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COMPARISON OF TOPRSS SCORE & PEDIATRIC EARLY WARNING SCORE (PEWS) IN PREDICTING OUTCOME IN PEDIATRIC INTENSIVE CARE UNIT

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Abstract

Objective

To determine the predictive performance of the TOPRSS score and the Paediatric Early Warning Score (PEWS) in predicting mortality among critically ill children admitted to the PICU.

Methodology

This cross-sectional study was conducted from November 2024 to April 2025 in the Paediatric Intensive Care Unit of The Indus Hospital, Karachi. A consecutive sample of 344 children aged 1 month to 16 years admitted to the PICU/PHDU was enrolled after guardian consent. TOPRSS and PEWS were recorded at admission, and outcomes included mortality. Data was analysed in SPSS 26 using ROC and logistic regression ($p < 0.05$).

Results

Among 344 children (mean age 5.1±4.6 years; 59% male), mortality was 25.9%. Non-survivors had significantly higher TOPRSS (4.36 vs 2.35) and PEWS scores (7.90 vs 4.59) (both p=0.0001). TOPRSS (AUC 0.943; sensitivity 88.8%; specificity 96.1%) and PEWS (AUC 0.940; sensitivity 79.8%; specificity 98.0%) showed excellent mortality discrimination. Increasing age reduced mortality risk (OR 0.868), while gender showed no significant association.

Conclusion

TOPRSS and PEWS both showed a high accuracy in predicting mortality in critically ill paediatric patients with similar values of AUC and complementary strengths. TOPRSS was more sensitive and PEWS more specific and thus the utility of these two could be useful in risk stratification of patients at the PICU admission stage. Non-survivors showed higher severity scores and more often died, patients with sepsis and comorbidities, such as malignancy, had more frequent mortality. Increasing age was protective. These results indicate that TOPRSS and

PEWS can be considered effective early warning systems in paediatric intensive care units still, the findings require multicentre research to establish their generalizability.

INTRODUCTION

The improvement of paediatric intensive care units (PICUs) in Pakistan over the last decade has enabled the admission of patients who require continuous monitoring, hemodynamic support, respiratory support, and advanced airway management to achieve better outcomes [1,2]. However, critically ill patients display significant variability in illness severity, disease course, and outcomes, which is influenced by multiple factors, such as the patient's intrinsic factors, nature or stage of illness, available resources, therapeutic approach, and others [3]. Therefore, early detection of critically ill patients and optimization of resource allocation are essential for ensuring better quality of care and patient safety, especially in low and middle-income countries like Pakistan, where resources are limited and a surge of critically ill paediatric patients can create a disbalance between needs and availability. In this context, an accurate, well-validated, and easy-to-calculate risk assessment tool can help prioritize patients and optimize resource use in the PICUs [5]. Such tools, which provide objectivity to critical illness, have been developed based on scoring systems that have been constantly explored by critical care health care providers since the establishment of PICU [1,6]. There is also a great degree of physiological diversity between paediatric populations of different ages, making it difficult to apply cutoff thresholds instead of generalizing early warning tools designed to work with diverse patient populations [7]. In addition, the Paediatric Early Warning Score (PEWS) has demonstrated clinical utility in predicting clinical deterioration on general paediatric wards; however, its predictive validity in high-acuity settings such as paediatric intensive care units (PICUs) remains inconsistent, particularly in resource-limited environments where challenges related to monitoring and documentation may be amplified [7,8]. In contrast, the TOPRSS (Temperature, Oxygen saturation, Pulse rate, Respiratory rate, Sensorium, Seizure activity, and blood glucose) score represents a simple, bedside-based clinical risk assessment tool that does not require laboratory support or complex calculations. Several prospective studies conducted in paediatric emergency departments and inpatient settings have demonstrated that the TOPRSS score is effective in predicting clinical outcomes and mortality among children, highlighting its potential utility in resource-constrained settings [9–11]. Prospective investigations in the emergency department have provided encouraging mortality prognosis with TOPRSS, especially at a threshold of more than three points, and comparative studies with PEWS in PICU units are scarce [12,13]. As the patient uniqueness, severity of illness, and constant monitoring evident in the PICUs, the outcome measures of general ward or emergency ward research might not be relevant in the behaviour of the tool in the intensive care unit. The relative strengths of TOPRSS and PEWS in predicting clinically significant outcomes e.g. mortality should thus be compared and analysed in a PICU population. This type of evidence is urgently required in low- and middle-income countries, where resource limits increase the urgency to have proper, effective, and locally relevant early warning systems. This study evaluates the predictive accuracy of these scoring systems and how they aid clinical decision-making in the PICU in a real-world scenario by assessing their predictive accuracy and their role in risk stratification, monitoring intensity, and critical care resource allocation.

METHODOLOGY

This cross-sectional study was conducted from November 2024 to April 2025 in the Paediatric Intensive Care Unit (PICU) of The Indus Hospital, Karachi, a tertiary-care facility, following institutional ethical approval (IHHN-IRB No. **IHHN_IRB_2024_09_015**). A non-probability consecutive sampling technique was used. Children aged 1 month to 16 years admitted to the PICU or Paediatric High Dependency Unit

(PHDU) were eligible for inclusion after informed guardian consent. Exclusion criteria included surgical illnesses, congenital anomalies, admissions solely for procedural sedation, patients leaving against medical advice, and those requiring cardiopulmonary resuscitation or experiencing death within the first two hours of admission.

Exposure variables were the TOPRSS score comprising temperature, oxygen saturation, pulse rate, respiratory rate, sensorium assessed using the AVPU scale, seizure activity, and random blood glucose and the Paediatric Early Warning Score (PEWS), which evaluates behaviour, cardiovascular status, and respiratory status. Both scores were calculated at admission using routinely recorded clinical parameters. Outcome variables included PICU mortality, defined as death during the index PICU admission. A final sample size of 344 participants was determined using PASS version 15, based on an assumed area under the curve (0.903)[9] for TOPRSS and (AUC) of (0.953)[19] for PEWS, with 80% power, a 5% significance level, and positive and negative correlation assumptions of 0.5 each. Data collection included demographic characteristics, comorbidities, admitting diagnosis, and all clinical measurements required to compute TOPRSS and PEWS, documented at admission and monitored throughout hospitalization.

Data were analysed using SPSS version 26. Descriptive statistics summarized baseline variables; ROC curves were constructed to evaluate discriminatory accuracy; and logistic regression was applied to assess predictors of mortality, with statistical significance set at $p < 0.05$.

RESULTS

Table I: Baseline and Clinical Characteristics of Study Participants (n=344)

Characteristics		Mortality		P-Value
		Yes (n=89)	No (n=255)	
Age in years, Mean ± SD		7.43 ± 4.85	4.29 ± 4.34	0.0001*
TOPRSS Score, Mean ± SD		4.36 ± 0.89	2.35 ± 0.69	0.0001*
PEWS Score, Mean ± SD		7.90 ± 1.28	4.59 ± 1.43	0.0001*
Gender	Male	52 (58.4)	155 (60.8)	0.696
	Female	37 (41.6)	100 (39.2)	
Diagnosis				
RTI	Pneumonia	16 (18.0)	120 (47.1)	0.0001*
	Bronchiolitis	4 (4.5)	9 (3.5)	
	Asthma	1 (1.1)	6 (2.4)	
Cardiovascular	Myocarditis	0 (0.0)	1 (0.4)	
	Cardiac failure	1 (1.1)	0 (0.0)	
CNS	Meningitis	6 (6.7)	29 (11.4)	
	Encephalitis	1 (1.1)	1 (0.4)	
	Cerebral malaria	2 (2.2)	1 (0.4)	
	SOL	1 (1.1)	3 (1.2)	
	GBS	0 (0.0)	2 (0.8)	
GIT & HBS	Acute gastroenteritis	1 (1.1)	6 (2.4)	

	Liver abscess	0 (0.0)	2 (0.8)	
	Celiac disease	0 (0.0)	2 (0.8)	
Haematology	Hemoglobinopathies	0 (0.0)	1 (0.4)	
	Anaemic failure	0 (0.0)	2 (0.8)	
Renal	AKI	0 (0.0)	1 (0.4)	
	UTI	0 (0.0)	1 (0.4)	
Infections	Malaria	0 (0.0)	1 (0.4)	
	Dengue	2 (2.2)	3 (1.2)	
	Typhoid	0 (0.0)	3 (1.2)	
	Sepsis	37 (41.6)	33 (12.9)	
	Septic shock	17 (19.1)	21 (8.2)	
Others	Trauma	0 (0.0)	2 (0.8)	
	Foreign body	0 (0.0)	1 (0.4)	
	Anaphylaxis	0 (0.0)	1 (0.4)	
	Poisoning	0 (0.0)	3 (1.2)	
Comorbidities	Chronic GI Disease	0 (0.0)	3 (1.2)	0.406
	Chronic Kidney Disease	1 (1.1)	6 (2.4)	0.421
	Chronic Liver Disease	1 (1.1)	1 (0.4)	0.451
	Chronic Lung Disease	1 (1.1)	11 (4.3)	0.138
	Congenital Heart Disease	2 (2.2)	11 (4.3)	0.302
	Diabetes	1 (1.1)	4 (1.6)	0.614
	Malignancy	61 (68.5)	38 (14.9)	0.0001*
	Others	6 (6.7)	24 (9.4)	0.442

Table I presents baseline and clinical features of the 344 paediatric participants comprising of 89 non-survivors and 255 survivors. The age was found to be significantly higher in the non-survivors (7.43 +- 4.85 years) compared to survivors (4.29 ± 4.34 years) (p = 0.0001). The severity indicators of the illness were also significantly higher among the mortality group, mean TOPRSS (4.36±0.89 vs. 2.35±0.69) and PEWS scores (7.90±1.28 vs. 4.59±1.43) (all p=0.0001). There was no significant difference between the genders of the groups (p=0.696). Diagnostic profiles varied significantly, with pneumonia being the most common respiratory diagnosis among survivors, whereas sepsis and septic shock were substantially more frequent among non-survivors (p=0.0001). Malignancy was closely linked with mortality as there was 68.5% in non-survivor and 14.9% in survivor (p=0.0001). Other comorbidities such as chronic kidney disease, liver disease, lung disease, congenital heart disease and diabetes were not significantly related to mortality (all p > 0.05).

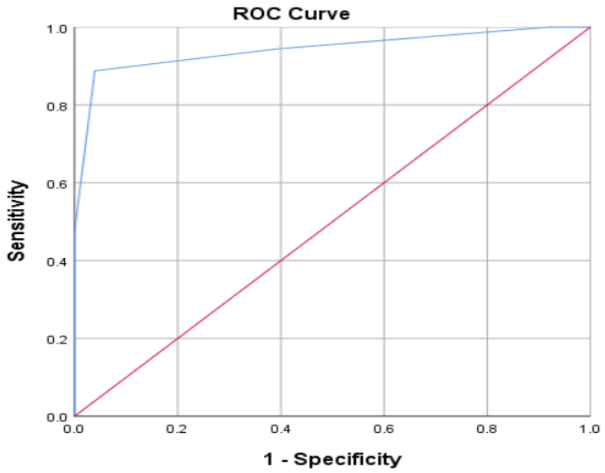

FIGURE I

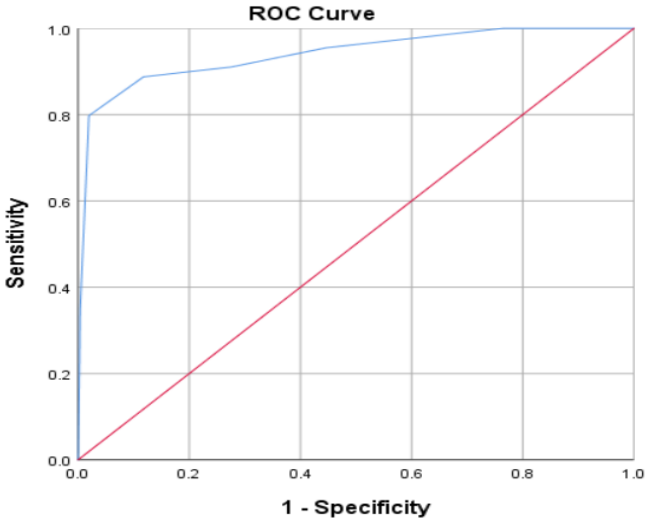

FIGURE II

Figure I and Figure II illustrate ROC curves of TOPRSS and PEWS respectively. Table II indicates that TOPRSS showed a good discriminatory ability with an AUC of 0.943 (SE 0.018; 95% CI: 0.908 to 0.977; p=0.0001). TOPRSS at an optimal cutoff of ≥3.50 had a sensitivity of 88.8 and specificity of 96.1. The positive likelihood ratio (22.77) was positive, which showed a strong rule-in value and the negative likelihood ratio (0.12) showed a strong rule-out ability. Likewise, PEWS had a very high predictive accuracy with an AUC of 0.940 (SE 0.016; 95% CI: 0.908-0.972; p=0.0001). A sensitivity of PEWS was 79.8% and a very high specificity was 98.0%. The likelihood ratio (39.9) was positive indicating better rule-in utility than TOPRSS, the negative likelihood ratio (0.21) was also moderate indicating moderate rule-out capability. All in all, these two scores showed excellent predictive accuracy of mortality, and TOPRSS was more sensitive, whereas PEWS was more specific.

Table II: ROC Curve Analysis of TOPRSS Score and PEWS Score for Predicting Mortality (n=344)	
TOPRSS SCORE	
Area under the curve (AUC)	0.943
Std. Error	0.018
95% Confidence Interval	0.908–0.977
P-Value	0.0001
Threshold Value	≥3.50
Sensitivity	88.8%
Specificity	96.1%
Positive Likelihood Ratio	22.77
Negative Likelihood Ratio	0.12
PEWS SCORE	
Area under the curve (AUC)	0.940
Std. Error	0.016
95% Confidence Interval	0.908–0.972
P-Value	0.0001
Threshold Value	≥7.50
Sensitivity	79.8%
Specificity	98.0%
Positive Likelihood Ratio	39.9
Negative Likelihood Ratio	0.21

Table III: Multivariable Logistic Regression Assessing the Impact of Age and Gender on the Mortality (n=344)

Predictor	Unadjusted Odd Ratio (95% C.I.)	P-value	Adjusted Odd Ratio (95% C.I.)	P-Value
Age (years)	0.871 (0.827 – 0.917)	0.0001	0.868 (0.824 – 0.915)	0.0001
Gender	0.907 (0.555 – 1.481)	0.696	0.787 (0.469 – 1.321)	0.365

Table III presents the multivariable logistic regression examining the effect of age and gender on mortality. Increasing age was independently associated with a lower risk of mortality, with age acting as a significant protective factor in both unadjusted (OR: 0.871; 95% CI: 0.827–0.917; p = 0.0001) and adjusted models (OR: 0.868; 95% CI: 0.824–0.915; p = 0.0001), indicating that each additional year of age was associated with approximately a 13% reduction in the odds of mortality. Gender was not significantly associated with mortality in either unadjusted (OR: 0.907; p = 0.696) or adjusted analyses (OR: 0.787; p = 0.365).

DISCUSSION

This study demonstrates that TOPRSS and PEWS have excellent discriminatory accuracy for predicting mortality among critically ill paediatric patients admitted to the PICU, with AUC values of 0.943 and 0.940, respectively. These findings are comparable to established intensive care-based severity scores such as PRISM III and PIM III, which have shown high mortality prediction accuracy but require extensive physiological and laboratory data [1,2]. In contrast, TOPRSS and PEWS offer comparable predictive performance using simple bedside parameters, making them practical tools for early risk stratification at PICU

admission, particularly in resource-limited settings. Conversely, the current study used both the instruments at the PICU admission, the point that the vital signs are measured more frequently and more precisely, which may have led to the increased predictive power of both scores. TOPRSS was more sensitive (88.8%) than PEWS (79.8%), indicating that it could be more useful in early detection of at-risk patients in resource-limited settings because it only uses easy-to-measured bedside parameters and does not need laboratory assistance. PEWS, on the other hand, was more specific (98.0%), which means that it was more able to rule-in. This increased specificity within the PICU environment could be a result of increased fidelity of scoring, increased attention, and increased physiological aberrations common in patients who are critically ill. These findings combined indicate that TOPRSS and PEWS have some complementary advantages that may contribute to the risk stratification and informational clinical choices. The mortality rate with sepsis is high based on the world literature that revealed sepsis as the major cause of PICU mortality [18]. Malignancy was also closely linked to death in this cohort, which is consistent with the information that the existence of malignancy in paediatric patients especially those with hematologic malignancies is greatly connected with the occurrence of death through immunosuppression, treatment-related toxicity, and high susceptibility to serious infections [14–16]. These results demonstrate the importance of increased surveillance and early detection among these high-risk populations. The age was identified as a protective factor with every year of age resulting in lower likelihood of mortality. Even though the previous literature has highlighted some difficulties in the application of a single set of scoring thresholds in different age groups of paediatric populations owing to physiological differences [7], the current analysis demonstrates that both TOPRSS and PEWS show a high level of predictive validity at the childhood stage when age is controlled independently. There are several strengths in this study. It simply compares two well-developed early warning systems used at the same time on the same group of patients, minimizing heterogeneity and allowing to provide a solid evaluation of comparative performance. Methodological rigour is increased using ROC analysis and multivariate logistic regression and the size of the sample that is used is relatively large to represent results of a single-centre PICU study and increases the reliability of the results. Moreover, evaluation in the daily PICU practice enhances the practicality and feasibility of results. Nevertheless, several limitations should be acknowledged. As the study was conducted in a single tertiary-care PICU, the findings may primarily reflect local patient characteristics and clinical practices, which could limit their broader applicability across different healthcare settings. The cross-sectional design did not allow assessment of dynamic changes in scores over time. Furthermore, the study did not evaluate the impact of staff training, scoring compliance, or the accuracy of real-time documentation, factors known to influence PEWS reliability [17]. Comparisons between electronic and paper-based scoring systems were also not performed, although previous studies have demonstrated that digital automation may enhance scoring accuracy and efficiency [18]. Despite these limitations, this study provides robust evidence on the comparative predictive performance of TOPRSS and PEWS for PICU mortality. The findings support the integration of structured early warning tools into routine critical care practice and highlight the need for future multicentre validation and further evaluation of automated or context-sensitive scoring systems to improve generalizability and documentation quality.

CONCLUSION

TOPRSS and PEWS both showed a high accuracy in predicting mortality in critically ill paediatric patients with similar values of AUC and complementary strengths. TOPRSS was more sensitive and PEWS more specific and thus the utility of these two could be useful in risk stratification of patients at the PICU admission stage. Non-survivors showed higher severity scores and more often died, patients with sepsis and comorbidities, such as malignancy, had more frequent mortality. Increasing age was protective.

These results indicate that TOPRSS and PEWS can be considered effective early warning systems in paediatric intensive care units still, the findings require multicentre research to establish their generalizability.

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