

ORIGINAL RESEARCH

Use of Pediatric Early Warning Signs in Febrile Patients Visiting Emergency Room to Predict the Need for Critical Care Admission

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ABSTRACT

Background: Pediatric Early Warning signs (PEWS) Scores are widely used tool for identifying early signs of deterioration in critically ill pediatrics patients and also provide a structured process for the reassessment and escalation of care which can help in prevention of a serious life-threatening event. **Objectives:** To evaluate the utility of the PEWSscoring system in predicting need for critical care admission of pediatric patients visiting emergency room (ER) in our hospital. **Methods:** A total of 280 children with fever visiting the ER of Department of Pediatrics during the study period were enrolled. Vitals and detailed physical examination were done as per the hospital protocol. PEWS score calculated using Brighton charts and documented along with patient records and proforma. PEWS used for prediction of ICU admission of the patients. **Results:** PEWS scores in the study children ranged from 0 to 10. The median age of children was 4.2 years; most of them (55%) were boys. Statistically significant difference ($p < 0.05$) was found between PEWS score of patients admitted to the PICU and PEWS score of patients who didn't require PICU admission. The mean respiratory rate were significant differ ($p < 0.05$) of patients needing PICU as compared to those who didn't need PICU. There is a significant difference in all the vital parameters between patients needing PICU and those who didn't need PICU. The PEWS score of 3, the sensitivity was 81% specificity was 76.8%, PPV was 22.1% and NPV was 98%. The implication of this finding is that if a child in ER has a score of < 3 , chances of PICU admission in the next 24 hours are less as compared to PEWS score ≥ 7 . **Conclusion:** PEWS is a best useful tool to predict critical care requirement, clinical deterioration, length of hospital stay and mortality in pediatric patients.

Keywords: PEWS Score, Emergency room, Screening tool, pediatric patients, PICU admission

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INTRODUCTION

The emergency department (ED) is often the initial point of contact for patients seeking medical care. To provide high-quality medical services, the prompt identification of patients at risk of clinical deterioration and the provision of a certain level of medical care commensurate with the severity or acuity of illness is essential [1]. Globally, failure to identify and intervene with pediatric patients experiencing clinical deterioration is a source of unintended harm including prolonged hospital stays or readmission, disability and death [2]. Various pediatric scoring

systems have been developed to provide an objective assessment of a patient's clinical status based on physiologic parameters. One of the earliest and simplest scoring systems was the Pediatric Early Warning Score (PEWS) described by Monaghan [3-4]. PEWS should support healthcare providers in identifying abnormal physiology, tracking trends across time and supporting structured processes for reassessment and escalation of care [5]. The risk factors found to be associated with recurrent wheezing include a family history of asthma, neonatal hospitalization, and parental history of allergic rhinitis

[6]. The Royal College of Physicians (RCP) standardized UK adult practice in 2012 with the National Early Warning Score (NEWS) and subsequent NEWS in 2017 [7]. NEWS demonstrated good discriminative ability in predicting intensive care unit (ICU) admission and death in adult Medical Admission Unit patients and has subsequently been successfully validated in both the Emergency Department (ED) and pre hospital setting [8-9]. In emergency department (ED) settings, the ability to identify deterioration or risk “in the moment”—without tracking over time – is critical; however, rapid identification of deterioration in the pediatric population has several complexities. These difficulties include: varying normal vital signs parameters by age, changes in physiologic parameters related to factors beyond the illness or injury (medication, pain, fear and anxiety), and compensation seen in pediatric patients when critically ill, underrepresenting the degree of deterioration [10-11].

AIMS AND OBJECTIVES

To calculate PEWS for all pediatric patients with fever visiting emergency room to evaluate need for hospitalization in PICU within 48 hours of ER visit

MATERIALS AND METHODS

This prospective single centre Cohort study was conducted in the department of pediatric (Emergency room) in a Tertiary care corporate hospital, Western India. Duration of study was one year from 15th June 2022 to 15th June 2023.

Inclusion criteria

- Children < 16 years of age with both gender
- All children visiting the ER of our hospital for fever
- Patients or their guardian who provided consent for the study

Exclusion criteria

- Children >16 years of age
- Incomplete score documentation
- Patients who didn't come for follow up or didn't respond to telephonic calls
- Patients or their guardian who not provided consent for the study

We collected demographic data including age, gender, ethnicity, and primary diagnosis for all patients

included in the study. The diagnoses were based on a systems approach into respiratory, gastrointestinal, fever, neurological or miscellaneous.

There were 950 patients with fever who visited the ER during the study period, out of which 280 patients were enrolled. Vitals and detailed physical examination were done as per the hospital protocol. PEWS scores, calculated using Brighton charts, were calculated and documented along with patient records and proforma, for all the patients.

A common set of questions were asked and the answers were documented in the patient proforma. They documented the PEWS score and followed the necessary response algorithm as per hospital protocols. If the patient re-visited the hospital within 72 hours with the same complaints of fever, the proforma was accordingly updated.

The initial appearance of the patient was preferably assessed in the parent's lap to reduce anxiety in the child, which may alter the vitals. Heart rate, saturation, and blood pressure (wherever possible) were measured using the monitor in the ER. Respiratory rates were measured by counting respiratory movements for 30 seconds.

Statistical analysis

Data were summarized using standard descriptive methods, frequency and percentages for categorical variables, and mean and SD or median and range for continuous variables. Chi-square test and student's t-test were performed for analysis of variance, $P < 0.05$ was considered statistically significant.

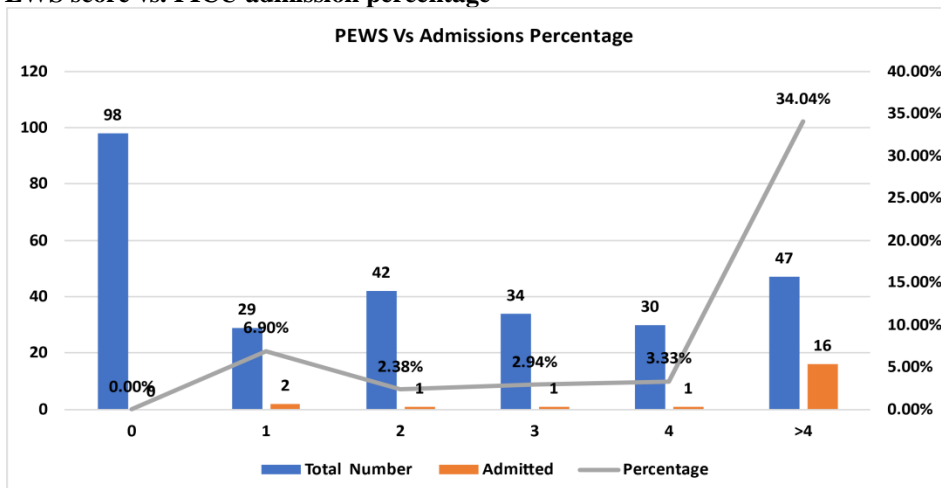
RESULTS

A total of 280 patients age ranged from 1 month to 13 years were enrolled in this research. The median age of children was 4.2 years. Most of them (55%) were boys and 45% were girls.

The commonest presenting symptoms along with fever were cough (32%), vomiting (15%) and simple febrile convulsions (10%).

PEWS scores in the study population ranged from 0 to 10. 98 (35%) patients scored zero and none of them needed PICU care. 37% of children admitted to PICU had a score of 4 or more. The mean PEWS score of patients admitted to the PICU was 5.9 ± 2.57 . The mean PEWS score of patients who didn't require PICU admission was 1.87 ± 1.85 , which is suggestive of a statistically significant difference ($p < 0.05$).

Figure 1: PEWS score vs. PICU admission percentage



The mean respiratory rate of patients needing PICU was 45.06 ± 8.07 and for those who didn't need PICU was 33.07 ± 4.77 , which is a significant difference ($p < 0.05$). A high respiratory rate would lead to high PEWS and this may be an important warning sign to be looked for at the time of triage. There is a significant statistical difference in all the vital parameters between patients needing PICU and those who didn't need PICU.

Table 1: Comparative analysis of ICU VS Non-ICU patients based on their basic vital parameters, PEWS score and duration of stay

Basic parameters	ICU admission		P value
	Yes	No	
Age (months)	49.10 ± 37.78	48.27 ± 34.22	0.917 (NS)
Weight (kg)	15.37 ± 7.33	15.42 ± 6.53	0.976 (NS)
Height (cm)	97.19 ± 22.81	96.88 ± 20.22	0.947 (NS)
Fever (days)	3.57 ± 1.72	2.66 ± 1.32	0.003 (S)
Heart Rate	155.24 ± 13.82	131.65 ± 13.60	0.000 (S)
RR	45.05 ± 8.07	33.07 ± 4.77	0.000 (S)
Temperature	102.21 ± 1.26	101.36 ± 1.01	0.000 (S)
SBP	103.57 ± 7.79	99.00 ± 6.41	0.002 (S)
DBP	64.86 ± 6.06	60.18 ± 6.59	0.002 (S)
MBP	77.95 ± 6.76	72.14 ± 7.55	0.001 (S)
SpO2	92.71 ± 5.09	98.37 ± 0.76	0.000 (S)
PEWS Score	5.90 ± 2.57	1.87 ± 1.85	0.000 (S)
Duration	5.86 ± 2.22	1.26 ± 1.79	0.000 (S)

The sensitivity, specificity, PPV, and NPV of PEWS in predicting PICU admissions were calculated at each cutoff score. For the PEWS score of 3, the sensitivity was 81% specificity was 76.8%, PPV was 22.1% and NPV was 98%. The implication of this finding is that if a child in ER has a score of less than 3 his/her

chances of PICU admission in the next 24 hours are less. For PEWS score ≥ 7

A high score has an important inference that the chances of the child being sick are very high and in a busy ER, a child with a high score shouldn't be sent home without a senior consultant examining the child or kept for observation until the scores normalize.

Table 2: Sensitivity, specificity, PPV and NPV of PEWS in predicting PICU admission

PEWS Score	Sensitivity	Specificity	PPV	NPV
0	100	37.8	11.5	100
1	90.5	48.3	12.4	98.4
2	85.7	64.3	16.2	98.2
3	81	76.8	22.1	98
4	76.2	88	34	97.9
5	66.7	98.5	77.8	97.3
6	42.9	99.6	90	95.6
> 7	23.8	100	100	94.2

DISCUSSION

PEWS are a simple tool that can be easily implemented in a busy ER. It provides an important method to quantitatively recognize a sick child in a busy ER manned by nurses and Junior Doctors. It is constituted by easy to access physiological signs: behaviour, cardiovascular status, respiratory status, nebulizer use, and persistent post-surgical vomiting. Multiple paediatric scoring systems have been developed the world over, Monaghans's PEWS is one of the most simple, quick to perform, and time tested. It is not age-specific, unlike Irish PEWS which has different charts for different age groups [12].

The present study found that the median age of children need for critical care admission were 4.2 years, in accordance with the Reis GG, et al [13].

We found that percentage of discharge was maximum in the cases who had a low PEWS at the time of admission (PEWS 0,1 or 2) and the increase in the number of deaths had almost a linear trend with the increase in PEWS (100% mortality at a PEWS score of 8, scoring done at admission). Similar results were reported by other researchers also: Paterson et al [14] and Ramteke S, et al [15].

In this study majority of the patients were boys that were comparable with the Romaine ST, et al [16].

Current study found the common presenting symptoms were fever, cough, vomiting and simple febrile convulsions, in agreement with the Saini A, et al [17].

The mean PEWS score was significantly higher ($p < 0.05$), in patients admitted to the PICU as compared to patients who didn't require PICU admission in the present study, similar observation seen in study conducted by Ramteke S, et al [18].

There is a significant statistical difference in all the vital parameters between patients needing PICU and those who didn't need PICU, constant results reported by McElroy et al [19] and Parshuram CS, et al [20].

Higher PEWS score was significantly associated with an increased risk of in-hospital stay in our study, concordance with the Olson et al [21].

A study done by Shafi O M, et al [22] observed a weakly positive correlation between the calculated PEWS with the hospital LOS for patients

Adshead and Thomson, et al [23] reviewed the implementation of PEWS to help adult-trained nurses triage children. The PEWS helped improve their confidence in recognizing deterioration in children and initiating correct interventions.

The results of the study done by Banque et al [24], showed a significant correlation between PEWS and clinical deterioration. PEWS of >4 was well correlated with PICU set-up admission and mortality.

This study showed a positive co-relation between the death and the PEWS at the time of admission. The relationship between the PEWS and the death showed almost a linear relationship between PEWS and the probability of death, consistent results shown by Peter J Lillitos, et al [25].

The sensitivity and specificity of PEWS in predicting PICU admissions were calculated at each cutoff score. For the PEWS score of 3, the sensitivity was 81% specificity was 76.8%, this was correlate with the other studies [26-27].

CONCLUSION

In our study we found that PEWS is highly sensitive and specific in predicting the mortality, differentially against the various PEWS scores. There is almost a linear trend between the probability of death and the PEWS scores. With the help of PEWS the alteration in the physiological parameters can be converted into scores and appropriate action can be taken according to the alteration in the scores.

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