

Description of Patient Demographic Characteristics and Mortality of Pediatric Sepsis Patients

Kartini Marpaung¹, Aridamuriany D. Lubis², Winra Pratita³

^{1,2,3}Department of Pediatrics, Faculty of Medicine, Universitas Sumatera Utara, Medan, Indonesia
Email: kartinimarpaung@students.usu.ac.id

ABSTRACT

Sepsis in children is a health problem associated with high morbidity and mortality. Lactate levels are a biomarker used to assess perfusion disorders and risk stratification in sepsis patients. However, evidence regarding the relationship between lactate levels and mortality in pediatric sepsis patients in Indonesia is still limited. This study aims to determine the demographic, clinical, and laboratory characteristics, mortality, and the relationship between lactate levels and mortality in pediatric patients with sepsis in the Pediatric Intensive Care Unit (PICU) of Haji Adam Malik General Hospital, Medan. The study used a descriptive quantitative design in the PICU. The population included pediatric patients with sepsis who were admitted from January 2023 to February 2024. The sample was selected using sequential sampling based on inclusion and exclusion criteria, with 101 patients. Data were obtained from medical records and analyzed descriptively and the relationship between lactate levels and mortality. Of the 157 patients, 101 met the study criteria. The majority were female (57.4%) and had normal nutritional status (39.6%). Respiratory distress was the most common indication for PICU admission (50.5%). The median length of stay was 5 days (1–79 days). A total of 72 patients (71.3%) died. The mean lactate level was 27.15 ± 26.12 mg/dL with a median of 20.2 mg/dL (4–166.5 mg/dL). The median lactate level in deceased patients was higher than in survivors (25.1 vs. 11.9 mg/dL; $p < 0.001$). A cut-off of 18.1 mg/dL had a sensitivity of 68.1%, a specificity of 86.2%, a positive predictive value of 92.6%, and a negative predictive value of 53.1%. Mortality was high. Higher lactate levels can be considered a biomarker to help stratify mortality risk.

Keywords: pediatric sepsis, mortality, demographic characteristics, PICU, nutritional status

INTRODUCTION

Sepsis is a clinical syndrome caused by the body's dysregulated response to severe infection. Sepsis in children remains a major global health problem. Pediatric sepsis is associated with high mortality and morbidity, highlighting the importance of early diagnosis and appropriate treatment (Schlapbach et al., 2024). Global estimates of the burden of pediatric sepsis indicate an incidence of approximately 1.2 million cases annually, with mortality rates ranging from 1–5% for sepsis and 9–20% for severe sepsis. Mortality in pediatric sepsis is influenced by several factors, including disease severity, underlying risk factors, and geographical variations (Souza et al., 2021).

Pediatric sepsis remains a major global health challenge, with substantial mortality rates and persistent disparities between low- and middle-income countries (LMICs) and high-income

countries (HICs). A systematic review and meta-analysis by Assies et al. (2022) highlighted the considerable mortality burden associated with shock in children in LMICs, particularly among those with sepsis.

More recent evidence has continued to demonstrate substantial variability in pediatric sepsis outcomes across resource settings. A systematic review and meta-analysis published in 2024, which included studies from LMICs, including Indonesia, emphasized that pediatric sepsis remains a major contributor to childhood mortality and that early recognition and accurate risk stratification are essential for improving outcomes. The review also highlighted the limited availability and validation of prognostic models specifically developed for resource-constrained settings (Jordan et al., 2024). Meanwhile, the mortality rate of pediatric sepsis reported in Manado in 2020 was 35.6% (Rampengan et al., 2021). These findings indicate that pediatric sepsis remains a serious health problem in Indonesia, with relatively high mortality rates in several regions (Pudjiadi et al., 2023).

Hyperlactatemia is an important clinical finding in patients with sepsis and septic shock. Hyperlactatemia is defined as a lactate level between 18–45 mg/dL in the absence of metabolic acidosis, whereas lactic acidosis is defined as a lactate level greater than 45 mg/dL accompanied by a blood pH below 7.35 (Loomba et al., 2022). Hyperlactatemia has been reported to be significantly associated with mortality in pediatric patients with sepsis. The results of Song et al. (2024) showed that elevated serum lactate levels at ICU admission were significantly associated with an increased risk of 28-day mortality, with the risk of death increasing by 17% for every 1 mmol/L increase in lactate levels. Furthermore, serum lactate levels ≥ 2.2 mmol/L were significantly associated with an increased risk of death. These findings indicate that hyperlactatemia is significantly associated with mortality in pediatric patients with sepsis and that serum lactate levels can be used as a prognostic indicator to identify children with sepsis who are at higher risk of death.

Although lactate levels have been shown to be associated with mortality in pediatric sepsis patients, evidence regarding the ability of lactate levels to predict mortality in the Indonesian pediatric population with sepsis remains limited. The optimal lactate cut-off value for identifying patients at high risk of death has not been validated specifically in the Indonesian population. This situation highlights the need to evaluate the prognostic value of lactate levels in the context of Indonesian healthcare. Differences in patient characteristics, source of infection, disease severity, and availability of healthcare resources can influence the prognostic value of a biomarker. Research results from other countries or populations may not be directly

applicable to pediatric sepsis patients in Indonesia. Local research is needed to generate evidence that is more tailored to the characteristics of the population and healthcare conditions in Indonesia.

The novelty of this study lies in evaluating the ability of lactate levels at ICU admission as a predictor of mortality in pediatric patients with sepsis in Indonesia and determining the optimal cut-off value through ROC and AUC analyses. This study not only assesses the relationship between lactate levels and mortality but also evaluates the discriminatory ability of lactate levels in identifying patients at high risk of death. Determining a local cut-off is expected to provide more appropriate prognostic value than using cut-offs derived from different populations. Furthermore, the results can provide empirical evidence regarding the sensitivity and specificity of lactate levels in predicting mortality. Thus, this study has the potential to support the use of lactate levels as a simple, rapid, and applicable indicator for risk stratification in pediatric patients with sepsis in Indonesia.

Therefore, this study aims to determine the demographic characteristics of pediatric sepsis patients treated in the Pediatric Intensive Care Unit (PICU) of Haji Adam Malik General Hospital, Medan.

METHODS

This study is a quantitative study using a descriptive quantitative design. It was conducted in the Pediatric Intensive Care Unit (PICU) at Haji Adam Malik General Hospital in Medan from June 2024 to January 2025, with the aim of examining the demographic characteristics and mortality rates among patients with sepsis. The population for this study consisted of all pediatric sepsis patients admitted to the Pediatric Intensive Care Unit (PICU) from January 2023 to February 2024.

The sample for this study was drawn from the accessible population that met the inclusion criteria and did not meet the exclusion criteria, including: age 0 to 18 years, sepsis patients, having complete medical records, patients admitted to the Pediatric Intensive Care Unit (PICU), and having clear discharge notes. The sample was obtained using sequential sampling. Based on the sample size calculation formula, the minimum required sample size was 101 patients. The inclusion criteria were pediatric sepsis patients who underwent lactate testing within <24 hours of admission to the Pediatric Intensive Care Unit (PICU).

The data collection instrument used in this study was a questionnaire covering demographic characteristics and mortality rates in pediatric sepsis patients. The questionnaire was developed by the researcher and tailored to the case study. After data collection, the data was processed using descriptive statistical analysis to see the frequency distribution, median, mean, standard deviation, minimum value, and maximum value which were presented in tabular form.

RESULTS

The results of the data analysis obtained in this study are presented systematically in the form of tables and narrative descriptions to provide a clearer picture of the characteristics of the respondents, the distribution of each research variable, and the results of the analysis of the relationships between the variables. The presentation of these research results is described in detail in the tables and narrative as follows:

Table 1. Demographic Characteristics of Pediatric Sepsis Patients

Demographic Characteristics	f	%
Gender		
Male	43	42.6
Female	58	57.4
Nutritional status		
Normal Nutrition	40	39.6
Moderate Malnutrition	32	31.7
Severe Malnutrition	28	27.7
Obesity	1	1.0
Indications for PICU Admission		
Respiratory	51	50.5
Cardiovascular	9	8.9
Central Nervous System	20	19.8
Shock	10	9.9
Postoperative	11	10.9
Referral Status		
Non-Referral	55	54.5
Referral	46	45.5
Length of stay in PICU		
Median (Min-Max)	5	1-79
Outcome		
Died	72	71.3
Survived	29	28.7

In this study, there were 157 pediatric sepsis patients treated in the Pediatric Intensive Care Unit (PICU). A total of 101 patients who met the inclusion and exclusion criteria were included in the final analysis. Based on gender distribution, the majority of patients were female, accounting for 58 patients (57.4%), while 43 patients (42.6%) were male. In terms of nutritional

status, most patients had normal nutritional status, accounting for 40 patients (39.6%). This was followed by moderate malnutrition in 32 patients (31.7%) and severe malnutrition in 28 patients (27.7%). Obesity was observed in only 1 patient (1%).

Regarding the indications for PICU admission, respiratory disorders were the most common indication, found in 51 patients (50.5%). This was followed by central nervous system disorders in 20 patients (19.8%), postoperative conditions in 11 patients (10.9%), shock in 10 patients (9.9%), and cardiovascular disorders in 9 patients (8.9%). Based on referral status, most patients were non-referral cases, accounting for 55 patients (54.5%), while 46 patients (45.5%) were referred from other healthcare facilities. The median length of stay in the PICU was 5 days, with a range from 1 to 79 days. Regarding patient outcomes, the majority of patients died, accounting for 72 patients (71.3%), while 29 patients (28.7%) survived.

Table 2. Laboratory Characteristics of Pediatric Sepsis Patients

Laboratory Characteristics	Mean $\pm$ SD	Median (Min - Max)
Lactate, mg/dL	27.15 $\pm$ 26.12	20.2 (4-166.5)
Hemoglobin, g/dL	9.9 $\pm$ 2.67	9.6 (2.3-22.8)
Hematocrit, %	30.73 $\pm$ 8.73	30.1 (5.2-75.8)
Leukocyte count ($\times 10^3/\mu\text{L}$)	17.15 $\pm$ 9.83	13.59 (1.67-40.83)
Platelet count ($\times 10^3/\mu\text{L}$)	293.63 $\pm$ 192.7	291 (13-1080)

The laboratory characteristics of the study subjects are presented in Table 2. The mean lactate level was 27.15 $\pm$ 26.12 mg/dL, with a median value of 20.2 mg/dL (range 4–166.5 mg/dL). The mean hemoglobin level was 9.9 $\pm$ 2.67 g/dL with a median of 9.6 g/dL (2.3–22.8 g/dL). The mean hematocrit value was 30.73 $\pm$ 8.73%, while the mean leukocyte count was 17.15 $\pm$ 9.83 $\times 10^3/\mu\text{L}$. The mean platelet count was 293.63 $\pm$ 192.7 $\times 10^3/\mu\text{L}$ with a median value of 291 $\times 10^3/\mu\text{L}$ (13–1080 $\times 10^3/\mu\text{L}$).

DISCUSSION

Data collection was carried out using medical records of pediatric sepsis patients treated in the Pediatric Intensive Care Unit (PICU). Based on an analysis of 101 subjects, the majority were female. Statistical analysis showed that there was no significant association between gender and mortality. A study conducted by Song et al. in China reported that male patients were more predominant among pediatric sepsis cases (Song et al., 2024).

In this study, most pediatric sepsis patients had respiratory tract diseases as the principal diagnosis. This finding is consistent with a study conducted by Abdelaziz et al. (2024), which reported that pneumonia was the most common diagnosis among pediatric sepsis patients

treated in the PICU at the University Children's Hospital. Similarly, a study by (Çeleğin & Çeleğin, 2022) investigated the relationship between vasoactive-inotropic score and early lactate clearance in children with septic shock, highlighting the potential prognostic value of lactate clearance and its association with clinical outcomes and mortality.

The majority of pediatric sepsis patients admitted to the pediatric intensive care unit in this study died. This mortality rate was higher than that reported for pediatric sepsis patients in the same unit at Dr. Cipto Mangunkusumo Hospital (Meliani & Siregar, 2024). Yuniar et al. (2022) reported that pediatric septic shock is associated with a substantial risk of mortality, as impaired tissue perfusion may lead to dysfunction or failure of vital organs, including the kidneys, lungs, liver, brain, and heart.

These findings differ from a study conducted in the United States by Yue et al. (2022) which reported a relatively lower mortality rate of 16% among pediatric sepsis patients. The high mortality observed among pediatric sepsis patients in an Indonesian tertiary-care PICU underscores the substantial burden of this condition and the importance of early recognition and appropriate clinical management. A retrospective study conducted in Indonesia reported substantial mortality among children with sepsis, with mortality associated with fluid overload, mechanical ventilation, vasoactive drug use, and congenital anomalies (Rusmawatiningsih et al., 2021).

Based on the characteristics of the research subjects according to outcomes, among the 72 pediatric sepsis patients who died, females were more common, accounting for 40 patients (55.6%). However, statistical analysis showed that there was no significant association between gender and mortality. This finding is consistent with the study conducted by Kennedy et al. (2025), which also reported no significant relationship between gender and mortality.

In this study, the median lactate level in the group of patients who died was significantly higher than that in the survivor group. This finding is consistent with a study conducted by Alam and Gupta (2020), which showed that lactate levels tended to be higher in the group of patients who died compared to survivors.

In this study, elevated lactate levels demonstrated high specificity and positive predictive value as a predictor of mortality in pediatric sepsis patients, despite moderate sensitivity and lower negative predictive value. A study conducted by Alam & Gupta (2020) demonstrated that higher lactate levels were associated with increased early mortality among children with severe sepsis. Lactate levels measured several hours after admission showed better predictive

performance than initial lactate levels, highlighting the potential value of serial lactate monitoring for mortality risk assessment.

In this study, nearly half of the patients were referred from other hospitals, with the vast majority of them dying. However, statistical analysis revealed no significant association between referral status and mortality. This lack of significance may be explained by the similarly high mortality rate observed among non-referral patients.

The median lactate level among referral patients was lower than that of non-referral patients. This may be due to referral patients having previously received fluid resuscitation before admission to the PICU, which may have improved tissue perfusion and reduced the level of hyperlactatemia. A study conducted by Moustafa et al. (2021) reported that lactate levels measured 6 hours after PICU admission were lower than the initial lactate levels after treatment was administered.

Lactate clearance refers to the percentage reduction in lactate levels after early resuscitation and is considered a useful indicator for predicting mortality. A study conducted by Choudhary et al. (2021) reported that decreased lactate clearance was associated with higher mortality rates. One limitation of the present study is that lactate clearance could not be evaluated because serial lactate measurements were not routinely performed.

LIMITATION

One limitation of this study is that data regarding previous fluid resuscitation or medications administered prior to PICU admission were not recorded. These factors may influence lactate levels measured upon admission to the PICU of Haji Adam Malik General Hospital, Medan.

CONCLUSION

Among 157 pediatric sepsis patients treated in the Pediatric Intensive Care Unit (PICU) of Haji Adam Malik Hospital from January 2023 to February 2024, a total of 101 patients met the inclusion and exclusion criteria and were included in this study. Most patients were female (57.4%) with a median age of 2 years. The majority of patients had normal nutritional status (39.6%), while the proportions of moderate malnutrition (31.7%) and severe malnutrition (27.7%) were higher than obesity (1%). Respiratory disorders were the most common indication for PICU admission (50.5%), followed by central nervous system disorders (19.8%). The mortality rate of pediatric sepsis patients in this study was high, accounting for 71.3% of

cases. Higher lactate levels were significantly associated with mortality in pediatric sepsis patients.

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