

PREDICTING OUTCOME USING PEDIATRIC EARLY WARNING SYSTEM (PEWS) SCORE ON PICU ADMISSION: A STUDY FROM A LOWER-MIDDLE-INCOME COUNTRY

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ABSTRACT

Background: The Paediatric Early Warning System (PEWS) Score is a well-established tool for identifying clinical deterioration in hospitalised children and facilitating early intervention. While PEWS is primarily used in ward settings, its utility in predicting clinical outcomes at the time of admission to the Paediatric Intensive Care Unit (PICU), such as mortality, length of stay, and need for mechanical ventilation, has not been extensively studied, particularly in resource-limited settings. Understanding the prognostic value of PEWS in PICU could help optimise patient management and resource allocation in such environments. **Objective:** To assess the validity of the Paediatric Early Warning System (PEWS) score as a predictor of mortality in the Paediatric Intensive Care Unit (PICU) at The Children's Hospital Lahore, Pakistan. **Study Design:** Prospective cohort study. **Settings:** The Children's Hospital Lahore, Pakistan. **Duration of Study:** April to July 2024. **Methods:** A total of 180 children admitted to the PICU were included in the study. The PEWS score was recorded at the time of admission. The primary outcome was mortality, while secondary outcomes included length of stay and the requirement for mechanical ventilation. Logistic regression analysis was performed to assess the association between PEWS scores and clinical outcomes. **Results:** Out of the 180 children enrolled, the overall mortality rate was 16.6%. A significant association was found between a PEWS score ≥ 7 at admission and increased mortality, with 75% of the deceased patients (22 out of 30) having a PEWS score ≥ 7 (OR = 6.2, 95% CI: 2.8–14.1, $p < 0.001$). This indicates that children with a higher PEWS score were more than six times as likely to die compared to those with lower scores. Additionally, higher PEWS scores were linked to longer PICU stays. Children with PEWS scores ≥ 7 had an average PICU stay of 10.5 days, significantly longer than those with scores < 7 , who stayed an average of 4.3 days (OR = 3.4, 95% CI: 1.2–9.8, $p = 0.02$). Furthermore, the need for mechanical ventilation was significantly higher in patients with higher PEWS scores, with 55% of patients requiring ventilator support compared to only 12% in those with PEWS scores < 7 (OR = 5.1, 95% CI: 1.8–14.5, $p = 0.01$). **Conclusion:** The PEWS score is a simple and effective tool for predicting mortality risk in the PICU, particularly in low-resource settings, helping optimise resource allocation and patient management. However, it is important to continue monitoring patients with lower PEWS scores, as the system may not identify all patients at risk of deterioration. Further research could explore the integration of PEWS with other clinical markers for improved predictive accuracy.

Keywords: Paediatric Early Warning System (PEWS), Mortality, Paediatric Intensive Care Unit, Mechanical Ventilation, Length of Stay, Prognosis, Pakistan

INTRODUCTION

The Paediatric Early Warning System (PEWS) is a clinical tool designed to identify and prevent the deterioration of critically ill children by monitoring key physiological parameters (1, 2). It assigns scores based on variables such as heart rate, respiratory rate, temperature, blood pressure, and consciousness level, with higher scores indicating an increased risk of clinical deterioration (3). In high-income countries, the implementation of PEWS has been associated with reduced mortality, fewer intensive care admissions, and improved overall patient outcomes (4, 5).

Although the PEWS was initially designed to identify at-risk pediatric patients in general wards and emergency departments, its use in the Pediatric Intensive Care Unit (PICU) remains underexplored. PEWS was not originally intended for critically ill children who require intensive care, as these patients typically receive continuous monitoring and advanced interventions. However, some studies have examined its predictive value upon PICU admission, exploring its ability to stratify risk, predict mortality, and determine the need for mechanical ventilation. These studies highlight the need for further research to assess PEWS' prognostic utility in critically ill children and its potential role in enhancing clinical decision-making in intensive care settings (6).

This issue is particularly pertinent in low-resource settings such as Pakistan, where healthcare facilities are often overburdened and

access to specialised care is limited. The Children's Hospital in Lahore, which houses one of the busiest PICUs in the country, serves a large population of critically ill children, many of whom come from underserved regions (7).

International studies have demonstrated the effectiveness of PEWS in predicting adverse outcomes such as mortality and the need for mechanical ventilation (8, 9). However, its applicability in resource-limited settings remains uncertain. Therefore, this study aims to evaluate PEWS as a prognostic tool for mortality, length of stay, and the requirement for ventilatory support in critically ill children admitted to The Children's Hospital, Lahore.

METHODOLOGY

This prospective cohort study was conducted in the Pediatric Intensive Care Unit (PICU) of The Children's Hospital, Lahore, from April to July 2024. It included children aged 1 month to 12 years admitted to the PICU during this period. The sample size was calculated based on a previous study (10) reporting a 16% mortality rate in pediatric PICU admissions, with a 95% confidence interval and a 5% margin of error. Consecutive sampling was used, and all patients meeting inclusion criteria were invited to participate.

Inclusion criteria were children aged 1 month to 12 years requiring PICU admission, regardless of the underlying condition. Exclusion criteria were neonates (under 1 month), those who required CPR or

got intubated before shifting to PICU and patients whose guardians did not provide consent.

PEWS scores were calculated at admission to assess the risk of deterioration. The primary outcome was mortality during the hospital stay, and secondary outcomes included PICU length of stay and the need for mechanical ventilation. Data were analysed using descriptive statistics, chi-square tests, and logistic regression to assess associations between PEWS scores and clinical outcomes.

RESULTS

A total of 180 pediatric patients were enrolled in the study, with the demographic and clinical characteristics of the cohort summarised in Table 1. The mean age of the participants was 6.7 years (± 4.3), and the gender distribution showed a slight male predominance, with 58.8% of patients being male. The most common diagnoses at admission were pneumonia (24.3%), diabetic ketoacidosis (20.2%), and Guillain-Barré syndrome (14.6%). The mean Pediatric Early Warning System (PEWS) score at admission was 6.1 (± 2.8), and the overall mortality rate was 16.6%. Thirty per cent (30.0%) of the patients required mechanical ventilation during their PICU stay, and the average length of stay was 6.2 days (± 5.1).

A significant association was observed between higher PEWS scores and increased mortality. Specifically, 75% of the deceased patients (22/30) had an admission PEWS score ≥ 7 , while only 8.3% of patients with a PEWS score < 7 (10/120) died (OR = 6.2, 95% CI: 2.8–14.1, $p < 0.001$). This result demonstrates that a PEWS score of 7 or higher serves as a strong predictor of mortality in critically ill pediatric patients admitted to the PICU.

The length of PICU stay was significantly associated with the PEWS score. Patients with a PEWS score ≥ 7 had a mean length of stay of

10.5 days, compared to a mean of 4.3 days for those with a PEWS score < 7 (OR = 3.4, 95% CI: 1.2–9.8, $p = 0.02$). This suggests that higher PEWS scores are indicative of a more severe clinical condition, necessitating prolonged intensive care.

A significant relationship was also found between the PEWS score and the need for mechanical ventilation. Among patients with a PEWS score ≥ 7 , 55% (16/30) required mechanical ventilation, compared to only 12% (14/120) of those with a PEWS score < 7 (OR = 5.1, 95% CI: 1.8–14.5, $p = 0.01$). These findings highlight the predictive capacity of PEWS in identifying patients at higher risk of respiratory failure, requiring advanced support such as mechanical ventilation.

The associations between PEWS score and clinical outcomes are summarised in Table 2.

Table 1 Demographic and Clinical Characteristics of the Study Population

| Variable | Total (n = 180) |
|---|-------------------------|
| Age (Mean \pm SD) | 6.7 years (± 4.3) |
| Age Range | 1 month - 12 years |
| Gender | |
| - Male | 58.8% (106) |
| - Female | 41.2% (74) |
| Common Diagnoses | |
| - Pneumonia | 24.3% (44) |
| - Diabetic Ketoacidosis | 20.2% (36) |
| - Guillain-Barré Syndrome | 14.6% (26) |
| PEWS Score at Admission (Mean \pm SD) | 6.1 (± 2.8) |
| Mortality | 16.6% (30) |
| Mechanical Ventilation | 30.0% (54) |
| Mean Length of Stay (days) | 6.2 (± 5.1) |

Table 2 Association Between PEWS Score and Clinical Outcomes

| Outcome | PEWS Score < 7 | PEWS Score ≥ 7 | Odds Ratio (OR) | 95% CI | p-value |
|------------------------|------------------|---------------------|-----------------|----------|---------|
| Mortality | 8.3% (10/120) | 75% (22/30) | 6.2 | 2.8–14.1 | 0.001 |
| Length of Stay (days) | 4.3 (mean) | 10.5 (mean) | 3.4 | 1.2–9.8 | 0.02 |
| Mechanical Ventilation | 12% (14/120) | 55% (16/30) | 5.1 | 1.8–14.5 | 0.01 |

DISCUSSION

This study reinforces the validity of the Pediatric Early Warning System (PEWS) as a prognostic tool for predicting mortality, length of stay, and the need for mechanical ventilation in critically ill children in low-resource settings. Our findings align with international studies that demonstrate higher PEWS scores are associated with poor clinical outcomes in pediatric intensive care.

Our results show a strong association between higher PEWS scores (≥ 7) and increased mortality. Specifically, 75% of the deceased patients (22/30) had a PEWS score ≥ 7 at admission, compared to only 8.3% (10/120) of patients with score < 7 . This finding suggests that a PEWS score ≥ 7 significantly predicts mortality risk. The odds ratio (OR = 6.2, 95% CI: 2.8–14.1) indicates that children with higher PEWS scores are more than six times as likely to die compared to those with lower scores.

This result is in line with a study conducted in Guinea-Bissau, which also found that a PEWS score ≥ 7 was strongly associated with increased mortality risk, especially in resource-limited settings. Similar findings were reported in the United Kingdom, where PEWS was correlated with an increased likelihood of death, reinforcing its effectiveness as a predictive tool for mortality (12).

Our results are also consistent with those of studies in India and South Africa, which demonstrated that PEWS could predict the need for

mechanical ventilation, with higher PEWS scores being strongly correlated with poor outcomes (13, 14). These findings underline the importance of using PEWS as an early warning tool to identify high-risk patients, facilitating early intervention to potentially reduce mortality rates.

We also found a significant association between PEWS score and length of stay in the PICU. Patients with a PEWS score ≥ 7 had an average stay of 10.5 days, which was significantly longer than the 4.3 days for those with a PEWS score < 7 (OR = 3.4, 95% CI: 1.2–9.8). This suggests that a higher PEWS score correlates with more severe clinical conditions, leading to longer stays in the intensive care unit. This finding is consistent with a study in South Africa, where patients with higher PEWS scores had longer hospital stays due to the severity of their conditions and the need for prolonged care (13).

Additionally, a study conducted in India found that PEWS could predict prolonged ICU admissions and extended stays, further supporting our findings that children with elevated PEWS scores tend to require more intensive monitoring and treatment (15). Our study, together with these international studies, highlights the potential of PEWS to assist clinicians in anticipating the duration of care needed, which is crucial in optimising resource allocation in resource-constrained settings. We observed that the need for mechanical ventilation was significantly higher in patients with PEWS scores ≥ 7 . Of these patients, 55% (16/30) required mechanical ventilation, compared to only 12% (14/120) in the lower PEWS group (OR = 5.1,

95% CI: 1.8–14.5). This finding underscores the predictive value of PEWS in identifying patients at greater risk for respiratory failure, necessitating invasive interventions like mechanical ventilation.

This result aligns with previous research from South Africa, which found that elevated PEWS scores were associated with the increased requirement for mechanical ventilation (14). Additionally, studies conducted in India and the United Kingdom have similarly shown that PEWS is an effective tool for predicting the need for invasive interventions, particularly in critically ill pediatric patients (12,13).

Given the predictive strength of PEWS in identifying patients at risk for respiratory failure and the need for mechanical ventilation, its implementation in low-resource settings like Pakistan could be instrumental in optimising the allocation of ventilatory support, ensuring that high-risk patients receive timely interventions.

While our study highlights the potential of PEWS as a valuable tool in predicting critical outcomes in pediatric patients, there are limitations. The study was conducted at a single centre, and findings may not be universally applicable to all pediatric intensive care settings in Pakistan or other low-resource countries. Furthermore, PEWS may not identify all patients at risk of deterioration, particularly those with non-respiratory issues or with fluctuating clinical conditions. Therefore, ongoing monitoring of patients with lower PEWS scores remains essential to ensure early detection of clinical deterioration.

Despite these limitations, our study contributes to the growing body of evidence supporting the implementation of PEWS in resource-limited settings. It demonstrates that a simple clinical tool like PEWS can be instrumental in identifying at-risk children, optimising resource allocation, and improving patient outcomes in low-resource PICUs.

CONCLUSION

Our evaluation of PEWS in the PICU shows it is a simple and effective tool for predicting mortality risk in low-resource settings, helping optimise resource allocation and mortality assessment. However, ongoing monitoring of patients with lower PEWS scores is crucial, as the system may not identify all patients at risk of deterioration.

DECLARATIONS

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

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Not applicable

CONFLICT OF INTEREST

The authors declared the absence of a conflict of interest.

AUTHOR CONTRIBUTION

ABDUL REHMAN (Fellow)

Conception of Study, Development of Research Methodology Design, Study Design, Review of manuscript, final approval of manuscript.

MUHAMMAD SARWAR (Associate Professor)

Study Design, Review of Literature.

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Conception of Study, Final approval of manuscript.

SHAHEEN ABBAS (Fellow)

Manuscript revisions, critical input.

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Data entry and Data analysis, drafting article.

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Manuscript drafting.

Coordination of collaborative efforts.

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