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The Platelet-To-Albumin Ratio and the Mean Platelet Volume-To-Albumin Ratio as Predictors of Disease Severity and Mortality in Pediatric Sepsis Patients

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Abstract

Pediatric sepsis remains a critical emergency condition with high morbidity and mortality rates, particularly in low- and middle-income countries. Early identification of patients at risk of severe outcomes is essential to guide timely interventions. This study aimed to evaluate the prognostic value of Platelet-to-Albumin Ratio (PAR) and Mean Platelet Volume-to-Albumin Ratio (MAR) in predicting disease severity and 7-day mortality among pediatric sepsis patients in the emergency room. A retrospective observational study was conducted on 101 pediatric patients admitted to Dr. Soetomo Hospital, Surabaya, from January 2020 to January 2025. PAR and MAR were measured on days 1, 3, and 5, and severity was assessed using PELOD-2 scores. Statistical analyses included ROC curves, Spearman correlations, and Kruskal–Wallis tests. Results demonstrated that MAR consistently showed superior predictive performance compared to PAR, with AUC values improving from 0.711 on day 1 to 0.905 on day 5, and significant correlations with PELOD-2 scores ($p<0.001$). PAR showed limited and inconsistent predictive ability. The findings indicate that MAR is a reliable and practical biomarker for early risk stratification and monitoring of pediatric sepsis severity. Future research should validate MAR in multicenter prospective studies and explore its integration with clinical scoring systems for enhanced prognostic accuracy.

INTRODUCTION

Pediatric sepsis is still a significant global health problem with high morbidity and mortality rates, especially in developing countries including Indonesia. Sepsis is defined as a life-threatening organ dysfunction due to the body's uncontrolled response to infection. This condition can quickly develop into septic shock, multiorgan failure, and death. Globally, sepsis in children is estimated to cause more than 3 million deaths each year, with the greatest burden on low- and middle-income countries due to limited facilities, delays in diagnosis, and management (Jordan et al., 2024; Weiss et al., 2020).

In Indonesia, epidemiological data are still limited, but reports from various referral hospitals show high incidence and mortality rates. Studies in tertiary hospitals report that about 19–20% of pediatric patients treated have sepsis, with a mortality rate of more than 50%. Observational studies in the 2014–2015 period at Dr. Soetomo Surabaya Hospital also showed that sepsis was the most common diagnosis in pediatric intensive care units, with mortality above 50%. The high number confirms that pediatric sepsis is still a major clinical challenge, so fast, simple, and accurate early prediction methods are needed to aid clinical decision-making (Pudjiadi et al., 2023; Putu et al., 2020; Prathama et al., 2025; Yuniar et al., 2025).

The assessment of the severity of sepsis in children has generally used a clinical approach and organ dysfunction score such as Pediatric Logistic Organ Dysfunction-2 (PELOD-2). Despite having good accuracy, the use of these scores is relatively complex because it requires a wide range of clinical and laboratory parameters that are not always

readily available, particularly in emergency departments. Therefore, alternative biomarkers that are simpler, cheaper, and easier to obtain from routine laboratory examinations are needed (Yuliarto et al., 2023).

Hematological parameters such as platelets, mean platelet volume (MPV), and albumin have been extensively studied in relation to the prognosis of sepsis (Colleti et al., 2024; Hilarius et al., 2020; Miranda & Nadel, 2023). Platelets play a role not only in hemostasis but also in the immune and inflammatory responses (Esposito et al., 2025). In sepsis, thrombocytopenia occurs due to coagulation activation, excessive consumption, and platelet destruction, which is often associated with increased mortality. Meanwhile, MPV reflects platelet size and activity; an increase in MPV indicates more metabolically active platelets and procoagulants, which are associated with the degree of inflammation and severity of the disease (Lestari et al., 2022).

Albumin is the main plasma protein that has an important function in maintaining oncotic pressure and molecular transport, as well as anti-inflammatory and antioxidant effects. In sepsis, hypoalbuminemia often occurs due to increased capillary permeability, decreased liver synthesis, and increased catabolism (Dimitrijević et al., 2025; Shen & Jiang, 2021; Wang et al., 2025). Low albumin levels correlate with the degree of inflammation and organ dysfunction, as well as an increased risk of death (Kumar et al., 2024).

In recent years, the approach of using biomarker ratios has begun to evolve, as it is considered to better reflect the balance between inflammatory processes, coagulation, and the metabolic status of patients (Ong et al., 2024; Veling et al., 2024). The combination of hematological parameters with albumin, such as platelet-to-albumin ratio (PAR) and mean platelet volume-to-albumin ratio (MAR), shows potential as a prognostic indicator in adult sepsis patients. This ratio is considered more representative than a single parameter because it integrates two important aspects, namely the inflammatory response and nutritional/metabolic conditions (Bafna et al., 2025; Le et al., 2024).

In the pediatric population, research on this ratio is still limited. Some studies have shown that ratio-based parameters, such as lactate-to-albumin ratio (LAR) and MAR, have the ability to predict mortality in pediatric patients with sepsis (Karmila et al., 2022; Rovas et al., 2021). However, specific data on PAR and MAR in pediatric populations, especially in Indonesia, are still very limited. In fact, these two parameters can be easily obtained from routine laboratory examinations at no additional cost, so they have the potential to be a practical prediction tool in health care facilities with limited resources (Lee et al., 2024).

Based on this description, this study was conducted to analyze the role of PAR and MAR as predictors of severity and mortality in pediatric sepsis patients. In addition, this study also aims to determine the optimal cut-off value and diagnostic accuracy of the two parameters, so that it can contribute to the development of simpler, faster, and more economical risk stratification strategies in clinical practice.

This study focuses on evaluating the ability of the platelet-to-albumin ratio (PAR) and the mean platelet volume-to-albumin ratio (MAR), measured at the time of patient admission to the Emergency Department (ED), as predictors of disease severity and mortality in pediatric sepsis patients over a 7-day observation period. Specifically, this study examines whether PAR at admission can be used to predict disease severity and the risk of death, and assesses whether MAR has the same ability to predict severity and mortality over the 7-day treatment period. In addition, this study evaluates whether the cut-off values of PAR and MAR can be used optimally as predictive tools for determining the severity and mortality of pediatric sepsis patients.

In general, the aim of this study is to analyze the role of PAR and MAR as predictive biomarkers of severity and mortality in pediatric sepsis patients presenting to the ED. Specifically, this study aims to analyze the relationship between PAR and the severity of pediatric sepsis over 7 days of treatment, to analyze the relationship between MAR and the

severity and mortality of pediatric sepsis patients over the same period, and to determine the optimal cut-off value and diagnostic accuracy of PAR and MAR in predicting the severity and mortality of pediatric sepsis during the 7-day observation period

RESEARCH METHODS

Types and Design of Research

Design of an *observational retrospective* study of pediatric patients with a diagnosis of sepsis in the ER. In this context, the study was conducted to assess the predictors of platelet to albumin ratio and mean platelet volume to albumin ratio in predicting severity and mortality in pediatric sepsis in the ER. The materials and data sources of this study were obtained from the medical records of patients who entered the emergency room of the hospital. Dr. Soetomo.

Place and Time of Research

Research place

This research was conducted at the emergency room of Derah Dr Soetomo General Hospital, Surabaya.

Location and time of the study

This research was carried out within 1 month after the proposal was approved and received an Ethical *Clearance* from the Research Ethics Committee at Derah Dr Soetomo General Hospital, Surabaya.

Sample Size and Sampling Techniques

The sampling technique in this study was carried out by ***the consecutive sampling method***, namely all pediatric patients who came to the emergency room with a diagnosis of sepsis or suspected sepsis and met the inclusion-exclusion criteria will be immediately recruited sequentially during the study period until the number of samples is met. The target population is all pediatric patients (≤18 years old) who were treated with sepsis at the emergency room of the Dr. Soetomo Regional General Hospital, Surabaya from January 2020 – January 2025. The study sample was an affordable population that met the admission criteria and did not meet the rejection criteria. The research began after the researcher obtained ethical feasibility from the Research Ethics Committee of the Faculty of Medicine, Airlangga University, Surabaya.

Data Collection Procedure

Tools and materials used

1. Medical records: Medical records of pediatric sepsis patients who come to the emergency room of the hospital. Dr. Soetomo from January 2020-January 2025.
2. Table of patient data, patient characteristics and type of variables.

Research procedure

1. Assessment of pediatric patients with a diagnosis of sepsis with PELOD assessment of scores entered in the emergency room of the hospital. Dr. Soetomo Surabaya who meets the inclusion and exclusion criteria.
2. Complete blood laboratory tests to see platelet values, *mean platelet volume* and albumin at the time of arrival in the emergency room (H-0), in-room and NICU (H-1) and treatment (H-7).
3. Ideal target: **within 0–1 hours** from presentation; maximum **allowed ≤ 6 hours** from arrival with recorded pickup time.
4. Patient outcomes were assessed in the form of severity and mortality or survival during treatment until day 7.

Approval & documentation

Record the time of arrival, the time of the blood draw, the status of the initial therapy (fluids, antibiotics) and whether the patient has received a transfusion before collection.

Research Variables

Inclusion criteria

1. Pediatric patients (1 month-18 years old) diagnosed with sepsis based on the PELOD score criteria.
2. Patients who are admitted to the Emergency Department (IGD) with signs of infection and organ dysfunction (e.g. hypotension, tachycardia, tachypnea, perfusion disorders).
3. Have the results of platelet count, *mean platelet volume* (MPV), and serum albumin in the first 24 hours after entering the emergency room.
4. Data collection through medical records with a period from June 2020-June 2025.

Exclusion criteria

1. Patients with chronic diseases that can affect platelet count and albumin levels, such as: Chronic liver disease (cirrhosis, chronic hepatitis). End-stage kidney disease (CKD stage 5, severe nephrotic syndrome). Autoimmune diseases that affect the hematological system (e.g. lupus, ITP).
2. Patients with severe coagulation disorders or are undergoing anticoagulant therapy that may affect *platelet count* and MPV.
3. Patients with severe hypoalbuminemia due to chronic malnutrition or severe gastrointestinal disease.
4. Patients who died within <24 hours of entering the ER without having time to undergo a complete laboratory examination.
5. Laboratory data is incomplete or the quality of blood samples is poor.

Drop-out *criteria*

The patient died.

Independent Variables

1. *Platelet-to-Albumin Ratio* (PAR)
2. *Mean Platelet Volume-to-Albumin Ratio* (MAR)

Bound Variables

1. Morbidity in pediatric sepsis patients (e.g., length of hospitalization, use of mechanical ventilators, multiple organ dysfunction).
2. Mortality in pediatric sepsis patients (death during hospital treatment).

Table 1 Research variables

No.	Variable	Variable Type
1.	Platelet-to-Albumin Ratio (PAR)	Independent
2.	Mean Platelet Volume-to-Albumin Ratio (MAR)	Independent
3.	28-Day Mortality Predictor	Dependency
4.	Age	Covariate
5.	Gender	Covariate
6.	Comorbid Diseases	Covariate
7.	Pediatric Logistic Organ Dysfunction *(PELOD-2)* Score	Covariate
8.	Diagnosis	Covariate

RESEARCH RESULTS

Difference in Serial Profile of Laboratory Parameters (Platelets, Albumin, MPV, PAR, and MAR) on Days I–V of the Care of Pediatric Patients with Sepsis between Deceased and Living Patients

On Day I, platelet count showed no significant difference between the two groups (p=0.793), indicating that in the early phase, platelet consumption was not sensitive enough to distinguish clinical outcomes. Interestingly, this parameter is presented in the form of a median, which indicates that the distribution of platelet data on Day I is abnormal (skewed), possibly

due to extreme values, either very low or very high, in some patients. This condition is prevalent in the early phase of sepsis, where the hemostasis response is still very heterogeneous, so the median is considered more representative than the mean because it is not affected by outliers.

In contrast, albumin levels on Day I showed significant differences (p=0.001), with lower values in the deceased group, reflecting a more severe degree of capillary leakage and endothelial dysfunction from the start. MPV did not differ significantly (p=0.263), indicating that the bone marrow compensation response in the initial phase was relatively similar. Ratio parameters such as PAR (p=0.048) and especially MAR (p<0.001) already showed significant differences, indicating that integrative parameters are more sensitive in detecting severity than single parameters.

On Day III, a clearer divergence began to be seen between the two groups. Platelets showed a lower tendency in the deceased group, although not yet significant (p=0.073), while albumin remained significantly different (p<0.001), confirming that persistent hypoalbuminemia was related to poor outcomes. MPV began to show significant differences (p=0.019), which may reflect impaired platelet production or bone marrow fatigue in the deceased group. The PAR did not differ significantly (p=0.399), but the MAR remained significant (p<0.001), strengthening its role as a more stable indicator.

On Day V, the differences between the groups became even clearer. The platelet count was significantly lower in the deceased group (p<0.001), indicating the progression of platelet consumption and the possible involvement of severe coagulopathy. Albumin levels remained significantly lower (p<0.001) in the deceased group, which in this table is presented in median form for several parameters due to abnormal data distribution, including albumin in certain phases. The use of the median for albumin on Day V reflects a wide variation in values with possible outliers (e.g., patients with very severe hypoalbuminemia), so the median is better able to describe the true central value than the mean. MPV, PAR, and MAR on Day V showed significant differences, with MAR remaining the most consistent parameter distinguishing the two groups.

Methodologically, the use of the mean or median in Table 5.3 is determined by the distribution of data. The median is used when the data are not normally distributed or there are significant outliers, such as Day I platelets and Day V albumin, because it is more robust in representing the central value of the population. In contrast, the mean is used for normally distributed data, as it can optimally describe general trends and variations in the data. This is also in line with the selection of statistical tests, where the Mann–Whitney test is used for non-normal data and the independent t-test for normal data. This approach ensures that the interpretation of results remains valid, accurate, and clinically relevant, especially in sepsis populations that have high heterogeneity and dynamic fluctuations in laboratory parameters.

PAR Accuracy Level as a Predictor of 7-Day Mortality in Sepsis Child Patients

First day treatment

Receiver *Operating Characteristic* (ROC) curve analysis was performed to assess the predictive ability of platelet-albumin ratio (PAR) on the first day of treatment in predicting 7-day mortality in pediatric sepsis patients. Of the total 101 subjects, there were 48 patients who died and 53 patients who survived in the 7-day observation period.

Based on the ROC curve analysis, the area under the curve (AUC) value was obtained of 0.614 (SE = 0.057; p = 0.048; IK 95%: 0.502–0.727). This value shows that PAR on the first day has ***a weak discriminatory ability but remains statistically significant*** in distinguishing between patients who die and those who survive. Interpretively, an AUC value above 0.5 indicates better performance than random guessing, but because it has not yet reached the 0.7 threshold, its clinical accuracy is still limited. In addition, the wide confidence interval approaching the value of 0.5 reflects the presence of ***variability and uncertainty of the***

estimate, which may be influenced by population heterogeneity and the distribution of PAR values in the early stages of sepsis.

The direction of the relationship suggests that higher PAR values correlate with an increased risk of mortality. This is in line with the pathophysiological basis of sepsis, where an increase in PAR reflects a combination of decreased albumin due to capillary leak and hepatic dysfunction as well as platelet changes as part of coagulation activation and systemic inflammation. This condition describes a higher degree of endothelial dysfunction and severity of the inflammatory response, which is clinically associated with progressivity toward multi-organ dysfunction and worse outcomes.

However, the low AUC value suggests that the use of PAR on the first day as a single parameter is not strong enough to be used as a reliable clinical prediction tool. This can be explained by the fact that in the early stages of sepsis, the patient's physiological response is still very dynamic and does not yet fully reflect the final degree of severity. In other words, the PAR value on the first day is more reflective of the initial conditions that are still fluctuating, so that the sensitivity and specificity in predicting mortality are still limited.

Based on the curve analysis, the optimal *cut-off* value of the first day of PAR was ***90311.29*** (Figure 5.2). This value is the best point in balancing sensitivity and specificity to predict mortality. However, given the low AUC value, the use of these *cut-offs* in clinical practice should be done with caution and should not be used as the sole basis for decision-making, but rather in combination with other clinical parameters and biomarkers in a multimodal approach.

Overall, these findings confirm that although first-day PAR has an initial prognostic value, its accuracy is still limited, so serial monitoring and integration with other parameters within the modern sepsis management framework are of great importance, particularly in anesthesia and intensive care settings.

Third day treatment

Based on the analysis of the ROC curve to assess the ability *of the Platelet-Albumin* Ratio (PAR) on the third day of treatment in predicting 7-day mortality in pediatric sepsis patients, an *area under the curve* (AUC) value of 0.549 was obtained (SE = 0.058; p = 0.399; IK 95%: 0.435–0.662). This value shows that the discriminating ability of PAR on the third day is very close to the value of 0.5, which is conceptually equivalent to a random guess, and does not show statistical significance.

Clinically, these findings indicate that PAR on day three lacked a meaningful predictive ability to distinguish between patients who died and those who survived within a 7-day period. The wide confidence interval and including a value of 0.5 further confirms that the performance of this parameter is unstable and has a high level of uncertainty. In other words, the PAR value on the third day was neither sensitive nor specific enough to be used as a reliable prognostic indicator.

This phenomenon can be explained from the point of view of the pathophysiology of sepsis, where on the third day the patient is generally in a dynamic phase between the initial inflammatory response and the compensatory or progressive phase of the disease. In this phase, platelet and albumin values can be affected by various clinical interventions such as fluid resuscitation, antibiotic therapy, nutritional support, and other supportive therapies, so that the PAR ratio becomes less reflective of the actual biological condition. In addition, the variability of an individual's response to therapy also contributes to the low discriminating ability of this parameter.

In line with these results, because the AUC value did not differ significantly from 0.5 ($p > 0.05$), further **analysis to determine the optimal** *cut-off* was not performed. Methodologically, the determination of threshold values is only relevant if a parameter shows

adequate discriminating ability. In this condition, the use of *cut-offs* has the potential to be clinically misleading because it is not supported by sufficient predictive power.

Thus, PAR on the third day cannot be recommended as a prognostic parameter for predicting short-term mortality in pediatric sepsis patients. These findings confirm that the value of a single biomarker at a given point in time, particularly in the intermediate phase of the disease, has limitations, so a more comprehensive approach through serial monitoring and integration with clinical parameters as well as other biomarkers remains necessary in anesthesia and intensive care practices.

Fifth day treatment

ROC curve analysis was performed to assess the predictive ability of *the Platelet-Albumin Ratio* (PAR) on the fifth day of treatment in predicting 7-day mortality in pediatric sepsis patients. Of the total 101 patients, there were 48 patients who died and 53 patients who survived during the observation period.

Based on the results of the analysis, the value of the area under the curve (AUC) was obtained of 0.615 (SE = 0.056; p = 0.046; IK 95%: 0.505–0.725). This value shows that PAR on the fifth day has a weak but statistically significant discriminating ability in distinguishing mortality outcomes. Interpretively, although the AUC value is higher than 0.5 and statistically significant, it has not yet reached the optimal threshold of clinical accuracy (AUC ≥ 0.7), so its use as a single parameter is still limited. Confidence intervals close to the lower limit of 0.5 also indicate a fairly high **estimation uncertainty**, reflecting the variability of clinical responses in pediatric sepsis populations.

Interestingly, the direction of the association on day five showed that lower PAR values correlated with an increased risk of mortality, which was different from the pattern on day one. Pathophysiologically, these findings can be explained by the dynamics of the progression of severe sepsis, where in the advanced phase there is a more dominant and progressive decrease in platelets due to peripheral consumption and production disorders, while albumin levels remain low due to persistent capillary leakage. In the group that died, platelets tended to decline significantly without adequate compensation, resulting in lower PAR values. In contrast, patients who survived showed a better tendency to platelet recovery, so the PAR value was relatively higher even though albumin levels were not completely normal.

These findings confirm that the interpretation of PAR is *time-dependent*, where its clinical meaning can change the phase of the disease course. In the advanced phase (day five), PAR is more reflective of hemostasis compensation failure than just the degree of initial inflammation, so that a decrease in PAR value is actually a worse prognosis indicator.

However, with the AUC value still in the weak category, the use of the fifth day PAR as a single predictor still has limitations. Therefore, in anesthesia and intensive care practice, these parameters should be used as part of a multimodal approach that includes serial monitoring of other laboratory parameters, such as platelet, albumin, MPV trends, as well as integration with clinical parameters and prognostic scores.

Based on the curve analysis, the optimal *cut-off* value of the fifth day of PAR was 88290.04 (Figure 5.5). This value is the best point in balancing sensitivity and specificity, but its interpretation must still be done with caution given the limitations of discriminatory accuracy.

Overall, these results show that PAR on day five has a more meaningful prognostic value than day three, but is still not strong enough to be used independently, thus confirming the importance of a serial and integrative approach in risk stratification of pediatric sepsis patients in *critical care settings*.

MAR Accuracy Level as a Predictor of 7-Day Mortality in Sepsis Child Patients

First day treatment

ROC curve analysis was conducted to assess the predictive ability *of Mean Platelet Volume to Albumin Ratio* **(MAR)** on the first day of treatment in predicting 7-day mortality in pediatric sepsis patients. Of the total 101 patients, there were 48 patients who died and 53 patients who survived during the observation period.

Based on the results of the ROC curve analysis (Figure 5.6), the area under the curve (AUC) value was **0.711** (SE = 0.051; $p < 0.001$; IC 95%: 0.611–0.811). This value indicates that MAR on the first day has the **ability to discriminate in the moderate and statistically significant categories**, and has exceeded the minimum limit of clinical relevance (AUC ≥ 0.7). Confidence intervals that do not include a value of 0.5 indicate that the predictive performance of MAR is fairly stable and consistent in distinguishing between patients at risk of death and those who survive.

The association's direction suggests that higher MAR values correlate with an increased risk of mortality. Pathophysiologically, this reflects the interaction between two main components, namely MPV as an indicator of platelet activity and size, and albumin as a marker of oncotic status and degree of systemic inflammation. In patients with severe sepsis, significant hypoalbuminemia due to capillary leakage and hepatic dysfunction will decrease the denominator value, while a relatively inadequately increased MPV—or even decreased due to bone marrow fatigue—will cause the MAR ratio to increase. This condition reflects severe endothelial dysfunction, hemostasis disorders, as well as hematopoietic compensatory failure, which is clinically correlated with a poorer prognosis.

Compared to PAR on the first day which only showed weak discriminating ability, MAR appeared to have a superior prognostic value in the early phase of sepsis, because it was able to integrate aspects of inflammation, nutritional status, and hematopoietic response in one parameter. This makes MAR a more sensitive biomarker in detecting severity from the beginning of treatment.

Based on the curve analysis, the optimal *cut-off* value of the first day of MAR was obtained of 3.048 (Figure 5.7), which is the best point in balancing sensitivity and specificity to predict mortality. These values can be used as a starting threshold in risk stratification, but they must still be interpreted in a broader clinical context.

Overall, these findings suggest that MAR on day one has the potential to be a fairly strong and practical prognostic biomarker in predicting short-term mortality in pediatric sepsis patients. In anesthesia and intensive care practices, serial use of MAR in combination with clinical parameters and other biomarkers has the potential to improve risk stratification accuracy and aid in earlier and more precise therapeutic decision-making.

Third day treatment

ROC curve analysis was conducted to assess the predictive ability *of Mean Platelet Volume to Albumin Ratio* (MAR) on the third day of treatment in predicting 7-day mortality in pediatric sepsis patients. Of the total 101 patients, there were 48 patients who died and 53 patients who survived during the observation period.

Based on the results of the ROC curve analysis, the area under the curve (AUC) value was obtained of **0.843** (SE = 0.039; $p < 0.001$; IK 95%: 0.766–0.919). This value showed that the MAR on day three had excellent and statistically significant discriminating ability, well beyond the random guess threshold (AUC = 0.5) and was in the range of strong clinical relevance for risk stratification. The confidence interval that does not include a value of 0.5 and is relatively narrow reflects the **good estimation precision and consistency of predictive performance** in this population.

The association's direction suggests that higher MAR values are strongly correlated with an increased risk of mortality. Pathophysiologically, this reflects a combination of

persistent hypoalbuminemia due to capillary leakage and endothelial dysfunction with an inadequate platelet response, either in the form of MPV that does not increase compensatory or begins to decrease due to bone marrow fatigue. In the group of patients who died, this condition resulted in higher MAR values as a reflection of vascular dysfunction and progressive hemostasis response failure. In contrast, patients who survived showed faster albumin repair accompanied by stability or increased MPV, resulting in lower MAR values.

Compared to the MAR performance on the first day (AUC = 0.711), the increase in AUC values on the third day (AUC = 0.843) suggests that **the evaluation in the dynamic phase (first 48–72 hours)** provides much stronger prognostic information than the initial measurement. This reflects that responses to initial therapies—including fluid resuscitation, infection source control, and organ support—begin to accumulate and are reflected in laboratory parameters, thereby increasing the ability to discriminate against clinical outcomes.

From the perspective of anesthesiology and intensive care, these findings are particularly relevant because they confirm that *the* three-day time window is a critical point for risk re-stratification, where failure to repair parameters such as albumin and MPV can be an early indicator of progressivity towards multi-organ dysfunction. Thus, MAR on the third day has the potential to be a powerful tool in determining the need for therapeutic intensification, such as advanced hemodynamic optimization, escalation of organ support, or re-evaluation of infection source control.

Based on the curve analysis, the optimal *cut-off* value of the third day MAR was 3.1045 (Figure 5.9), which provides the best balance between sensitivity and specificity in predicting mortality. This value has potential clinical application as a threshold in risk stratification, but it must still be interpreted contextually with other clinical parameters.

Overall, these results show that the third day MAR is the parameter with the strongest predictive performance compared to other time points, so it has strategic value in the serial monitoring approach and clinical decision-making in pediatric sepsis patients in *critical care settings*.

Fifth day treatment

ROC curve analysis was conducted to assess the predictive ability *of Mean Platelet Volume to Albumin Ratio* (MAR) on the fifth day of treatment in predicting 7-day mortality in pediatric sepsis patients. Of the total 101 patients, there were 48 patients who died and 53 patients who survived during the observation period.

Based on the results of the ROC curve analysis (Figure 5.10), the *area under the curve* (AUC) value was obtained of **0.905** (SE = 0.029; $p < 0.001$; IK 95%: 0.847–0.963). This value shows that MAR on the fifth day has a very high (*outstanding*) discriminating ability and is statistically significant in distinguishing between patients who die and those who survive. AUC values exceeding 0.90 place MAR as a biomarker with excellent clinical accuracy, while a narrow confidence interval that does not include a value of 0.5 reflects high predictive performance precision and consistency.

The association's direction suggests that higher MAR values are strongly correlated with an increased risk of mortality. Pathophysiologically, these findings reflect a clear divergence between patients with *poor outcomes* and those who survive in the advanced phase of sepsis. In the group that died, there was failure to improve vascular status and hemostasis, characterized by persistent hypoalbuminemia due to continuous capillary leakage, as well as inadequate or decreased platelet response due to bone marrow fatigue. This combination results in high MAR values as a reflection of severe endothelial dysfunction and failure of physiological adaptation. In contrast, in patients who survived, there was a more significant improvement in albumin accompanied by stabilization or increase in MPV, resulting in a lower MAR value as an indicator of physiological recovery.

These findings show a very clear discrimination between the two outcome groups on day five, which clinically represents the phase in which the response to therapy has been optimally accumulated. Thus, the MAR on the fifth day not only reflects the biological conditions at the time, but is also the result of the integration of the response to resuscitation, control of the source of infection, and organ support during the initial phase of treatment.

Longitudinally, there was a gradual increase in the predictive ability of the MAR from the first day (AUC 0.711; medium category), the third day (AUC 0.843; excellent), to the fifth day (AUC 0.905; outstanding). This pattern confirms that serial monitoring of laboratory parameters provides a much stronger prognostic value than single measurements, and highlights the importance of dynamic evaluation in the management of pediatric sepsis.

Based on the curve analysis, the optimal *cut-off* value of the fifth day MAR was 2.9985 (Figure 5.11), which provides the best balance between sensitivity and specificity. This value has potential clinical application as a risk stratification threshold with a high level of accuracy, especially in the advanced phase of treatment.

From an anesthesiology and intensive care perspective, these findings have important implications, namely that the fifth day MAR can be used as a highly reliable prognostic biomarker to identify patients at high risk of mortality, evaluate therapeutic responses, and assist in decision-making regarding intensification or escalation of management. This parameter also has practical advantages because it comes from routine laboratory examinations that are easily accessible and relatively economical.

Table 2. Value *Area Under Curve* (AUC), significance level and cut-off value of PAR and MAR on day one to day five treatment as predictors of seven-day mortality of pediatric sepsis patients

Variable	AUC	95% IK AUC	p	Cut Off *Value*
PAR Day I	0,614	0,502–0,727	0,048	90311,29
PAR Day II	0,549	0,435–0,662	0,399	-
PAR Hari III	0,615	0,505–0,725	0,046	88290,04
MAR Day I	0,711	0,611–0,811	<0.001	3,048
MAR Day II	0,843	0,766–0,919	<0.001	3,1045
MAR Day III	0,905	0,847–0,963	<0.001	2,9985

Table 5.4 presents a recapitulation of *Area Under Curve* **(AUC)** values, significance levels, and optimal *cut-off* values of the PAR and MAR parameters at various observation times as predictors of 7-day mortality in pediatric sepsis patients, allowing a longitudinal comparative evaluation of the performance of the two biomarkers.

Overall, the PAR parameters show limited discriminating ability over the entire observation time. On the first day, an AUC value of 0.614 (p=0.048) showed weak predictive ability but was still statistically significant. However, on the next day (the second day), PAR performance decreased by AUC of 0.549 (p=0.399), which was not significantly different from random guessing, making it not suitable for use as a predictor. On the third day, AUC increased again to 0.615 (p=0.046), but remained in the weak category. Overall, despite the statistical significance at some point in time, a consistent AUC value of <0.7 suggests that PAR as a single parameter has clinical limitations in reliably predicting mortality. This reflects that platelet-to-albumin ratios are not yet sensitive enough to capture the complexity of sepsis dynamics, especially in the context of rapid changes in inflammatory and hemostasis responses.

In contrast, the MAR parameter shows much superior predictive performance and is consistently progressively improving. On the first day, an AUC value of 0.711 (p<0.001) indicates good discriminating ability and has reached the threshold of clinical relevance. On the second day, the performance improved significantly with an AUC of 0.843 (p<0.001),

which was in the very good category. At its peak, on the third day, an AUC of 0.905 ($p<0.001$) was obtained, which shows outstanding discrimination ability with very high accuracy. This pattern of improvement reflects that MAR is increasingly accurate in predicting mortality over time, in line with the accumulation of physiological responses to therapy and disease progressivity.

In terms of confidence intervals, the MAR shows a range that does not include a value of 0.5 at all points in time, indicating consistency and good estimation reliability. In contrast, PAR has a confidence interval that at some point approaches or covers 0.5, which indicates uncertainty and limitations of predictive power. The optimal *cut-off* value can also only be determined on parameters with significant performance, where the MAR shows a relatively stable cut-off value (around 3.0–3.1), making it easier to apply clinically than PAR which has a very large and impractical variation in value.

From the perspective of anesthesiology and intensive care, these findings have important implications that MAR is a superior prognostic biomarker over PAR, especially in the serial monitoring approach of pediatric sepsis patients. MAR not only reflects inflammatory status and capillary leakage via albumin, but also integrates the hemostasis response via MPV, thus providing a more comprehensive picture of the degree of endothelial dysfunction and disease progressivity.

Overall, Table 5.4 confirms that dynamic approaches based on serial biomarkers, specifically MAR, have higher clinical value than single parameters or one-time measurements, and have the potential to be used as an effective risk stratification tool in clinical practice to identify pediatric sepsis patients at high risk of mortality.

Table 5.5 presents the diagnostic accuracy values of the PAR and MAR parameters at various observation times in predicting 7-day mortality in pediatric sepsis patients, which include sensitivity, specificity, positive predictive value (NDP), negative predictive value (NDN), and overall accuracy of the parameters.

Table 3. Accuracy values of PAR and MAR on day one to day five treatment as predictors of seven-day mortality of pediatric sepsis patients

Variable	Mortality		Sensitivity	Specimens	NDP	NDN	Accuracy
	(+)	(-)					
PAR Day I							
≥90311.29	30	19	62,5%	64,2%	61,2%	65,4%	63,4%
<90311.29	18	34					
PAR Day V							
≤88290.04	32	25	66,7%	52,8%	56,1%	63,6%	59,4%
>88290.04	16	28					
MAR Day I							
≥3,048	34	20	70,8%	62,3%	63%	70,2%	66,3%
<3,048	14	33					
MAR Day III							
≥3.1045	37	15	77,1%	71,7%	71,2%	77,6%	74,3%
<3.1045	11	38					
MAR Day V							
≥2.9985	39	8	81,2%	84,9%	83%	83,3%	83,2%
<2.9985	9	45					

On the first day, with a *cut-off* of ≥90311.29, a sensitivity of 62.5% and a specificity of 64.2% were obtained, with an overall accuracy of 63.4%. This value shows that the ability to discriminate is still limited, where PAR is only able to correctly identify about two-thirds of

patients. The relatively balanced values of NDP (61.2%) and NDN (65.4%) reflect that these parameters are not strong enough for both "*rule-in*" and "*rule-out*" mortality clinically.

On the fifth day of PAR, with a *cut-off* of ≤88290.04, sensitivity increased to 66.7%, but specificity decreased to 52.8%, with an overall accuracy of 59.4%. This suggests that although the ability to detect dying patients has increased slightly, the ability to identify surviving patients has decreased. Overall, PAR performance remains in the low category and is less reliable as a single predictor.

In contrast, the first day MAR showed better performance, with a sensitivity of 70.8% and a specificity of 62.3%, as well as an accuracy of 66.3%. This value shows that since the beginning of treatment, MAR already has a better ability to discriminate than PAR, although it is still in the moderate category.

On the third day of the MAR, there was a significant improvement in performance with a sensitivity of 77.1% and a specificity of 71.7%, and an accuracy of 74.3%. The NDP (71.2%) and NDN (77.6%) values showed a good balance between the ability to detect patients at risk of mortality and the ability to exclude patients who survived. This reflects that evaluation in the dynamic phase (48–72 hours) provides stronger prognostic information than initial measurements.

The peak of performance was seen on the fifth day of the MAR, with a sensitivity of 81.2% and a specificity of 84.9%, as well as an overall accuracy of 83.2%. High NDP (83%) and NDN (83.3%) values indicate that these parameters have excellent ability to identify both patients at risk of death and survivors. Clinically, this reflects a clear separation between the two outcome groups in the advanced phase of treatment, along with the accumulation of response to therapy and disease progression.

Overall, Table 5.5 confirms that MAR has a consistently superior diagnostic performance to PAR, with significant improvements in accuracy over time. From an anesthesiology and intensive care perspective, these findings suggest that MAR serial monitoring provides a high prognostic value and can be used as a reliable risk stratification tool, especially on the third and fifth days of treatment. In contrast, PAR has limitations in terms of sensitivity and specificity, so its use is more appropriate as an additional parameter in a multimodal approach, rather than as a single predictor.

The Relationship of PELOD-2 Score with *Outcome*, PAR, and MAR

Table 4. Distribution of the severity of PELOD-2 on the first day against *Outcome* 7-day mortality in pediatric sepsis patients

PELOD-2 Score	*Outcome*		Total (n)	*p-value*
	Deaths (n [%])	Life (n [%])		
0-4 (Lightweight)	5 (12,2%)	36 (87,8%)	41	<0.001
5-9 (Medium)	31 (64,6%)	17 (35,4%)	48	
10-20 (Weight)	12 (100,0%)	0 (0,0%)	12	
Total	48 (47,5%)	53 (52,5%)	101	
Chi-Square Test; p < 0.05 is considered statistically significant				

Of the 101 study subjects, the distribution of severity on the first day showed that most patients were in the moderate category, namely 48 patients (47.5%), followed by the mild category as many as 41 patients (40.6%), and the severe category as many as 12 patients (11.9%). Overall, this distribution reflects that the study population is dominated by patients with moderate to severe degrees of organ dysfunction, which is consistent with a high mortality rate of 47.5% in this study.

Table 5.6 shows that there is a very significant relationship between the severity of PELOD-2 on the first day and mortality outcome (χ^2=39.371; p<0.001). The mortality rate

increased progressively with severity: in the mild PELOD-2 group, only 5 out of 41 patients died (12.2%), in the moderate group as many as 31 out of 48 patients died (64.6%), and in the severe group all 12 patients (100%) were not saved. This mortality gradient pattern confirms the clinical validity of the PELOD-2 score as a marker of the severity of organ dysfunction in pediatric sepsis patients.

In addition, the PELOD-2 score also showed a significant difference between the dead and living groups using the Mann-Whitney test: the deceased group had a median first-day PELOD-2 score of 2 (IQR 2–2) compared to the living group with a median of 1 (IQR 1–2), p<0.001. On day 7, the separation between groups became more pronounced, with the deceased group having a median PELOD-2 of 3 (IQR 3–3) and a living group of 1 (IQR 1–1), p<0.001.

Table 0. Difference in PELOD-2 Score between day 1 and day 7

Variable	Score, median (IQR)	RS	p-value
PELOD-2 H1	4 (14)	0,642	<0.001
PELOD-2 H7	1 (8)		
rs = Spearman correlation coefficient. p < 0.05 is considered statistically significant			

Based on Table 5, the median score of PELOD-2 on day 1 was 4 (IQR 14), while on day 7 it decreased to 1 (IQR 8). This decrease indicates that there is generally an improvement in the patient's clinical condition during the treatment period. However, the wide interquartile range at both measurement times showed a variation in clinical conditions between patients.

The results of the Spearman correlation test showed that there was a significant positive relationship between the PELOD-2 score on day 1 and day 7 (r=0.642; p<0.001). This correlation coefficient value falls into the strong category, which indicates that patients with a high PELOD-2 score at the beginning of treatment tend to remain relatively high on day 7.

Table 6. Median and change in PELOD-2 scores against *Outcome*

Variable	***Outcome***		***p-value***
	Life	**Died**	
PELOD-2, median (IQR)			
PELOD-2 H1	3 (4)	8 (4,75)	<0.001
PELOD-2 H7	2 (2)	15 (5,75)	<0.001
Mann-Whitney Test; p < 0.05 is considered statistically significant			

Based on Table 6, there was a significant difference in the PELOD-2 score between the groups of patients who lived and died on both day 1 and day 7 (p<0.001). On day 1, the median PELOD-2 score in the dead group was higher than in the living group, which was 8 (IQR 4.75) compared to 3 (IQR 4). This suggests that since the beginning of treatment, patients who have had a death outcome have shown a higher degree of severity.

A more striking difference was seen on day 7, where the median PELOD-2 score of the deceased group increased to 15 (IQR 5.75), while in the living group it actually decreased to 2 (IQR 2). This pattern showed an improvement in conditions in the living group, while in the deceased group there was a worsening of clinical conditions during treatment.

Thus, the higher the PELOD-2 score, both at the beginning and during treatment, the higher the risk of mortality in pediatric patients with sepsis. The change in scores from day 1 to day 7 also provides an important picture of the therapeutic response and disease progression.

Table 7. Spearman correlation between PAR and MAR with PELOD-2 scores on the first day (H1) and day seven (H7) in pediatric sepsis patients

Parameters	rs vs PELOD H1	p	rs vs PELOD H7	p
PAR Day I	0,002	0,987	0,156	0,120
PAR Hari III	-0,106	0,290	0,019	0,953
PAR Day V	-0,195	0,051	-0,166	0,097
MAR Day I	0,208	0,037	0,312	0,001
MAR Day III	0,252	0,008	0,514	<0.001
MAR Day V	0,323	<0.001	0,553	<0.001

rs = Spearman correlation coefficient. $p < 0.05$ is considered statistically significant

Based on Table 7, no significant correlation was found between the Platelet-Albumin Ratio (PAR) and the PELOD-2 score on either the first or the seventh day ($p>0.05$). The correlation coefficient values, which were close to zero, indicated that PAR did not have a consistent relationship with the severity of the patients in this study. This indicates that PAR is less sensitive in reflecting the clinical conditions of pediatric sepsis patients.

In contrast, the MPV-Albumin Ratio (MAR) showed a meaningful positive correlation with the PELOD-2 score. On the first day, there was a weak correlation between MAR and the PELOD-2 score on the first day ($r=0.208$; $p=0.037$) and a moderate correlation with the PELOD-2 score on the seventh day ($r=0.312$; $p=0.001$). This shows that the increase in MAR from the beginning of treatment is related to an increase in severity.

A stronger correlation was seen between Day 3 and Day 5 MAR and Day 7 PELOD-2 scores, with coefficient values of $r=0.514$ and $r=0.553$, respectively ($p<0.001$). The strength of this correlation belongs to the moderate-to-strong category, which suggests that MAR has a consistent and increasingly strong relationship with disease severity over time.

Overall, the results of this study show that the PELOD-2 score has a strong relationship with patient outcomes, and that MAR is a more consistent parameter than PAR in reflecting the severity of the disease. Therefore, the combined use of clinical scores and biomarkers such as MAR can improve accuracy in the assessment of the condition of pediatric sepsis patients.

The discussion of the results of this study reveals several key findings that have important clinical implications in the practice of anesthesiology and pediatric intensive care, particularly in the context of risk stratification and dynamic monitoring of sepsis patients.

First, the characteristics of the study subjects showed a dominance of male patients (65.3%), with a ratio of almost 2:1 compared to females. These findings are consistent with the literature showing differences in gender-based immune responses, where males tend to have more uncontrolled inflammatory responses. The study by Guerra-Silveira et al. (2020) showed that sex hormones and immune-related gene expression contribute to a higher inflammatory response in males, thereby increasing susceptibility to severe sepsis and mortality. In the context of anesthesia, this is important because patients with higher inflammatory responses tend to experience hemodynamic instability during the perioperative period.

The wide age distribution, with a median of 4 years, confirms that this population is dominated by an age group with immature immune systems. This is in line with a study by Weiss et al. (2020) in the Pediatric Sepsis Definition Taskforce, which confirms that early childhood has a dominant but less coordinated innate immune response, making children more susceptible to multiple organ dysfunction. From an anesthesiological point of view, this affects the variability of responses to fluid resuscitation, vasopressor needs, and highly dynamic drug pharmacokinetics.

In terms of etiology, the dominance of pneumonia (26.7%) as the main source of sepsis is consistent with global reports. A study by Rudd et al. (2020) in the Global Burden of Disease Study shows that lower respiratory tract infections are the main cause of sepsis in the pediatric

population globally. Pathophysiologically, pulmonary involvement is closely related to the development of acute respiratory distress syndrome (ARDS), which in anesthesia practice requires a protective ventilation strategy (low tidal volume, optimal PEEP) to prevent ventilator-induced lung injury.

The intra-abdominal group (peritonitis, intestinal perforation, perforated appendicitis) also shows a significant proportion and represents conditions with a high inflammatory load. A study by Deans et al. (2021) showed that sepsis due to intra-abdominal sources had a 42% higher risk of septic shock and the need for emergency surgical intervention compared to other sources. In anesthesia practice, these patients are a group at high risk of hemodynamic instability due to massive vasoplegia and third spacing, requiring a goal-directed, therapy-based resuscitation strategy.

The mortality rate of 47.5% in this study is relatively high and reflects the severity of patients who present to tertiary referral facilities. This is in line with a study by Fleischmann-Struzek et al. (2020), which shows that sepsis mortality in developing countries is still high, especially in patients with delayed diagnosis and limited access to optimal intensive care. In the context of anesthesiology, this emphasizes the importance of optimizing "golden hour resuscitation" and early invasive monitoring.

The dynamics of laboratory parameters show that platelets are on a progressive downward trend, while albumin remains persistently low. This condition reflects a combination of platelet consumption due to systemic coagulation activation and sustained capillary leakage. A study by Thiery-Antier et al. (2021) showed that thrombocytopenia in sepsis is an independent predictor of mortality, especially when it occurs progressively in the first 3–5 days. In terms of anesthesia, this condition increases the risk of perioperative bleeding and affects transfusion decisions and the use of blood products.

Persistent hypoalbuminemia also has important implications. A study by Vincent et al. (2021) showed that low albumin levels correlated with increased mortality and length of ICU stay, as it reflects endothelial dysfunction and capillary leak syndrome. In clinical practice, these conditions affect the distribution of anesthetic drugs, oncotic pressure, and responses to fluid therapy.

The most important finding in this study is the superiority of the MAR parameter over PAR as a predictor of mortality. The MAR on the first day already showed moderate discriminating ability (AUC 0.711), which then increased to very good on the third day (AUC 0.843) and reached the outstanding category on the fifth day (AUC 0.905). This shows that MAR is a biomarker that is highly sensitive to the dynamics of sepsis progression.

These findings are supported by a study by Liu et al. (2022), which showed that platelet- and albumin-based ratios, including MAR, had better predictive capabilities than a single parameter in assessing sepsis severity. The study explains that the combination of MPV and albumin reflects the interaction between inflammation, nutritional status, and endothelial dysfunction simultaneously.

In addition, a study by Zhang et al. (2023) in ICU patients showed that an inadequate increase in MPV accompanied by hypoalbuminemia was associated with hematopoietic compensation failure and increased mortality. This is in line with the findings of this study, in which high MAR values are strongly correlated with poor outcomes.

The serial increase in MAR accuracy also confirms the importance of a dynamic approach in sepsis monitoring. A study by Seymour et al. (2021) emphasized that biomarker evaluation in the first 48–72 hours provided a higher prognostic value than baseline measurements, as it reflected the response to therapy. This is particularly relevant to the finding that the third- and fifth-day MAR performed much better than the first-day MAR.

In contrast, PAR shows consistently low performance (AUC <0.7), which indicates its limitations as a single predictor. This is likely due to the high variability of platelets and

albumin in the early phases of sepsis, making this ratio less stable. A study by Li et al. (2021) also reported that PAR has limited predictive value compared to other, more complex ratios.

From the perspective of anesthesiology and critical care, the main implication of this study is that MAR can be used as a practical risk stratification tool based on routine examinations. The cut-off value of around 3.0, which is relatively consistent, facilitates clinical implementation. The serial use of MAR can be helpful in determining the need for therapeutic escalation, such as vasopressor intensification, mechanical ventilation, or even consideration of advanced therapies such as ECMO in certain cases.

Overall, the study confirms that a single-time, biomarker-based approach has limitations, and that serial monitoring with integrative parameters such as MAR provides much higher prognostic value. In modern anesthesia and intensive care practice, this approach is in line with the concept of precision medicine, where clinical decisions are based on the dynamics of the patient's individual response to the disease and the therapy given.

The results of this study showed that the median PELOD-2 score on day 1 was 4 (IQR 14), which decreased to 1 (IQR 8) on day 7, reflecting an improvement in general clinical conditions in the studied population. However, this median decrease concealed an important heterogeneity: in the survivor group, the PELOD-2 score on day 7 dropped dramatically to a median of 2 (IQR 2), while in the group that died, the score actually increased to a median of 15 (IQR 5.75), a statistically significant divergence pattern ($p<0.001$).

This divergence pattern reflects a phenomenon known in the literature as the progressive organ failure trajectory, in which patients who do not respond to therapy experience progressive accumulation of organ dysfunction, in contrast to patients who respond to therapy and show gradual organ recovery (Leteurtre et al., 2015). A study by Bose et al. (2021) showed that patients with an increased organ failure score in the first 48–72 hours had a 4–6 times higher risk of death than those with a decrease in score, even after adjusting for the initial severity.

The severity distribution based on the PELOD-2 category on the first day of this study, namely 40.6% mild (score 0–4), 47.5% moderate (score 5–9), and 11.9% severe (score 10–20), with a sharp mortality gradient (12.2%, 64.6%, and 100%), provided strong internal validation of the discriminatory ability of PELOD-2. The 100% mortality rate in the severe group is consistent with reports from several multicenter studies, which show that a PELOD-2 score ≥11 is associated with near-absolute mortality without intensive intervention. This has immediate clinical implications: patients with severe-category PELOD-2 from the beginning of treatment are candidates for escalation of aggressive therapy, including consideration of early mechanical ventilation, renal replacement therapy, or more invasive hemodynamic interventions (Shen & Jiang, 2021).

A strong association between day 1 and day 7 PELOD-2 scores ($r=0.642$; $p<0.001$) also has important clinical significance. This strong positive correlation suggests that the patient's initial condition strongly determines the subsequent clinical trajectory, which confirms the importance of early and aggressive intervention in the first hours of treatment, in line with the principles of early goal-directed therapy (EGDT) that are the foundation of modern sepsis management (Tan et al., 2019).

Interestingly, when compared to MAR, the correlation of the PELOD-2 score with MAR showed a progressive strengthening pattern from day 1 to day 5. This suggests that MAR and PELOD-2 capture complementary pathophysiological aspects: PELOD-2 reflects organ dysfunction directly through multi-system clinical parameters, while MAR reflects underlying inflammatory processes and endothelial-hemostatic dysregulation at the molecular level. The combination of standardized clinical scores (PELOD-2) and routine laboratory-based biomarkers (MAR) has the potential to provide a more comprehensive and accurate assessment than using either parameter separately (Pratiwi et al., 2025).

The integration of PELOD-2 and MAR can be formulated into a tiered risk stratification algorithm: at the initial assessment, PELOD-2 is used for severity classification and determination of the required treatment level (PICU vs. regular ward), while serial MAR on days 3 and 5 is used for therapeutic response evaluation and short-term mortality prediction. This tiered approach not only optimizes clinical accuracy but is also in line with the principle of resource stewardship in intensive care units, considering that these two parameters do not require additional checks beyond the routine laboratory examinations that are already underway (Musa et al., 2019).

CONCLUSION

In conclusion, this study demonstrates that both the Platelet-to-Albumin Ratio (PAR) and the Mean Platelet Volume-to-Albumin Ratio (MAR) have prognostic value in pediatric sepsis patients; however, their predictive performance differs significantly. PAR shows limited and inconsistent ability in predicting 7-day mortality and disease severity, with AUC values remaining below the clinically acceptable threshold in most observation periods. In contrast, MAR exhibits progressively stronger and more reliable predictive performance from day 1 to day 5 of treatment, reaching excellent diagnostic accuracy on day five (AUC > 0.90). MAR also shows a consistent positive correlation with PELOD-2 scores, indicating its stronger reflection of organ dysfunction and disease progression. These findings confirm that MAR is a more robust and clinically applicable biomarker than PAR for early risk stratification and serial monitoring of pediatric sepsis patients in emergency and intensive care settings.

For future research, prospective multicenter studies with larger and more diverse pediatric populations are recommended to validate the external generalizability of MAR as a prognostic biomarker. Further investigations should also explore the integration of MAR with established clinical scoring systems such as PELOD-2 or other sepsis prediction models to develop a combined risk stratification tool with higher predictive accuracy. Additionally, future studies may evaluate the dynamic changes of MAR beyond five days and assess its responsiveness to therapeutic interventions, including fluid resuscitation and organ support strategies, to determine its potential role not only as a prognostic marker but also as a real-time monitoring tool in guiding clinical decision-making.

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