International Journal of Biomedicine 16(4) (2026) 486-491
http://dx.doi.org/10.21103/Article16(4)_OA4

ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF BIOMEDICINE

Evaluation of Mortality Using the PRISM Score System in a Pediatric Intensive Care Unit

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Abstract

Background: Mortality and morbidity remain fundamental indicators for assessing the quality of care and clinical performance in intensive care units. The Pediatric Risk of Mortality (PRISM) score is a widely recognized tool for the early identification of mortality and morbidity risk among critically ill children admitted to Pediatric Intensive Care Units (PICUs). Despite variations in patient populations and healthcare resources, the PRISM model continues to be a reliable and valuable prognostic tool in centers outside the countries where it was originally developed.

Objective: To evaluate the utility of the PRISM score for the early assessment of mortality and morbidity risk in patients admitted to the Pediatric Intensive Care Unit of a tertiary-care hospital in Tirana, Albania.

Methods and Results: This prospective study was conducted between March 2024 and January 2026. All patients aged 1 month to 14 years admitted to the Pediatric Intensive Care Unit at the University Hospital Center "Mother Teresa" in Tirana, Albania, were included. PRISM III scores were calculated and analyzed in relation to patient outcomes.

A total of 710 patients were included in the study, of whom 613 met the inclusion criteria. The mean PRISM III score was 3.56 ± 3.56 points. The overall observed mortality rate was 5.38% (33/613). The PRISM III model demonstrated excellent discriminative performance, with an area under the receiver operating characteristic curve (AUC) of 0.991 (95% CI: 0.982-0.998). The model showed good calibration, with 33 observed deaths compared with 31.0 expected deaths, resulting in a standardized mortality ratio (SMR) of 1.06. This indicates that observed mortality was approximately 6.4% higher than predicted by the PRISM III model. At the optimal ROC cutoff, the model achieved a sensitivity of 93.9% and a specificity of 97.2%.

Conclusion: The PRISM III score showed excellent discriminatory ability for predicting mortality risk and proved to be a highly effective prognostic tool in critically ill children admitted to the PICU. **(International Journal of Biomedicine. 2026;16(4):486-491.)**

Keywords: PRISM III • mortality • morbidity • pediatric intensive care unit • risk prediction • validation.

For citation: Gjeta I, Bakalli I, Sala D, Çelaj E, Hoxha V, Biqiku M, Kola E. Evaluation of Mortality Using the PRISM Score System in a Pediatric Intensive Care Unit. International Journal of Biomedicine. 2026;16(4):486-491. doi:10.21103/Article16(4)_OA4

Introduction

Recent advances in healthcare have significantly improved patient outcomes; however, they have also increased the demand for financial, technological, and human resources worldwide. Ensuring high-quality healthcare while maintaining efficient use of available resources remains a major challenge for healthcare systems. Intensive Care Units (ICUs) represent one of the most resource-intensive areas of hospital care and therefore require continuous evaluation of performance and quality indicators. Assessment of clinical outcomes, including mortality, morbidity, patient safety, treatment effectiveness, and quality of care, is essential for monitoring and improving healthcare services in these highly specialized environments.

In Pediatric Intensive Care Units (PICUs), outcome evaluation is not limited to measuring mortality rates alone. Risk-adjusted assessment of mortality, identification of risk factors, and evaluation of disease severity are increasingly recognized as more reliable indicators of quality of care. These approaches enable clinicians to better understand patient prognosis, compare outcomes between institutions, and optimize the allocation of healthcare resources.

Several scoring systems have been developed to evaluate illness severity and predict mortality risk in critically ill children. Among them, the Pediatric Risk of Mortality (PRISM) score is one of the most widely used and validated prognostic tools. The PRISM scoring system was first introduced by Pollack et al. in 1988 as a refinement of the Physiologic Stability Index (PSI), reducing the number

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of variables required while maintaining strong predictive performance for mortality risk assessment.[1] The original PRISM score included 14 physiological variables and was validated in 1,227 pediatric patients admitted to six Pediatric Intensive Care Units.[1]

In 1996, the model was revised and expanded into PRISM III, aiming to improve predictive accuracy through the incorporation of 17 physiological variables categorized into specific ranges of abnormality.[2] These variables assess abnormalities across multiple organ systems, including cardiovascular, respiratory, neurological, metabolic, hematologic, and coagulation functions.[2] A total of 26 abnormal physiological ranges are evaluated, and the most abnormal value recorded during the first 12 to 24 hours following PICU admission is used for score calculation.[1,2] The total PRISM III score is subsequently incorporated into a logistic regression model to estimate the probability of mortality.[2]

The PRISM III model was validated using data from 11,165 PICU admissions across 32 centers and diverse patient populations, demonstrating strong predictive performance and broad applicability in pediatric critical care settings.[2] Owing to its reliability and reproducibility, PRISM III became one of the most widely accepted mortality prediction systems in PICUs worldwide. The latest evolution of the model, PRISM IV, was introduced and validated in 2015.[3] In addition to the physiological variables included in PRISM III, PRISM IV incorporates several important clinical predictors, including source of admission (emergency department, inpatient ward, or transfer from another hospital), cardiopulmonary resuscitation within 24 hours before PICU admission, and the presence of malignancy or chronic disease, further improving the accuracy of mortality prediction.[3]

The main purpose of the PRISM scoring system is to assess illness severity and predict mortality risk among critically ill pediatric patients.[1,2,4-8] Early identification of patients at high risk of adverse outcomes can support clinical decision-making, facilitate timely interventions, and improve prognostic evaluation.[5-10] Furthermore, objective mortality risk assessment can help healthcare professionals communicate more effectively with families regarding prognosis and expected outcomes.[5-10]

Beyond its clinical utility, the PRISM score can contribute to more efficient utilization of healthcare resources. By identifying patients at greater risk of mortality, intensive care teams can prioritize monitoring, interventions, and resource allocation according to clinical need.[1,2,10-12] The system also provides a valuable tool for quality assessment and benchmarking, enabling comparisons of outcomes across different PICUs and patient populations.[8,12] In addition, accurate risk stratification may support hospital management in planning staffing requirements, resource distribution, and overall healthcare expenditures within the intensive care setting.

Given the widespread use of PRISM and the limited data available from Albania, evaluating its performance in local PICU populations is important. Therefore, the aim of the present study was to assess the utility and predictive performance of the PRISM III score for early evaluation of mortality risk among patients admitted to the Pediatric Intensive Care Unit of a tertiary-care hospital in Tirana, Albania.

Materials and Methods

Study Design and Setting: This prospective observational study was conducted in the Pediatric Intensive Care Unit (PICU) of the University Hospital Center "Mother Teresa", Tirana, Albania, between March 2024 and January 2026. The PICU is a tertiary-care referral center that provides medical and surgical intensive care for children aged 1 month to 14 years. Neonates younger than one month are admitted only for the management of surgical conditions requiring specialized intensive care.

A total of 613 consecutive patients admitted during the study period who met the inclusion criteria were included in the analysis. Patients who did not meet the inclusion criteria were excluded, including neonates (n = 47), patients discharged within two hours of admission (n = 21), patients who died within the first 24 hours of hospitalization (n = 4), and patients with incomplete data (n = 25). The study protocol was reviewed and approved by the Ethics Committee for Research Projects of the Medical University of Tirana and was conducted in accordance with the principles of the Declaration of Helsinki.

Study Population

Inclusion Criteria

Children aged 28 days to 14 years admitted to the PICU during the study period.

Exclusion Criteria

- Neonates younger than 28 days of age.
- Patients discharged within two hours of admission.
- Patients who died within the first 24 hours after PICU admission.
- Patients with incomplete clinical or laboratory data required for PRISM III score calculation.

Data Collection: For each patient, demographic, clinical, and laboratory data were prospectively collected using a standardized data collection form. Variables included in the PRISM III scoring system were recorded, including:

- Systolic blood pressure
- Heart rate
- Body temperature
- Glasgow Coma Scale (GCS)
- Arterial blood gas parameters
- Blood glucose level
- Blood urea nitrogen (BUN)
- Serum creatinine
- Electrolyte levels
- White blood cell count
- Platelet count
- Prothrombin time (PT)
- Activated partial thromboplastin time (aPTT)

For each variable, the most abnormal value recorded during the first 24 hours following PICU admission was used for score calculation. PRISM III scores were calculated

according to the methodology described by Pollack et al. The corresponding predicted probability of death for each patient was subsequently determined using the logistic regression equation associated with the PRISM model.

Study Objectives: The primary objective of the study was to evaluate the predictive performance of the PRISM III score for mortality among critically ill children admitted to our PICU. Specifically, the study aimed to assess the discrimination and calibration abilities of the PRISM III model in predicting mortality risk within our patient population.

Statistical Analysis: Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) software.

Discrimination Analysis: The discriminatory performance of the PRISM III model was evaluated using the receiver operating characteristic (ROC) curve analysis. The area under the ROC curve (AUC) was calculated to determine the ability of the model to distinguish between survivors and non-survivors. An AUC value closer to 1.0 indicates superior predictive performance.

Calibration Analysis: Calibration of the PRISM III model was assessed by comparing predicted mortality with observed mortality in the study population. The agreement between expected and observed outcomes was analyzed to evaluate the goodness-of-fit of the model.

Comparative Analysis: The association between PRISM III score categories and patient outcomes was assessed using the Chi-square test. Differences in PRISM III scores between survivors and non-survivors were analyzed using the Mann-Whitney U test, as score distributions were non-parametric.

Multivariable Analysis: Binary logistic regression analysis was performed to identify independent predictors of mortality. After adjustment for age and mechanical ventilation, the PRISM III score remained a significant predictor of mortality (OR=2.09, 95% CI: 1.61-2.72, $p < 0.001$). Mechanical ventilation during the first hour of ICU admission was also independently associated with mortality (OR=9.97, 95% CI: 2.17-45.71, $p = 0.003$). Age was not significantly associated with mortality (OR= 0.94, 95% CI: 0.78-1.14, $p = 0.555$).

Results

A total of 710 consecutive patients admitted to the Pediatric Intensive Care Unit (PICU) between March 2024 and January 2026 were screened for eligibility. Of these, 613 patients met the inclusion criteria and were included in the study, while 97 patients were excluded for not meeting the study eligibility requirements. The PICU of the University Hospital Center "Mother Teresa" in Tirana is the only tertiary pediatric intensive care unit in Albania, providing care for critically ill children aged 1 month to 14 years, with a capacity of 16 beds.

The mean age of the study population was 2.74 ± 3.67 years (32.9 months). Male patients predominated, representing 56.3% of all admissions. The mean PRISM III score for the entire cohort was 3.56 ± 3.56 points. Baseline demographic and clinical characteristics of the population are presented in Table 1.

Table 1.

Baseline characteristics.

Characteristic	Value
Patients	613
Male	345 (56.28%)
Female	268 (43.72%)
Mean age	2.74 year
Median age	0.92 year
Mean LOS	4.42 ± 5.23 days
Mortality	33 (5.38%)

The mean PRISM III score among survivors was 2.95 ± 2.31, compared with 14.3 ± 4.48 among non-survivors. The mean length of PICU stay was 4.42 ± 5.23 days. Mechanical ventilation for more than 72 hours was required in 45 patients (7.3%).

Table 2.

Comparison of clinical characteristics between survivors and non-survivors.

Group	N	PRISM Mean (SD)	Heart Rate Mean (SD), /min	Platelets Mean (SD), / mm^3	
Survived	580	2.95 (2.31)	152.65 (33.71)	369,777.76	(165,743.97)
Died	33	14.3 (4.48)	183.12 (31.69)	326,054.55	(251,909.92)

The overall mortality rate was 5.4% (33/613 patients). Mortality increased progressively with higher PRISM III score categories. No deaths occurred among patients with a PRISM III score of 0 to 5. Mortality rates according to PRISM III categories were as follows:

Table 3.

Risk stratification by PRISM score category.

PRISM Score	Patients	Deaths	Mortality (%)
0	80	-	0.00%
1–5	433	-	0.00%
6–10	73	8	1.31%
11–20	22	20	3.26%
>20	5	5	0.82%
Total	613	33	5.38%

Receiver Operating Characteristic (ROC) curve analysis demonstrated excellent discriminatory performance of the PRISM III score for predicting mortality. The area under the ROC curve (AUC) was 0.991 (95% Confidence Interval 0.982 to 0.998), indicating excellent ability to distinguish survivors from non-survivors (Figure 1).

Calibration of the PRISM III model was assessed by comparing observed and predicted mortality across risk strata. The calibration plot demonstrated generally good agreement between predicted and observed mortality. A slight deviation above the line of identity was observed among higher-risk patients, indicating a modest tendency of PRISM

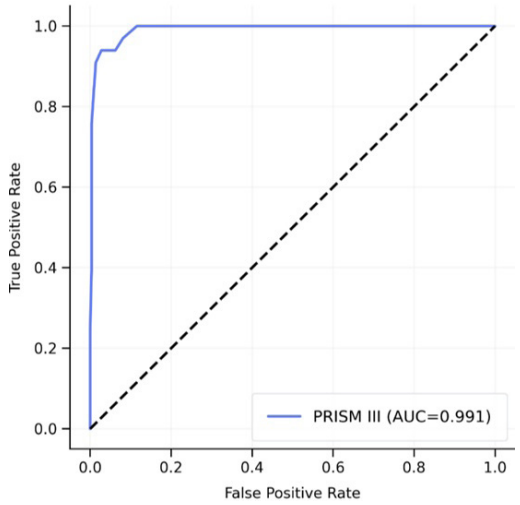


Figure 1. *ROC Chart for PRISM III.*

III to underestimate mortality. This finding is consistent with the standardized mortality ratio (SMR) of 1.06 and suggests overall satisfactory calibration of the model in this cohort.

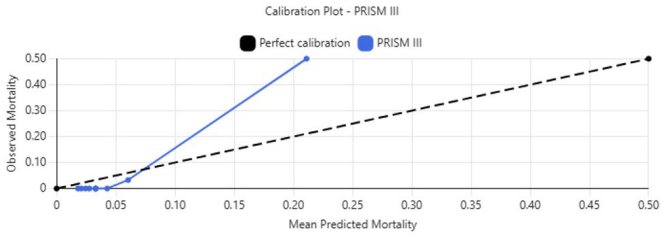


Figure 2. *Calibration Plot for PRISM III.*

The standardized mortality ratio (SMR) was 1.06, indicating close agreement between observed and predicted mortality and suggesting only a slight underestimation of mortality risk by the PRISM III model in our study population.

Table 4.

PRISM performance metrics.

Metric	Value
AUC	0.991
95% CI	0.982 to 0.998
SMR	1.064
Expected deaths	31.01
Youden index cutoff	0.106
Sensitivity	93.9%
Specificity	97.2%

Overall, these findings confirm that the PRISM III score is a highly effective tool for mortality risk stratification in critically ill pediatric patients admitted to the PICU, demonstrating excellent discrimination in our study population.

Discussion

Although the PRISM scoring system has been widely recognized and validated in pediatric intensive care settings worldwide, its performance should be evaluated in different healthcare environments and patient populations before being routinely adopted as a reliable prognostic tool. In the present study, which included 613 patients admitted to a tertiary Pediatric Intensive Care Unit in Albania, PRISM III demonstrated excellent performance in predicting mortality. Our findings showed a strong association between increasing PRISM III scores and mortality risk. Furthermore, ROC curve analysis yielded an AUC of 0.991, indicating excellent discriminatory ability and confirming the capacity of the model to distinguish between survivors and non-survivors.

The high AUC value observed in our study is consistent with findings reported in previous validation studies. Pollack et al. reported an AUC of 0.944 during the original validation of PRISM III, while Tajamul et al. found an AUC of 0.977. Similarly, Agrawal et al. reported an AUC of 0.99, Slater et al. an AUC of 0.93, Gonzalez et al. an AUC of 0.92, and Joshi et al. an AUC of 0.916.[2,4,9,13-15] The similarity of these findings across diverse PICU populations supports the robustness of the PRISM III model and confirms its value as an effective prognostic tool for mortality prediction in critically ill children.

From a clinical perspective, these results suggest that PRISM III can provide an objective and reliable assessment of illness severity early during PICU admission. Early identification of high-risk patients may facilitate timely interventions, optimize resource allocation, improve communication with families, and support clinical decision-making. In resource-limited settings, where intensive care resources must often be prioritized, accurate risk stratification is particularly important.

The overall mortality rate observed in our study was 5.4%, which is comparable to rates reported by Pollack et al. (4.9%) and Gonzalez et al. (5.21%).[1,15] However, our mortality rate was lower than those reported by Khilnani (6.7%), Gemke (6.6%), Bilan (9.05%), Varma (14.8%), and Tajamul (19.7%).[16-19] Differences in mortality rates among studies may be explained by variations in patient characteristics, disease severity, admission criteria, referral patterns, availability of intensive care resources, and differences in healthcare systems.

The mean PRISM III score in our cohort was relatively low (3.56 ± 3.56), suggesting that a substantial proportion of admitted patients had less severe illness compared with those included in some previous studies. Nevertheless, mortality increased markedly across PRISM III score categories, ranging from 0% among patients with a score of 0, to 91 % among patients with scores between 11 and 20, and reaching 100% among patients with scores greater than 20. These findings demonstrate a clear relationship between increasing PRISM III scores and mortality risk and agree with previously published studies.[1,2,5,8,9,13,19-22]

The progressive increase in mortality across PRISM III categories highlights the clinical usefulness of the score for early severity classification and risk stratification. Identification of patients at elevated risk immediately after

admission allows clinicians to implement closer monitoring, more aggressive therapeutic interventions, and individualized management strategies aimed at improving outcomes.

The present study has several strengths. It represents one of the largest prospective evaluations of PRISM III conducted in Albania and was performed in the country's sole tertiary pediatric intensive care center, providing a comprehensive representation of critically ill pediatric patients requiring intensive care. The prospective nature of data collection and the relatively large sample size further strengthen the validity of our findings.

However, several limitations should be acknowledged. First, this was a single-center study, which may limit the generalizability of the results to other healthcare systems and PICUs with different patient populations and clinical practices. Second, the study focused exclusively on in-hospital mortality and did not evaluate long-term outcomes following PICU discharge. Finally, factors such as underlying chronic diseases, socioeconomic determinants, and other clinical variables not incorporated into the PRISM III model may have influenced patient outcomes.

Despite these limitations, PRISM III demonstrated excellent discriminatory performance in our patient population and proved to be an effective tool for mortality risk prediction. The model successfully differentiated survivors from non-survivors and may assist clinicians in identifying patients who require closer monitoring and more intensive therapeutic interventions. Our findings support the continued use of PRISM III as a valuable prognostic instrument in the Pediatric Intensive Care Unit and highlight the importance of ongoing local validation to ensure optimal performance in different clinical settings.

Conclusion

The PRISM score demonstrated excellent discriminative performance in predicting mortality, supporting its value as a reliable risk stratification tool. Given its strong predictive ability, PRISM could be integrated into routine clinical practice and quality improvement initiatives to facilitate timely interventions and optimize patient outcomes. However, further multicenter studies are needed to validate these findings across diverse healthcare settings. Additionally, future research should assess the predictive value of the PRISM score for long-term outcomes beyond PICU discharge.

Author Contributions

I. Gjeta: Conceptualization, methodology, investigation, analysis, manuscript writing, and review.
I. Bakalli: Investigation, manuscript review, and editing.
D. Sala: Investigation and data curation.
E. Celaj: Investigation and data curation.
V. Hoxha: Investigation and data curation.
M. Biqiku: Investigation and data curation.
E. Kola: Manuscript review, editing, and final revision.

Conflicts of Interest

The authors declare no conflicts of interest.

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