.001$), indicating that higher NLR values were associated with lower levels of consciousness. Most patients with low levels of consciousness—specifically those categorized as Sopor (GCS 6–5), soporous comatose (GCS 4), and coma (GCS 3)—had elevated NLR values (> 3.13). Conversely, patients with higher levels of consciousness ($\text{GCS} \geq 10$) were predominantly found in the normal NLR group (≤ 3.13). These results reinforce the association between systemic inflammatory response, reflected by NLR elevation, and neurological deterioration in critically ill pneumonia patients. These findings are consistent with a study by Kastilong et al (2018). This study is also consistent with those of Mohamed et al. (2021), who reported that elevated Neutrophil-to-Lymphocyte Ratio (NLR) values were significantly associated with lower Glasgow Coma Scale (GCS) scores and early neurological deterioration in patients with intracerebral hemorrhage.

The average NLR in this study was 3.67, which exceeds the normal NLR value (≤ 3.13 in normal inflammatory conditions). Neutrophils and lymphocytes work to help the immune system fight pathogen attacks ([Ghosh et al., 2025](#)). However, when there is an excessive inflammation, too many neutrophils and lymphocytes are produced and damaged, triggering a cytokine storm (Kastilong et al., 2018). Excessive inflammation increases neutrophil activation and lymphocyte depletion, resulting in an elevated NLR and a dysregulated inflammatory response. This process promotes endothelial injury, microvascular thrombosis, impaired tissue oxygenation, and organ dysfunction, including reduced cerebral perfusion, which may contribute to decreased levels of consciousness in patients with severe pneumonia (Kastilong et al., 2018).

Another finding from this study revealed that there is a significant relationship between NLR and the mortality. This research is in accordance with research by Alzoubi & Khanfar (2022) and [Zhang et al., \(2025\)](#), which shows that NLR was significantly associated with increased mortality risk in pneumonia patients. Another study suggested that serial NLR measurement rather than a single assessment is recommended to better predict prognosis and monitor early treatment response ([Lee et al., 2021](#)). However, the finding is in contrast to a study by ([Tekin et al., 2024](#)) which revealed that NLR is less specific in predicting the mortality in patients with pneumonia.

Systemic inflammation increases neutrophil counts and decreases lymphocyte counts, resulting in an elevated NLR. This dysregulated immune response promotes tissue damage, organ dysfunction, and susceptibility to secondary infections, thereby contributing to poor clinical outcomes and increased mortality (Russell et al., 2019). The neutrophil-to-lymphocyte ratio (NLR) is a readily available biomarker of systemic inflammation that reflects the balance between innate and adaptive immune responses. An elevated NLR has been associated with greater disease severity and poor clinical outcomes, including

mortality. According to research by ([En Masrika et al., 2022](#)), the average NLR value was elevated, which was associated with a higher risk of severe clinical manifestations related to comorbidities and advanced age. These factors may contribute to reduced immune system effectiveness against infection (Kastilong et al., 2018).

The study population was predominantly characterized by the presence of comorbidities (77.8%), a mean age of 54 years, and a higher proportion of male patients (71.4%), all of which are recognized factors associated with poorer outcomes in pneumonia, and the majority of respondents died within ≤ 48 hours after entering the ICU (77.8%).

This research was conducted on patients who predominantly had comorbidities. If researchers only took patients who did not have comorbidities, then the sample used would not represent the research results. As a result, this factor becomes a confounder because it makes it possible that the worsening condition of pneumonia patients seen from their medical records is not purely due to their pneumonia. However, to anticipate the large number of confounding factors, the researchers took a sample of ICU patients who had not been given any treatment.

As a health worker, knowledge about the value of the Neutrophil Lymphocyte Ratio (NLR) in pneumonia patients is essential in the nursing field because it can provide additional information to identify patients who may require more intensive monitoring and treatment, and can provide clues about disease progression and potential mortality in pneumonia patients ([Torres & Cillo, 2021](#)). According to the Indonesian National Nurses Association (INNA), nurses are responsible to monitor laboratory results by identifying laboratory tests, monitoring laboratory results, and checking the suitability of laboratory results with the patient's clinical appearance ([TIM Pokja PPNL, 2018](#)). Apart from that, nurses take blood samples, interpret, and collaborate with doctors regarding patient laboratory results.

CONCLUSION

The results showed a significant negative correlation between NLR and the level of consciousness, which a higher NLR value (>3.13) was associated with a lower GCS score. Similarly, there was a significant correlation between NLR and patients' mortality. The average NLR in this study was 3.67, higher than the normal value of ≤ 3.13 . Overall, the study suggested that NLR may serve as a predictor of poor outcomes in pneumonia patients. This study highlight the importance of improving nurses' monitoring to NLR value for patients in ICU as it can be used for early identification of patients' worsening conditions. Continuous monitoring and prompt reporting of abnormal NLR levels can support timely medical interventions, prevent deterioration, and improve patient outcomes. Furthermore, integrating NLR as part of routine nursing monitoring may strengthen evidence-based practice and decision-making in the management patients with pneumonia in the Intensive Care Units.

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AUTHOR CONTRIBUTION

RH : Conceptualization, Methodology, Data Curation, Writing –Original Draft.
LF : Investigation, Project Administration, Writing –Original Draft.
RAY : Data Curation, Formal Analysis, Writing –Original Draft.
BS : Writing –Review & Editing, Final Approval of the Manuscript.

ETHICAL APPROVAL AND CONSENT

This research has received ethical approval from the Ethics Commission of the Faculty of Nursing, Jember University, with number 2136/UN25.1.14/SP/2024, permission from LP2M, Bangkesbangpol, to retrieve medical record data from the medical records section of the Intensive Care Unit at Jember Pulmonary Hospital. The study has also been registered with the Indonesia Clinical Research Registry

(INA-CRR) by the number INA- 4D9C1E5. Patient confidentiality was maintained by anonymizing all data prior to analysis.

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CONFLICT OF INTEREST

The authors hereby declare that there's no conflict of interest in this study, either to any institutions or individuals

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study were obtained from the medical records of Jember Pulmonary Hospital. Due to ethical and privacy restrictions related to patient confidentiality, the data are not publicly available. De-identified data may be made available from the corresponding author upon reasonable request and with permission from Jember Pulmonary Hospital and the institutional ethics committee.

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