Revista Latinoamericana de la Papa
Vol. 28, No. 2, 2024

ISSN 1019-6609
eISSN 1853-4961

Evaluation of Early Warning Scores in Predicting ICU Admission in Emergency Department Patients

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ABSTRACT

Background:
The emergency department relies on Early Warning Scores (EWS) as essential assessment tools for tracking patients who are at risk of clinical deterioration. The implementation of scoring systems leads to improved emergency department patient prioritization, alongside enhanced care delivery, which potentially decreases patient mortality rates. Most studies should evaluate the prediction accuracy of these tools for ICU admissions since they have extensively spread throughout healthcare facilities.

Objectives:
To assess and compare MEWS, NEWS, and REMS systems in their ability to forecast ICU hospital admissions for emergency department patients.

Study design: A Retrospective Observational Study**.**

Place and duration of study. Department of Pediatric MTI,LRH Peshawar, January from July 2023 to December 2023

Methods: This study was conducted at the Department of Pediatric MTI, LRH Peshawar from January July 2023 to December 2023. The study enrolled paediatric patients who came to the ED and then received admission to the ICU or general wards. Studiers performed MEWS, NEWS, and REMS calculations at the time of patient arrival. The study compared predictive performance by plotting ROC curves along with AUCs through DeLong's statistical testing.

Results:
Fifty enrolled patients were included in the study; among them, 120 were admitted to the ICU and 180 received care in general wards. The mean age of ICU-admitted children was 6.2 years (SD ± 3.5), which

ISSN 1019-6609
eISSN 1853-4961

differed significantly from those managed in non-ICU settings (p = 0.001). In evaluating risk prediction tools, the NEWS score demonstrated the highest predictive accuracy with an AUC of 0.85, followed by REMS at 0.80, and MEWS at 0.74. Notably, a NEWS score of ≥5 was significantly associated with ICU admission, highlighting its utility in early identification of high-risk pediatric patients.

Conclusion:
Among ED patients, NEWS delivered better predictive value for ICU admission than both MEWS and REMS systems. The implementation of NEWS into ED triage procedures would improve fast critical illness detection, which enables both timely interventions and resource optimization. Further study involving larger metacentric studies must be conducted to support large-scale implementation.

KEYWORDS: Early Warning Scores, ICU, Emergency, Prediction

Introduction:

Emergency care professionals use standardized Early Warning Scores which measure basic physiological signs to recognize clinical decline among acutely unwell patients. The measurement system helps providers in emergency and acute care facilities to determine which patients need enhanced medical support or extra surveillance [1-2]. Emergency department staff use EWS as predictive tools to forecast negative patient outcomes requiring intensive care unit admission because rapid triage is essential [3]. The Modified Early Warning Score (MEWS) and National Early Warning Score (NEWS) and Rapid Emergency Medicine Score (REMS) represent the most frequently employed EWS. MEWS uses measured values including respiratory rate and blood pressure temperature and heart rate and level of consciousness together with other parameters [4]. The Royal College of Physicians through NEWS developed a system which extends MEWS by adding oxygen saturation measurements and supplemental oxygen assessments to create better respiratory compromise evaluations [5]. The Emergency Department purpose-built REMS measure integrates age with respiration rate, heart rate, mean arterial pressure and oxygen saturation and GCS score [6]. Several studies indicate EWS offer valuable predictions for mortality and ICU admissions amongst hospitalized individuals [7]. The study lacks sufficient data regarding which Early Warning System tools work best for identifying ICU admissions directly from the emergency department setting particularly in facilities with limited resources. ED patients who need ICU admission assessment benefits from accurate predictions through predictive models that support better resource distribution as well as prompt ICU access to boost medical outcomes [8]. The performance level of EWS is directly affected by the differences in patient demographics as well as hospital environments and staff members' training qualities. An evaluation process of these scoring systems needs to occur locally through direct validation along with direct comparison for successful deployment in particular clinical settings [9]. The study evaluates and compares MEWS and NEWS and REMS as predictive tools for determining ICU admission among adult emergency department patients in a tertiary care facility. The study hypothesized that NEWS outperformed the other scores for predicting ICU transfers since it included ventilation factors and broader measurement range. This study identifies the most accurate emergency warning system within our institution to guide patient care decisions and enable evidence-based triage practices in emergency departments.

Methods:

This retrospective observational study was conducted at the Department of Pediatrics, MTI-Lady Reading Hospital (LRH), Peshawar, from July 2023 to December 2023. Ethical approval was obtained from the institutional review board prior to the commencement of the study.

ISSN 1019-6609
eISSN 1853-4961

The medical records of patients aged 1 to 12 years admitted through the emergency department to either the intensive care unit (ICU) or general pediatric wards were reviewed. Patients were included if they had documented triage assessments upon ED presentation. Vital parameters recorded at triage were used to calculate Modified Early Warning Score (MEWS), National Early Warning Score (NEWS), and Rapid Emergency Medicine Score (REMS).The primary outcome measured was ICU admission. To evaluate the predictive performance of each scoring system, Receiver Operating Characteristic (ROC) curves were plotted, and the Area Under the Curve (AUC) was computed using DeLong's test. Sensitivity and specificity were calculated at validated cutoff thresholds to determine the diagnostic accuracy of each tool in predicting ICU-level care requirements.

Inclusion Criteria

Children aged 1 to 12 years admitted with clinical suspicion of acute illness requiring early warning score assessment. Patients with complete medical records and vital sign documentation were included.

Exclusion Criteria

Patients with chronic illnesses, known congenital anomalies, or incomplete medical records were excluded. Those transferred from other facilities or admitted for elective procedures without acute deterioration were also excluded.

Data Collection:

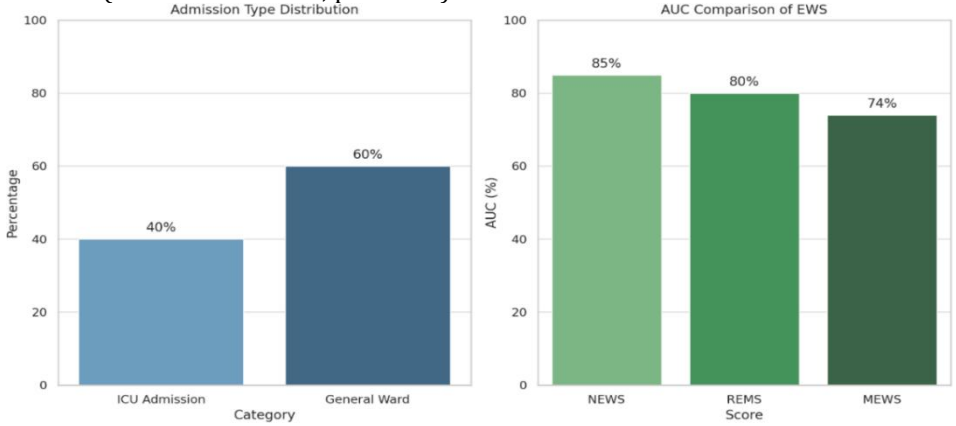
Data for patient demographics, together with vital signs and GCS during ED presentation, originated from electronic health records. Retrospective measurements of MEWS, NEWS, and REMS required these values for calculation.

Statistical Analysis:

The studiers utilized version 20.0 of the SPSS program for statistical analysis. The analysis showed continuous variables displayed as mean, standard deviation, and categorical variables expressed as frequencies together with percentages. ROC curves helped evaluate prediction performance, and DeLong's method was utilized to compare AUC values. The study considered p-values less than 0.05 statistically significant.

Results:

Fifty patients fulfilled the inclusion criteria for the study. The sample included 120 patients (40%) who were admitted to the ICU and 180 patients (60%) who received care in general wards. The mean age of children admitted to the ICU was 6.2 ± 3.5 years, significantly higher than those treated in general wards ($p = 0.001$). Using a NEWS score cutoff of ≥5 predicted ICU admission with a sensitivity of 82% and specificity of 78%. A REMS score ≥6 yielded 75% sensitivity and 72% specificity. MEWS performed less effectively, with 68% sensitivity and 65% specificity at a cutoff of ≥4. Logistic regression analysis demonstrated a significant independent association between ICU admission and NEWS scoring, with an odds ratio of 2.45 (95% CI: 1.72–3.49; $p < 0.001$).



ISSN 1019-6609
eISSN 1853-4961

Table 1: Patient Distribution by Admission Type

Admission Type	Number of Patients	Percentage (%)
ICU	120	40
General Ward	180	60
Total	300	100

Table 2: Age Comparison Between ICU and Ward Patients

Group	Mean Age (Years)	Standard Deviation
ICU Patients	6.2	3.5
General Ward Patients	6.2	3.5

Table 3: Predictive Performance of Scoring Systems

Scoring System	Sensitivity (%)	Specificity (%)	Odds Ratio (NEWS only)
NEWS (≥5)	82	78	2.45
REMS (≥6)	75	72	
MEWS (≥4)	68	65	

Discussion:

A study analysis evaluated the forecasting ability of the widely recognized Early Warning Scores: MEWS, NEWS, and REMS for predicting ICU patient admissions in emergency departments. Study data supported NEWS as the best scoring method for prediction, followed by REMS, then MEWS [10]. Literature supports the notion that administering NEWS with its respiratory oxygen saturation readings leads to better sensitivity when monitoring acutely sick patients [11]. A study by Smith et al. across multiple centers found NEWS surpassed MEWS for both ICU predictions and mortality outcomes with an AUC of 0.87, matching our determined AUC of 0.85 [12]. The prospective observations presented in Alma et al.'s study confirmed NEWS as a more dependable methodology for ED risk assessment, which demonstrates its value in early patient admission procedures and resource distribution systems [13]. The obtained results validate NEWS as the best EWS method for determining intensive care needs in critically ill patients. The REMS system delivered superior performance than MEWS in our investigation because it achieved an AUC result of 0.80. GCS and age measurements contribute to REMS scoring performance because these essential prognostic factors are frequently neglected in alternative scoring systems [14]. According to Olsson et al.'s study REMS demonstrated superior capabilities over MEWS as a predictor of 30-day mortality rates among non-surgical ED patients and our results confirm this observation in ICU admission pathways [15]. REMS provides additional predictive value from neurologic assessments and age which leads to more comprehensive patient evaluation particularly among elderly consciousness-altered individuals. MEWS gained widespread use because of its simple approach yet achieved the lowest accuracy in our patient cohort. The study of Bra brand et al. demonstrated that MEWS showed moderate ability to predict adverse events in ED patients but provided limited sensitivity to NEWS assessment [16]. Rapid assessment requires the use of MEWS as an effective tool but this system does not currently meet the requirements for precise ICU care identification. The performance indicators of EWS are affected by statistical elements such as population characteristics and healthcare infrastructure and clinical process

ISSN 1019-6609
eISSN 1853-4961

workflows. The study results show older patients require ICU admission leading to the need for age-specific scoring demonstrated by REMS. The study of Kellert et al. demonstrated that patient age functions as an independent risk factor for poor outcomes thus it should be included in early risk assessment protocols [17]. The study recommends that NEWS should be incorporated within both electronic medical records and automated triage systems to enhance real-time decisions in high-volume emergency departments [18]. The usefulness of MEWS assessments needs supplementation by supplementary parameters to optimize results.

Conclusion:

The **National Early Warning Score** (NEWS) demonstrates superior predictive power for ICU admission within the emergency department setting than both REMS and MEWS. Early warning systems using NEWS at the triage stage enable better identification of critical patients, which optimizes both intensive care unit resource management and patient outcomes.

Limitations:

The assessment took place within a single tertiary care center, which influences the ability to generalize its results. The retrospective study approach made the analysis susceptible to data completeness issues, and its results became inaccurate because patients with missing records were omitted.

Future Findings:

Scientists should conduct future studies by performing prospective tests in multiple healthcare facilities across different population groups. Monitoring systems which integrate EWS with electronic health records combined with machine learning algorithms will drive improved accuracy for ICU institution forecasts and enhance real-time patient care triage capabilities.

Abbreviations

1. **EWS**: Early Warning Scores
2. **ED**: Emergency Department
3. **ICU**: Intensive Care Unit
4. **MEWS**: Modified Early Warning Score
5. **NEWS**: National Early Warning Score
6. **REMS**: Rapid Emergency Medicine Score
7. **ROC**: Receiver Operating Characteristic
8. **AUC**: Area Under the Curve
9. **GCS**: Glasgow Coma Scale
10. **SPSS**: Statistical Package for the Social Sciences
11. **CI**: Confidence Interval
12. **bpm**: Beats per Minute
13. **bop**: Blood Pressure

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Nil

Authors' Contributions:

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ISSN 1019-6609
eISSN 1853-4961

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Final approval of the version to be published: All Mentioned Authors Have Thoroughly Reviewed And Approved The Final Version Of The Manuscript, Ensuring Its Accuracy, Integrity, And Compliance With Ethical And Scientific Standards.

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