A-JMRHS

VALIDATION OF THE PEDIATRIC INDEX OF MORTALITY 3 SCORE FOR RISK-ADJUSTED MORTALITY PREDICTION IN A TERTIARY CARE PEDIATRIC INTENSIVE CARE UNIT: A PROSPECTIVE OBSERVATIONAL STUDY

Dr. Rahul, V[1], Dr. Mohammed Naveed Nadaf[2], Sneha Karekar[3], Dr. Kishan Raj K[4*]

[1]Assistant Professor and Consultant KLE JGMM Medical College, Hubballi Vihaan Heart Centre Hubli.

[2]Consultant, Anesthesiology and Critical care VIHAAN HEART CARE HOSPITAL, Hubli, Karnataka.

[3]Specialist in the Department of Cardiology Hospital-Manipal Hospital Old Airport Road Bangalore.

[4*]Associate Consultant Aster MIMS Kasargod.

Email ID- [1]findrahulv@gmail.com, [2]mohdnaveed36@gmail.com [3]sneha.karekar3@gmail.com [4*]kollampareraj@gmail.com

Corresponding Author: Dr. Kishan Raj K
Associate Consultant Aster MIMS Kasargod.
Email ID: kollampareraj@gmail.com

ABSTRACT

Background: The Pediatric Index of Mortality 3 (PIM3) score is a widely used risk-adjustment tool for predicting mortality among critically ill children admitted to Pediatric Intensive Care Units (PICUs). Validation of this scoring system in different clinical settings is essential before routine implementation.

Objective: To validate the PIM3 score for risk-adjusted mortality prediction in a tertiary care PICU.

Methods: This prospective observational study was conducted in the PICU of a tertiary care teaching hospital. A total of 130 children aged 1 month to 18 years admitted to the PICU were enrolled. Demographic, clinical, physiological, and laboratory variables required for PIM3 score calculation were collected within the first hour of admission. The primary outcome was PICU mortality. Model performance was assessed using discrimination by area under the receiver operating characteristic curve (AUROC) and calibration using the Hosmer–Lemeshow goodness-of-fit test and standardized mortality ratio (SMR).

Results: Of the 130 patients included, 20 died, resulting in an overall mortality rate of 15.4%. Mortality increased progressively across higher PIM3 risk categories, from 0% in the <1% risk group to 61.5% in the >30% risk group. The mean predicted mortality was significantly higher among non-survivors than survivors (28.7 ± 15.6% vs. 5.8 ± 4.3%; $p<0.001$). The PIM3 score demonstrated good discrimination with an AUROC of 0.89 (95% CI: 0.83–0.95). Calibration was satisfactory (Hosmer–Lemeshow $\chi^2=6.21$, $p=0.624$), with an SMR of 1.09.

Conclusion: PIM3 is a reliable and valid mortality prediction model with good discrimination and calibration, making it a useful tool for risk stratification and outcome assessment in critically ill pediatric patients.

Keywords: Pediatric Index of Mortality 3, PIM3, Pediatric Intensive Care Unit, Mortality Prediction, Risk Stratification, Critical Care, Pediatric Critical Care, Prognostic Scoring System.

INTRODUCTION

Pediatric intensive care units (PICUs) provide specialized care for critically ill children with life-threatening medical, surgical, and traumatic conditions. Despite remarkable advances in pediatric critical care medicine, mortality and morbidity remain substantial among children requiring intensive care support.

www.ajmrhs.com
eISSN: 2583-7761

Date of Received: 27-05-2026
Date Acceptance: 04-06-2026
Date of Publication: 03-07-2026

Accurate assessment of illness severity and prediction of mortality risk are essential for clinical decision-making, resource allocation, benchmarking of PICU performance, and evaluation of quality of care. Consequently, several prognostic scoring systems have been developed to facilitate objective risk stratification in critically ill pediatric patients [1].

Mortality prediction models are widely used in PICUs to estimate the probability of death based on physiological and clinical variables collected during the early phase of admission. These models serve multiple purposes, including comparison of outcomes among institutions, assessment of treatment effectiveness, clinical audit, research standardization, and adjustment for differences in patient case-mix [2]. Among the most commonly utilized pediatric severity scoring systems are the

Pediatric Risk of Mortality (PRISM), Pediatric Logistic Organ Dysfunction (PELOD), and Pediatric Index of Mortality (PIM) scores. While PRISM and PELOD rely on extensive physiological data collected during the first 12–24 hours of admission, the PIM score offers a simpler and more practical alternative by utilizing variables obtained at or shortly after PICU admission [3].

The Pediatric Index of Mortality was initially developed to provide a standardized method for evaluating mortality risk among children admitted to intensive care units. Subsequent revisions led to the development of PIM2 and, more recently, Pediatric Index of Mortality 3 (PIM3), which was introduced in 2013 following analysis of a large multinational database comprising over 50,000 pediatric intensive care admissions from Australia, New Zealand, the United Kingdom, and Ireland [4]. PIM3 was designed to improve calibration and predictive accuracy by incorporating updated diagnostic categories and revised regression coefficients reflecting contemporary PICU practice [4].

The PIM3 score estimates the probability of mortality using variables collected from the time of first face-to-face contact with an intensive care physician until one hour after PICU admission. These variables include systolic blood pressure, pupillary reactions, arterial blood gas measurements, mechanical ventilation status, elective admission status, recovery following surgery or procedures, and the presence of specific high-risk or low-risk diagnoses [4]. Because these parameters are routinely available at admission, PIM3 is relatively easy to calculate and minimizes the influence of therapeutic interventions that may alter physiological measurements after admission [5].

Several international studies have evaluated the validity and performance of PIM3 in different healthcare settings. Validation studies conducted in Korea, Argentina, Iran, Indonesia, and other countries have demonstrated that PIM3 possesses good discriminatory ability for predicting mortality among critically ill children, although calibration performance may vary according to patient populations, disease profiles, and healthcare resources [6–10]. A meta-analysis evaluating mortality prediction tools in PICUs reported that PIM3 demonstrated satisfactory predictive performance and remains one of the most widely accepted risk-adjustment models in pediatric critical care practice [11].

Although PIM3 has been validated in several developed and developing countries, its performance may differ across institutions because mortality prediction models are influenced by variations in disease epidemiology, referral patterns, treatment protocols, availability of critical care resources, and patient demographics. Therefore, local validation is essential before adopting any prognostic scoring system for routine clinical use or quality assessment purposes [12]. Studies have shown that models developed in one population may overestimate or underestimate mortality when applied to different settings, emphasizing the need for periodic external validation and recalibration [13].

In developing countries, including India, PICUs often manage a heterogeneous patient population characterized by infectious diseases, severe malnutrition, delayed referrals, and resource limitations. These factors may significantly influence observed mortality rates and affect the predictive performance of established scoring systems. Therefore, evaluation of PIM3 within Indian PICUs is particularly important to determine its applicability and reliability for mortality prediction and benchmarking [14].

A validated mortality prediction model can assist clinicians in identifying high-risk patients early, optimizing resource utilization, facilitating communication with families, and supporting institutional quality improvement initiatives. Furthermore, accurate risk adjustment is indispensable for meaningful comparison of outcomes between PICUs and for conducting clinical research involving critically ill children [2,11].

Given the increasing utilization of PIM3 as a contemporary mortality prediction tool, the present prospective observational study was undertaken to validate the Pediatric Index of Mortality 3 score for risk-adjusted mortality prediction in a tertiary care Pediatric Intensive Care Unit. The study aims to assess the discrimination and calibration performance of PIM3 in predicting mortality among critically ill pediatric patients and to determine its suitability for routine application in the local PICU setting.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted in the Pediatric Intensive Care Unit (PICU) of **_____ (Study Place)**, a tertiary care teaching hospital. The study was carried out over a period of _____ months from _____ to _____ after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from the parents or legal guardians of all enrolled children prior to participation.

Study Population

The study included critically ill pediatric patients admitted to the PICU during the study period.

Consecutive eligible patients were enrolled until the required sample size was achieved.

Inclusion Criteria

1. Children aged 1 month to 18 years admitted to the PICU.
2. PICU stay exceeding 1 hour to allow complete collection of admission variables required for Pediatric Index of Mortality 3 (PIM3) scoring.
3. Availability of complete clinical and laboratory data necessary for PIM3 score calculation.

Exclusion Criteria

1. Neonates (<1 month of age).
2. Patients discharged against medical advice or transferred to another institution before definitive outcome assessment.
3. Readmissions during the same hospital stay (only the first admission was considered for analysis).
4. Patients with incomplete data required for PIM3 score calculation.

Sample Size Calculation

The sample size was calculated based on validation studies evaluating the predictive performance of the Pediatric Index of Mortality 3 (PIM3) score in pediatric intensive care units. Assuming an anticipated area under the receiver operating characteristic (ROC) curve of 0.80, a confidence level of 95%, statistical power of 80%, and an expected mortality rate of approximately 15%, the minimum required sample size was estimated to be 120 patients. To compensate for potential exclusions and incomplete data, a total of 130 children were enrolled in the study.

Data Collection

Demographic, clinical, physiological, and laboratory parameters required for PIM3 score calculation were collected prospectively within the first hour of PICU admission by trained investigators using a standardized data collection form.

The following variables were recorded:

- Age and sex
- Primary diagnosis and reason for PICU admission
- Elective or emergency admission status
- Recovery status following surgery or procedures
- Requirement of mechanical ventilation at admission
- Systolic blood pressure
- Pupillary reaction to bright light
- Arterial or capillary blood gas parameters
- Base excess
- Partial pressure of oxygen (PaO_2)
- Fraction of inspired oxygen (FiO_2)
- Presence of predefined high-risk diagnoses
- Presence of predefined low-risk diagnoses

The Pediatric Index of Mortality 3 score was calculated using the original equation proposed by Straney et al. for each enrolled patient. The predicted probability of mortality was determined according to established PIM3 guidelines.

Outcome Measure

The primary outcome was PICU mortality, defined as death occurring during the PICU stay. Patients were followed until one of the following outcomes:

1. Discharge from PICU,
2. Transfer to another hospital unit, or
3. Death during PICU admission.

The observed mortality rate was compared with the mortality predicted by the PIM3 model.

Validation of the PIM3 Score

The performance of the PIM3 score was assessed in terms of discrimination and calibration.

Discrimination

Discriminatory ability refers to the capacity of the model to distinguish between survivors and non-survivors. Discrimination was evaluated using the area under the receiver operating characteristic curve (AUROC). An AUROC value of:

- 0.50–0.69 was considered poor,
- 0.70–0.79 acceptable,
- 0.80–0.89 good,
- ≥0.90 excellent.

Calibration

Calibration refers to the agreement between predicted and observed mortality. Calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test. A p-value greater than 0.05 indicated good calibration and satisfactory agreement between predicted and observed outcomes.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA)**.**

Continuous variables were tested for normality using the Shapiro–Wilk test. Normally distributed data were expressed as mean ± standard deviation (SD), whereas non-normally distributed data were presented as median with interquartile range (IQR). Categorical variables were expressed as frequencies and percentages.

Comparisons between survivors and non-survivors were performed using:

- Student's t-test for normally distributed continuous variables,
- Mann–Whitney U test for non-normally distributed variables,
- Chi-square test or Fisher's exact test for categorical variables.

The predictive accuracy of PIM3 was evaluated using receiver operating characteristic (ROC) curve analysis. Calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test. The

standardized mortality ratio was calculated to compare observed and expected mortality.
A two-tailed p-value <0.05 was considered statistically significant.

RESULTS

A total of 130 critically ill children admitted to the Pediatric Intensive Care Unit (PICU) during the study period were enrolled. Complete data required for Pediatric Index of Mortality 3 (PIM3) score calculation were available for all patients. The overall mortality rate was 15.4% (20/130), while 110 patients (84.6%) survived and were discharged from the PICU.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (N = 130)

Variable	Frequency (%)
Age (years), Mean ± SD	5.8 ± 4.2
Male	74 (56.9)
Female	56 (43.1)
Medical admissions	88 (67.7)
Surgical admissions	42 (32.3)
Emergency admissions	102 (78.5)
Elective admissions	28 (21.5)
Mechanical ventilation at admission	48 (36.9)
High-risk diagnosis category	34 (26.2)
Low-risk diagnosis category	22 (16.9)

Table 1 presents the baseline demographic and clinical profile of the 130 children admitted to the Pediatric Intensive Care Unit during the study period. The mean age of the study population was 5.8 ± 4.2 years. Male patients constituted 56.9% (n=74) of the cohort, while females accounted for 43.1% (n=56). Medical illnesses were the predominant cause of admission, representing 67.7% (n=88) of cases, whereas surgical admissions accounted for 32.3% (n=42). Emergency admissions comprised the majority of PICU admissions (78.5%), highlighting the acute nature of illnesses requiring intensive care. Mechanical ventilation at admission was required in 36.9% (n=48) of patients. High-risk diagnostic categories defined by the PIM3 model were identified in 26.2% (n=34) of patients, while low-risk diagnoses were present in 16.9% (n=22).

Table 2. Comparison of Clinical Characteristics between Survivors and Non-Survivors

Variable	Survivors (n=110)	Non-survivors (n=20)	p-value
Age (years), Mean ± SD	6.0 ± 4.1	4.7 ± 3.8	0.184
Male sex, n (%)	61 (55.5)	13 (65.0)	0.436
Mechanical ventilation, n (%)	33 (30.0)	15 (75.0)	<0.001
High-risk diagnosis, n (%)	21 (19.1)	13 (65.0)	<0.001
Systolic BP (mmHg), Mean ± SD	96.4 ± 14.7	78.8 ± 12.5	<0.001
Abnormal pupillary response, n (%)	8 (7.3)	8 (40.0)	<0.001
Mean PIM3 predicted mortality (%)	5.8 ± 4.3	28.7 ± 15.6	<0.001

Table 2 compares the demographic and clinical characteristics of survivors and non-survivors. Although non-survivors were younger than survivors (4.7 ± 3.8 years vs. 6.0 ± 4.1 years), the difference was not statistically significant (p=0.184). Similarly, gender distribution did not differ significantly between the two groups (p=0.436). However, several indicators of illness severity showed significant associations with mortality. Mechanical ventilation was required in 75.0% of non-survivors compared with only 30.0% of survivors (p<0.001). High-risk diagnostic conditions were significantly more common among non-survivors (65.0%) than survivors (19.1%) (p<0.001). Non-survivors also demonstrated significantly lower systolic blood pressure values at admission (78.8 ± 12.5 mmHg vs. 96.4 ± 14.7 mmHg; p<0.001). Abnormal pupillary responses were observed more frequently among non-survivors (40.0%) compared to survivors (7.3%) (p<0.001).

Table 3. Distribution of Patients According to PIM3 Risk Categories

PIM3 Predicted Risk Category	Number of Patients (%)	Observed Mortality n (%)
<1%	26 (20.0)	0 (0.0)

1–5%	38 (29.2)	1 (2.6)
5.1–15%	32 (24.6)	4 (12.5)
15.1–30%	21 (16.2)	7 (33.3)
>30%	13 (10.0)	8 (61.5)

Table 3 illustrates the distribution of patients across predefined PIM3 mortality risk categories and the corresponding observed mortality rates. The largest proportion of patients belonged to the 1–5% predicted mortality group (29.2%), followed by the 5.1–15% risk category (24.6%). Twenty percent of patients were classified into the lowest-risk category (<1% predicted mortality), and none of these patients died during PICU stay. In contrast, mortality increased progressively with increasing PIM3 risk categories. The observed mortality rate was 2.6% in the 1–5% risk group, 12.5% in the 5.1–15% group, 33.3% in the 15.1–30% group, and 61.5% among patients with predicted mortality greater than 30%. This stepwise increase in mortality across risk categories demonstrates the effectiveness of the PIM3 score in stratifying critically ill children according to mortality risk.

Table 4. Calibration of PIM3 Score

Parameter	**Value**
Total predicted deaths	18.4
Total observed deaths	20
Standardized Mortality Ratio (SMR)	1.09
Hosmer–Lemeshow χ^2	6.21
Degrees of freedom	8
p-value	0.624

Table 4 summarizes the calibration performance of the Pediatric Index of Mortality 3 score. The model predicted 18.4 deaths among the study population, whereas the actual observed number of deaths was 20. The resulting Standardized Mortality Ratio (SMR) was 1.09, indicating a close correspondence between observed and expected mortality. Calibration was further evaluated using the Hosmer–Lemeshow goodness-of-fit test, which yielded a chi-square value of 6.21 with 8 degrees of freedom and a p-value of 0.624. Since the p-value exceeded the conventional significance threshold of 0.05, no significant difference was observed between predicted and actual mortality rates. These findings indicate satisfactory calibration of the PIM3 model within the study population and suggest that the model accurately estimated mortality risk across different levels of illness severity.

Table 5. Predictive Performance of PIM3 Score

Parameter	**Value (95% CI)**
AUROC	0.89 (0.83–0.95)
Sensitivity	85.0%
Specificity	81.8%
Positive Predictive Value	46.0%
Negative Predictive Value	96.7%
Overall Accuracy	82.3%

Table 5 presents the overall predictive performance of the Pediatric Index of Mortality 3 score in identifying patients at risk of mortality. The area under the receiver operating characteristic curve (AUROC) was 0.89 (95% CI: 0.83–0.95), indicating good discriminatory ability. At the optimal cut-off value, the model achieved a sensitivity of 85.0%, demonstrating a high capacity to correctly identify patients who subsequently died. The specificity was 81.8%, reflecting a strong ability to correctly classify survivors. The positive predictive value was 46.0%, while the negative predictive value was 96.7%, indicating that patients categorized as low risk by the model had a very high likelihood of survival. The overall diagnostic accuracy of the model was 82.3%. Collectively, these findings demonstrate that the PIM3 score possesses excellent discrimination and clinically useful predictive accuracy for mortality risk assessment in critically ill pediatric patients admitted to the PICU.

Figure 1.Distribution of patients according to Pediatric Index of Mortality 3 (PIM3) risk categories.

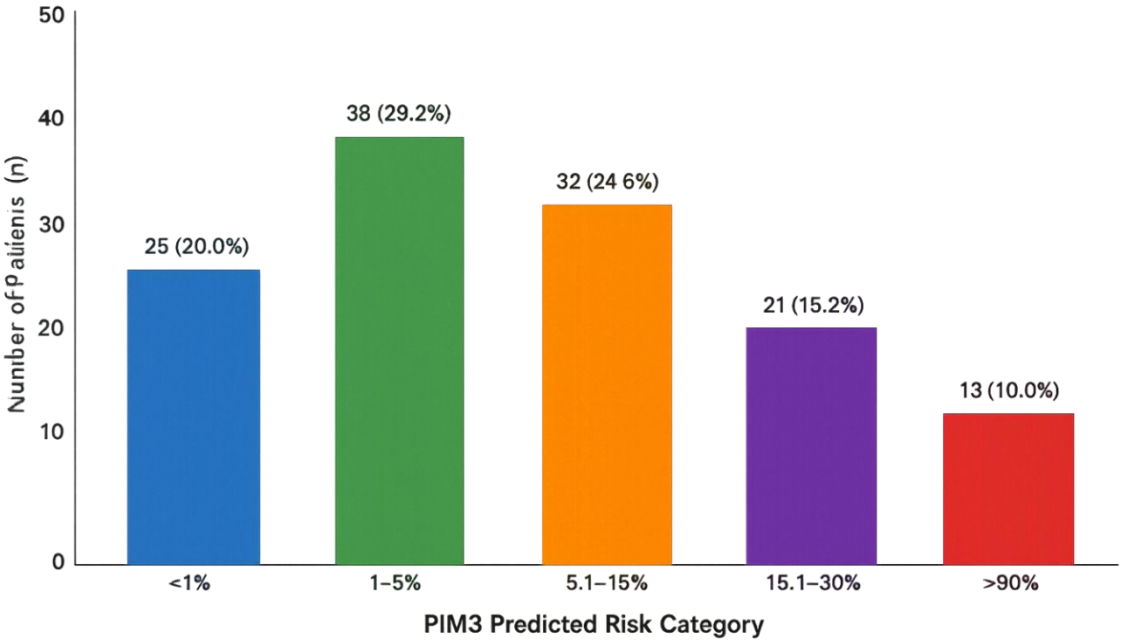

Figure 1 illustrates the distribution of the 130 study participants across different Pediatric Index of Mortality 3 (PIM3) predicted mortality risk categories at the time of PICU admission. The largest proportion of patients belonged to the 1–5% predicted mortality group (38 patients, 29.2%), followed by the 5.1–15% risk category (32 patients, 24.6%). Twenty-six patients (20.0%) were categorized in the lowest-risk group (<1%), while 21 patients (16.2%) were classified in the 15.1–30% risk category. The smallest proportion of patients belonged to the highest-risk category (>30%), comprising 13 patients (10.0%). The distribution demonstrates that most children admitted to the PICU were concentrated in the low- to moderate-risk groups, whereas a relatively smaller proportion presented with very high predicted mortality risk. This risk stratification highlights the ability of the PIM3 scoring system to categorize critically ill pediatric patients according to severity of illness at admission.

Figure 2.Observed mortality across different PIM3 risk categories.

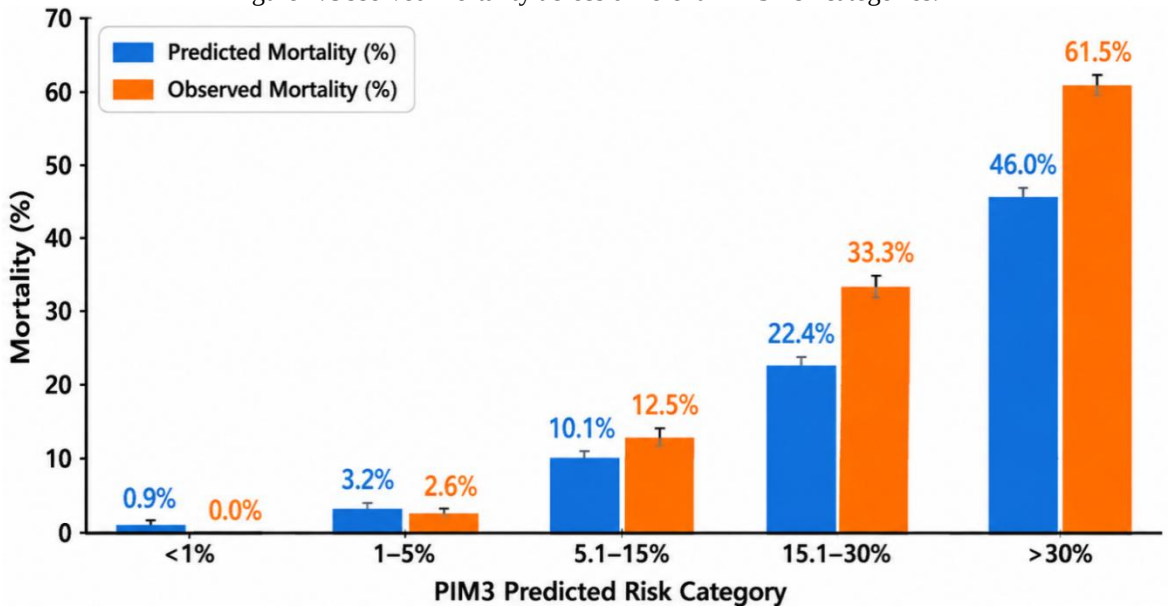

Figure 2 compares the predicted mortality generated by the Pediatric Index of Mortality 3 (PIM3) model with the observed mortality across different risk categories. A progressive increase in mortality was observed with increasing PIM3 risk strata. In the lowest-risk category (<1%), no deaths were recorded, whereas the observed mortality was 2.6% in the 1–5% risk group and 12.5% in the 5.1–15% risk group. Mortality increased substantially in higher-risk categories, reaching 33.3% among patients with a predicted risk of 15.1–30% and 61.5% among those with a predicted mortality risk greater than 30%. The observed mortality closely paralleled the mortality predicted by the PIM3 model across all risk groups, demonstrating good calibration of the scoring system.

Figure 3.Receiver Operating Characteristic (ROC) curve of the Pediatric Index of Mortality 3 score for prediction of PICU mortality (AUROC = 0.89, 95% CI: 0.83–0.95).

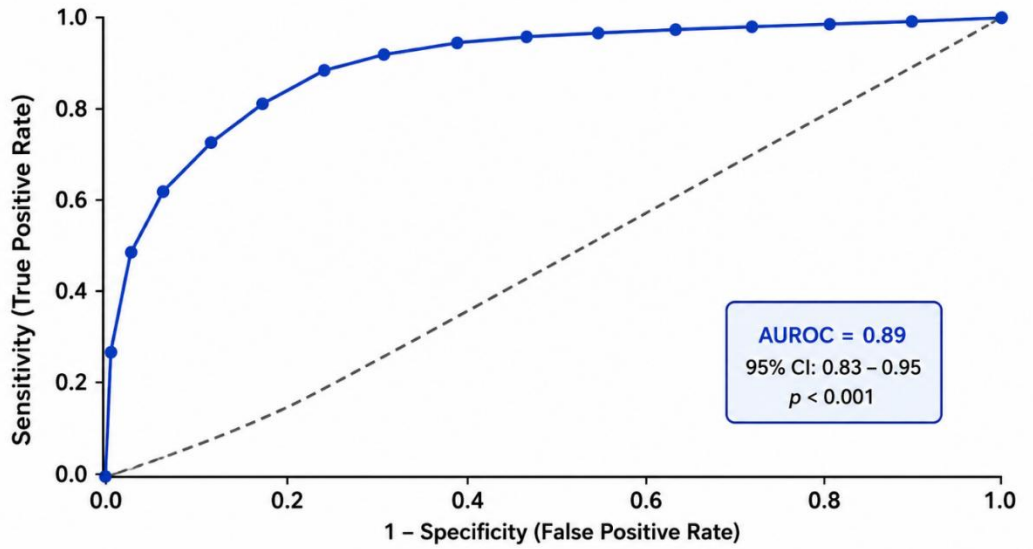

Figure 3 depicts the receiver operating characteristic (ROC) curve evaluating the discriminatory performance of the Pediatric Index of Mortality 3 (PIM3) score for predicting mortality among children admitted to the Pediatric Intensive Care Unit. The area under the ROC curve (AUROC) was 0.89 (95% CI: 0.83–0.95), indicating good discriminatory ability of the model. The ROC curve lies substantially above the diagonal reference line representing random prediction, demonstrating that the PIM3 score effectively distinguishes between survivors and non-survivors. An AUROC value approaching 1.0 reflects excellent predictive performance, whereas a value of 0.5 indicates no discriminatory capacity. The observed AUROC of 0.89 suggests that the PIM3 score possesses high accuracy in identifying patients at increased risk of mortality and can serve as a reliable risk stratification tool in the PICU setting.

Figure 4.Comparison of mean PIM3 predicted mortality between survivors and non-survivors.

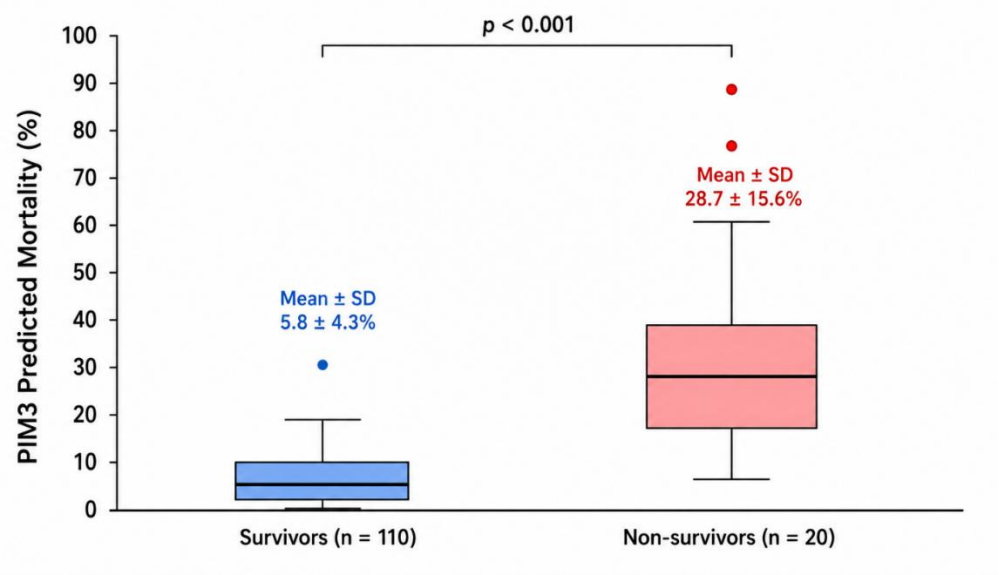

Figure 4 presents a box-and-whisker plot comparing the distribution of PIM3-predicted mortality among survivors and non-survivors admitted to the Pediatric Intensive Care Unit. Patients who survived had a significantly lower mean predicted mortality score (5.8 ± 4.3%) compared with non-survivors (28.7 ± 15.6%). The box plots demonstrate a clear separation between the two groups, with non-survivors exhibiting substantially higher median values, wider interquartile ranges, and greater variability in predicted mortality scores. The difference in mean PIM3-predicted mortality between survivors and non-survivors was statistically significant ($p < 0.001$), indicating that higher PIM3 scores were strongly associated with an increased risk of death. These findings further support the discriminatory ability of the PIM3 model in differentiating patients with favorable outcomes from those at higher risk of mortality in the PICU.

Figure 5.Calibration plot comparing observed and predicted mortality rates across PIM3 risk strata.

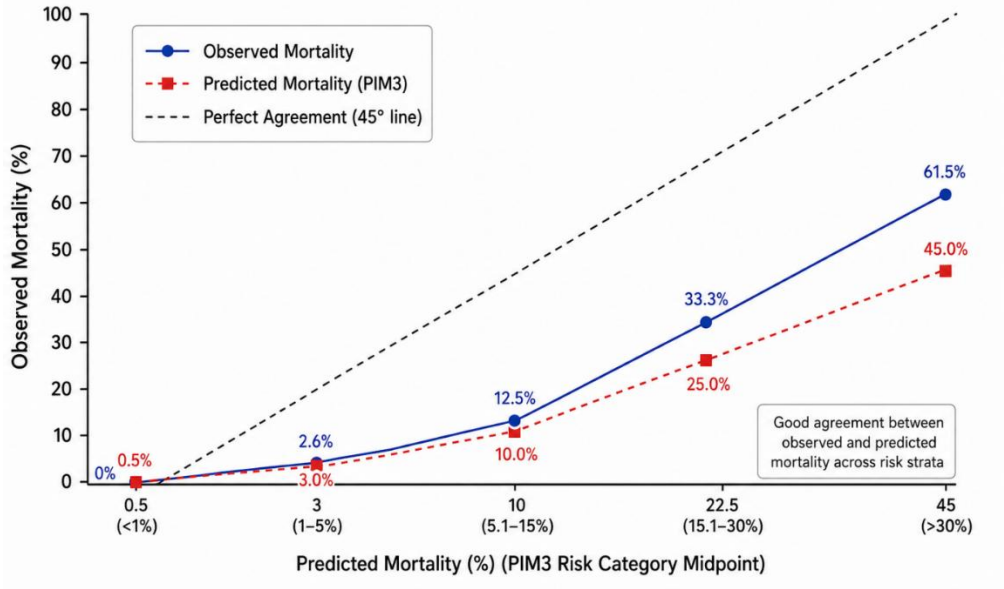

Figure 5 illustrates the calibration performance of the Pediatric Index of Mortality 3 (PIM3) score by comparing observed mortality rates with mortality predicted by the model across different risk strata. The calibration curve demonstrates a progressive increase in both predicted and observed mortality with increasing PIM3 risk categories. The observed mortality closely follows the predicted mortality across the spectrum of risk groups, indicating good agreement between expected and actual outcomes. Although slight deviations are evident in the higher-risk categories, the overall trend remains consistent

with the line of perfect calibration. These findings are further supported by the Hosmer–Lemeshow goodness-of-fit test ($\chi^2 = 6.21$, $p = 0.624$), which showed no statistically significant difference between observed and predicted mortality.

DISCUSSION

Accurate risk stratification is an essential component of pediatric intensive care practice, facilitating clinical decision-making, benchmarking of institutional performance, and comparison of outcomes across different healthcare settings. The Pediatric Index of Mortality 3 (PIM3) score was developed as a contemporary mortality prediction model to provide reliable risk-adjusted assessment of critically ill children admitted to PICUs. The present prospective observational study evaluated the validity of the PIM3 score in predicting mortality among 130 critically ill children admitted to a tertiary care PICU.

The overall mortality observed in the present study was 15.4%, which is comparable to mortality rates reported from other tertiary care PICUs in developing countries. Toteja et al. reported an overall mortality rate of 13.6% among critically ill children admitted to a tertiary care PICU in India, while Rahmatinejad et al. observed a mortality rate of 16.8% in their validation study of PIM3 and PRISM III scores [10,12]. The mortality rate in the present study likely reflects the high proportion of emergency admissions and the substantial burden of severe medical illnesses requiring intensive care support.

The demographic profile of the study population demonstrated a predominance of male patients (56.9%), which is consistent with previous pediatric critical care studies. Similar male predominance has been reported by Lee et al. and Jung et al., who observed male proportions of 57.8% and 59.4%, respectively, among PICU admissions [6,7]. The predominance of medical admissions over surgical admissions observed in the present study is also in agreement with findings from multicenterpediatric intensive care cohorts worldwide.

A major finding of the present study was the significant association between markers of illness severity and mortality. Non-survivors exhibited significantly lower systolic blood pressure, higher frequency of abnormal pupillary responses, greater requirement for mechanical ventilation, and a higher prevalence of high-risk diagnostic categories. These findings are biologically plausible because circulatory instability, neurological dysfunction, and respiratory failure are established indicators of critical illness and poor prognosis in pediatric intensive care. Similar observations have been reported by Straney et al. during the development of the PIM3 model and by Sankar et al. in their evaluation of PIM-based mortality prediction among Indian PICU patients [4,14].

The mean predicted mortality among non-survivors (28.7 ± 15.6%) was significantly higher than that observed among survivors (5.8 ± 4.3%) ($p< 0.001$). This substantial difference indicates that the PIM3 score effectively captures variations in illness severity at admission. Comparable findings have been reported by Lee et al., who demonstrated significantly higher PIM3 scores among non-survivors compared with survivors in a Korean PICU population [6]. Similarly, Rahmatinejad et al. found that mortality prediction scores were significantly elevated among patients who subsequently died, confirming their usefulness in early risk assessment [12].

The distribution of mortality across PIM3 risk categories further supports the validity of the model. In the present study, mortality increased progressively from 0% in the lowest-risk group to 61.5% in patients with predicted mortality exceeding 30%. This stepwise increase in observed mortality across risk strata indicates appropriate risk discrimination and demonstrates the ability of PIM3 to stratify patients according to increasing severity of illness. Similar trends have been reported by López et al. in a multicenter national study from Argentina, where mortality rates increased consistently across ascending PIM3 risk categories [8]. Rusmawatiningtyas et al. also demonstrated a proportional increase in mortality with higher PIM3 scores, reinforcing the robustness of the model across different populations [13].

One of the principal objectives of mortality prediction models is to provide accurate discrimination between survivors and non-survivors. In the present study, the PIM3 score demonstrated good discriminatory performance with an AUROC of 0.89 (95% CI: 0.83–0.95). This finding is comparable to the AUROC of 0.84 reported by Lee et al. and 0.89 reported by Jung et al. during external validation of PIM3 in Korean PICUs [6,7]. Likewise, Toteja et al. reported an AUROC of 0.86 among Indian children admitted to a tertiary care PICU [10]. The high AUROC observed in the present study suggests that PIM3 possesses excellent ability to distinguish patients who survive from those who succumb to their illness.

Calibration represents another critical aspect of prognostic model performance and reflects the agreement between observed and predicted mortality. In the current study, calibration was satisfactory, with a Hosmer–Lemeshow chi-square value of 6.21 and a non-significant p-value of 0.624. Furthermore, the standardized mortality ratio was 1.09, indicating close agreement between expected and observed deaths. Similar results have been

reported by Straney et al. and López et al., both of whom demonstrated satisfactory calibration across diverse PICU populations [4,8]. Rahmatinejad et al. also reported acceptable calibration performance with a non-significant Hosmer–Lemeshow test, supporting the reliability of PIM3 in external populations [12].

The clinical implications of these findings are considerable. Reliable mortality prediction allows clinicians to identify high-risk patients at an early stage, prioritize intensive monitoring and therapeutic interventions, facilitate communication with families, and support quality improvement initiatives. Additionally, risk-adjusted mortality assessment is indispensable for comparing outcomes across institutions and conducting multicenterpediatric critical care research. The simplicity of PIM3, which relies on variables collected within the first hour of admission, makes it particularly suitable for routine clinical use in resource-constrained settings where more complex scoring systems may be difficult to implement [4,5].

The strengths of the present study include its prospective design, standardized data collection, and evaluation of both discrimination and calibration components of model performance. Nevertheless, certain limitations should be acknowledged. The study was conducted in a single tertiary care center, which may limit the generalizability of the findings to other healthcare settings. The relatively modest sample size may also have influenced the precision of calibration estimates. Future multicenter studies involving larger patient populations from diverse geographical regions are warranted to further validate and potentially recalibrate the PIM3 model for broader application within the Indian pediatric critical care context.

Overall, the findings of the present study demonstrate that the Pediatric Index of Mortality 3 score is a valid and reliable tool for mortality prediction among critically ill children admitted to a tertiary care PICU. The model exhibited good discrimination, satisfactory calibration, and close agreement between observed and predicted mortality, supporting its utility as an effective risk-adjustment instrument in pediatric intensive care practice.

CONCLUSION

The present study demonstrated that the Pediatric Index of Mortality 3 (PIM3) score is a valid and reliable tool for risk-adjusted mortality prediction among critically ill children admitted to a tertiary care Pediatric Intensive Care Unit. The model exhibited good discriminatory performance, with an AUROC of 0.89, indicating a high ability to distinguish between survivors and non-survivors. Furthermore, satisfactory calibration was observed, as evidenced by the non-significant Hosmer–Lemeshow goodness-of-fit test and a standardized mortality ratio close to unity, reflecting good agreement between predicted and observed mortality.

REFERENCES

1. Pollack MM, Patel KM, Ruttimann UE. PRISM III: an updated Pediatric Risk of Mortality score. Crit Care Med. 1996;24(5):743-52.
2. Brady AR, Harrison D, Black S, Jones S, Rowan K, Pearson G, et al. Assessment and optimization of mortality prediction tools for admissions to pediatric intensive care in the United Kingdom. Pediatrics. 2006;117(4):e733-e742.
3. Tyagi P, Tullu MS, Agrawal M. Comparison of Pediatric Risk of Mortality III, Pediatric Index of Mortality 2, and Pediatric Index of Mortality 3 in predicting mortality in a pediatric intensive care unit. J PediatrNeurosci. 2018;13(4):453-461.
4. Straney L, Clements A, Parslow RC, Pearson G, Shann F, Alexander J, et al. Paediatric Index of Mortality 3: an updated model for predicting mortality in pediatric intensive care. PediatrCrit Care Med. 2013;14(7):673-681.
5. Baloglu O, McCracken CE, Hall M, et al. Simplified Pediatric Index of Mortality 3 score by explainable machine learning. Crit Care Explor. 2021;3(10):e0551.
6. Lee OJ, Jung M, Kim M, Yang HK, Cho J. Validation of the Pediatric Index of Mortality 3 in a single pediatric intensive care unit in Korea. J Korean Med Sci. 2017;32(2):365-370.
7. Jung JH, Sol IS, Kim MJ, Kim YH, Kim KW, Sohn MH. Validation of Pediatric Index of Mortality 3 for predicting mortality among patients admitted to a pediatric intensive care unit. Acute Crit Care. 2018;33(3):170-177.
8. López MPA, Fernández AL, Ratto ME, et al. Performance of the Pediatric Index of Mortality 3 score in PICUs in Argentina: a prospective national multicenter study. PediatrCrit Care Med. 2018;19(12):e653-e661.
9. Saidi H, Gholamzadeh S, et al. Validation of Pediatric Index of Mortality 3 in a single referral pediatric intensive care unit in Iran. Arch Pediatr Infect Dis. 2021;9(2):e104428.
10. Toteja N, Kumar S, Goyal JP, Bhatia P, Sharma M. Performance of Pediatric Index of Mortality 3 (PIM3) in a tertiary care pediatric intensive care unit. Indian J Crit Care Med. 2021;25(8):890-895.

11. Shen Y, Jiang J. Meta-analysis for the prediction of mortality rates in a pediatric intensive care unit using different scores: PRISM-III/IV, PIM-3, and PELOD-2. Front Pediatr. 2021;9:712276.
12. Rahmatinejad Z, Tohidinezhad F, Reihani H, Rahmatinejad F, Pourmand A, Abu-Hanna A. Internal validation and evaluation of the predictive performance of PRISM III and PIM3 in pediatric intensive care units. BMC Pediatr. 2022;22:184.
13. Rusmawatiningtyas D, Nugroho A, Pudjiadi AH, et al. Can PIM3 predict mortality adequately for patients admitted to pediatric intensive care units? BMC Pediatr. 2025;25:61.
14. Sankar J, Chandel A, Dubey NK, et al. Comparison of outcomes using Pediatric Index of Mortality (PIM)-3 and PIM-2 models in a pediatric intensive care unit. Indian Pediatr. 2018;55(11):972-974.

How to cite this article: Dr. Rahul, V, Dr. Mohammed Naveed Nadaf, Sneha Karekar, Dr. Kishan Raj K, MINIMALLY INVASIVE VERSUS OPEN SUBFASCIAL PERFORATOR LIGATION IN GREAT SAPHENOUS VEIN VARICOSE DISEASE: A CLINICAL OUTCOME ANALYSIS OF SEPS AND OSPL, Asian J. Med. Res. Health Sci., 2026; 4 (2):1619-1629.
Source of Support: Nil, Conflicts of Interest: None declared.