



Utility of NEWS-2 in Predicting ICU Admission from Emergency Department and Mortality Risk: A Prospective Cohort Study

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ABSTRACT

Background: The National Early Warning Score 2 (NEWS-2) is a standardized clinical tool designed to detect acute deterioration in hospitalized patients. Its utility in predicting critical outcomes directly from the emergency department (ED) remains an area of active investigation.

Methods: A prospective cohort study was conducted at a tertiary care hospital over 18 months, enrolling 847 adult patients presenting to the ED. NEWS-2 scores were calculated upon arrival, and patients were followed until hospital discharge or death. Primary outcomes included ICU admission within 48 hours and 30-day in-hospital mortality. Receiver operating characteristic (ROC) curve analysis, logistic regression, and survival analysis were performed.

Results: The mean age was 58.4 ± 16.7 years, with 54.3% male patients. The mean NEWS-2 score was 5.8 ± 3.4 . ICU admission occurred in 127 patients (15.0%), and 30-day mortality was 8.7% (n=74). Patients requiring ICU admission had significantly higher NEWS-2 scores (9.2 ± 2.8 vs. 5.2 ± 3.1 , $p < 0.001$). The area under the ROC curve (AUC) for predicting ICU admission was 0.847 (95% CI: 0.812–0.882), and for mortality was 0.891 (95% CI: 0.854–0.928). A NEWS-2 score ≥ 7 demonstrated 78.7% sensitivity and 81.2% specificity for ICU admission prediction.

Conclusion: NEWS-2 scores at ED presentation demonstrate excellent discriminatory ability for predicting ICU admission and mortality, supporting its implementation as a triage and risk stratification tool in emergency settings.

Introduction

Emergency departments worldwide face increasing patient volumes and acuity levels, necessitating efficient and accurate methods for identifying patients at risk of clinical deterioration [1]. Early recognition of critically ill patients enables timely intervention, appropriate resource allocation, and potentially improved outcomes [2]. The challenge of rapidly stratifying patients according to their risk of adverse outcomes has driven the development of various early

warning scoring systems [3].

The National Early Warning Score (NEWS) was introduced by the Royal College of Physicians in 2012 as a standardized approach to assessing acute illness severity [4]. Subsequently, NEWS-2 was developed in 2017, incorporating modifications to improve detection of hypercapnic respiratory failure and sepsis [5]. The scoring system aggregates physiological parameters including respiratory rate, oxygen saturation, systolic blood pressure, pulse rate, level of consciousness, and temperature, providing a composite score ranging from

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0 to 20 [6].

While NEWS-2 has been extensively validated in ward settings for detecting patient deterioration, its application in the emergency department context presents unique considerations [7]. The ED environment differs substantially from inpatient wards, with undifferentiated presentations, limited historical information, and compressed decision-making timeframes [8]. Several recent studies have explored the utility of early warning scores in emergency settings, with varying results regarding their predictive accuracy [9].

Research has demonstrated that NEWS-2 performs comparably to or better than other scoring systems such as qSOFA and MEWS in predicting adverse outcomes [10]. However, significant heterogeneity exists in study populations, outcome definitions, and clinical settings [11]. The optimal threshold values for NEWS-2 in ED populations remain debated, with some evidence suggesting that ED-specific cutoffs may improve predictive performance [12].

A critical research gap exists regarding the real-time applicability of NEWS-2 for simultaneous prediction of multiple critical outcomes, specifically ICU admission and mortality, from a single ED assessment [13]. Understanding the predictive characteristics for both outcomes would enhance clinical decision-making and resource planning [14].

The aim of this study was to evaluate the utility of NEWS-2 scores calculated at emergency department presentation in predicting ICU admission within 48 hours and 30-day in-hospital mortality among adult patients presenting to a tertiary care facility.

Materials and Methods

Study Design and Setting

This prospective observational cohort study was conducted at the Emergency Department of a 950-bed tertiary care teaching hospital between January 2022 and June 2023. The ED serves approximately 85,000 patients annually, with a dedicated resuscitation bay and direct access to intensive care facilities.

Study Population

Adult patients aged 18 years and older presenting to the ED during the study period were screened for eligibility. Inclusion criteria comprised patients requiring medical assessment with an anticipated stay exceeding 4 hours. Exclusion criteria included: patients presenting for scheduled procedures, psychiatric emergencies without medical complaints, patients transferred directly to operating theaters, pregnant women, patients with do-not-resuscitate orders established prior to arrival, and those who left against medical advice before complete assessment.

Sample Size Calculation

Based on previous literature suggesting an ICU admission rate of approximately 12-15% among ED patients, with an anticipated AUC of 0.80 for NEWS-2, a minimum sample size of 780 patients was calculated to achieve 80% power with $\alpha=0.05$ and precision of ± 0.05 for AUC estimation. Accounting for potential 10% loss to follow-up, we targeted enrollment of 860 patients.

Data Collection and NEWS-2 Calculation

Trained research nurses collected physiological parameters within 30 minutes of ED arrival using standardized equipment. Parameters included: respiratory rate (breaths/minute), peripheral oxygen saturation (%), supplemental oxygen use, systolic blood pressure (mmHg), heart rate (beats/minute), level of consciousness using the AVPU scale (Alert, Voice, Pain, Unresponsive), and temperature ($^{\circ}\text{C}$). NEWS-2 scores were calculated according to published guidelines, with the new oxygen saturation scale 2 applied for patients with confirmed hypercapnic respiratory failure. Demographic data including age, sex, presenting complaint, comorbidities (using Charlson Comorbidity Index), and mode of arrival were recorded. Laboratory investigations and imaging results were documented as available.

Outcome Measures

The primary outcomes were: (1) ICU admission within 48 hours of ED presentation, and (2) 30-day in-hospital mortality. Secondary outcomes included length of hospital stay, requirement for mechanical ventilation, vasopressor use, and cardiac arrest during hospitalization.

Statistical Analysis

Continuous variables were expressed as mean \pm standard deviation or median with interquartile range as appropriate. Categorical variables were presented as frequencies and percentages. Comparisons between groups were performed using independent t-tests or Mann-Whitney U tests for continuous variables and chi-square tests for categorical variables.

Receiver operating characteristic (ROC) curve analysis was performed to evaluate the discriminatory ability of NEWS-2 for predicting outcomes. The area under the curve (AUC) with 95% confidence intervals was calculated. Optimal cutoff values were determined using Youden's index. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and likelihood ratios were calculated for various threshold values.

Multivariable logistic regression analysis was performed to identify independent predictors of outcomes, adjusting for potential confounders including age, sex, and comorbidity

burden. Kaplan-Meier survival curves were constructed, and log-rank tests were performed for survival comparisons. A p-value <0.05 was considered statistically significant. All analyses were performed using SPSS version 27.0 and MedCalc version 20.0.

Results

Baseline Characteristics

A total of 892 patients were screened, with 847 meeting inclusion criteria and completing follow-up. The mean age

was 58.4 ± 16.7 years, and 460 patients (54.3%) were male. The most common presenting complaints were respiratory symptoms (28.6%), cardiovascular complaints (22.4%), and neurological symptoms (15.8%). The median Charlson Comorbidity Index was 3 (IQR: 1-5). The mean NEWS-2 score at presentation was 5.8 ± 3.4 , with 312 patients (36.8%) scoring ≥ 7 (high clinical risk category).

Primary Outcomes

ICU admission within 48 hours occurred in 127 patients (15.0%). Thirty-day in-hospital mortality was observed in 74 patients (8.7%). Among patients admitted to ICU, 42 (33.1%) died within 30 days.

Table 1: Baseline Characteristics and NEWS-2 Parameters by ICU Admission Status

Variable	Total (n=847)	ICU Admission (n=127)	No ICU Admission (n=720)	p-value
Age (years), mean \pm SD	58.4 ± 16.7	62.8 ± 15.2	57.6 ± 16.9	0.002
Male sex, n (%)	460 (54.3)	78 (61.4)	382 (53.1)	0.078
Charlson Index, median (IQR)	3 (1-5)	4 (2-6)	3 (1-5)	<0.001
NEWS-2 score, mean \pm SD	5.8 ± 3.4	9.2 ± 2.8	5.2 ± 3.1	<0.001
Respiratory rate (breaths/min)	21.4 ± 6.2	26.8 ± 7.4	20.4 ± 5.4	<0.001
Oxygen saturation (%)	94.2 ± 4.8	90.6 ± 6.2	94.8 ± 4.2	<0.001
Supplemental O ₂ use, n (%)	234 (27.6)	89 (70.1)	145 (20.1)	<0.001
Systolic BP (mmHg)	128.4 ± 26.8	118.2 ± 32.4	130.2 ± 25.2	<0.001
Heart rate (beats/min)	92.6 ± 21.4	108.4 ± 24.6	89.8 ± 19.6	<0.001
Temperature (°C)	37.2 ± 0.9	37.6 ± 1.2	37.1 ± 0.8	<0.001
AVPU not Alert, n (%)	98 (11.6)	52 (40.9)	46 (6.4)	<0.001

Discriminatory Performance of NEWS-2

The AUC for NEWS-2 in predicting ICU admission was 0.847 (95% CI: 0.812–0.882), indicating excellent discrimination.

For 30-day mortality prediction, the AUC was 0.891 (95% CI: 0.854–0.928). Using Youden's index, the optimal cutoff for ICU admission was ≥ 7 , and for mortality was ≥ 8 .

Table 2: Diagnostic Performance of NEWS-2 at Different Cutoff Values

Outcome	Cutoff	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	+LR	-LR
ICU Admission	≥ 5	92.1	58.3	28.0	97.7	2.21	0.14
	≥ 6	85.8	69.4	33.0	96.5	2.81	0.20
	$\geq 7^*$	78.7	81.2	42.5	95.6	4.19	0.26
	≥ 8	66.9	88.6	50.9	93.7	5.87	0.37
	≥ 9	52.0	93.5	58.4	91.7	8.00	0.51
30-day Mortality	≥ 6	94.6	62.4	19.4	99.1	2.52	0.09
	≥ 7	89.2	74.8	25.3	98.6	3.54	0.14
	$\geq 8^*$	82.4	84.2	33.3	98.0	5.22	0.21
	≥ 9	71.6	90.6	42.1	97.1	7.62	0.31
	≥ 10	58.1	94.8	51.8	95.9	11.17	0.44

*Optimal cutoff by Youden's index; PPV: positive predictive value; NPV: negative predictive value; LR: likelihood ratio

Multivariable Analysis and Risk Stratification

Multivariable logistic regression confirmed NEWS-2 as an

independent predictor of both outcomes after adjusting for age, sex, and Charlson Comorbidity Index.

Table 3: Multivariable Logistic Regression Analysis for Primary Outcomes

Variable	ICU Admission		30-day Mortality	
	OR (95% CI)	p-value	OR (95% CI)	p-value
NEWS-2 score (per point)	1.42 (1.32-1.53)	<0.001	1.51 (1.38-1.65)	<0.001
Age (per 10 years)	1.18 (1.04-1.34)	0.012	1.32 (1.12-1.56)	0.001
Male sex	1.24 (0.82-1.87)	0.308	1.18 (0.71-1.96)	0.524
Charlson Index (per point)	1.12 (1.03-1.22)	0.008	1.28 (1.15-1.42)	<0.001
NEWS-2 Risk Categories				
Low (0-4) vs. High (≥ 7)	Reference	-	Reference	-
Medium (5-6) vs. High (≥ 7)	2.84 (1.42-5.68)	0.003	3.12 (1.28-7.61)	0.012
High (≥ 7)	8.92 (4.86-16.38)	<0.001	12.46 (5.84-26.58)	<0.001

Among patients with NEWS-2 scores 0-4 (low risk, n=384), ICU admission rate was 4.4% and mortality was 1.8%. For scores 5-6 (medium risk, n=151), ICU admission was 11.9% and mortality was 5.3%. For scores ≥ 7 (high risk, n=312), ICU admission was 28.2% and mortality was 17.6%.

Secondary Outcomes

Median length of hospital stay was significantly longer in patients with NEWS-2 ≥ 7 (8 days, IQR: 5-14) compared to those with NEWS-2 < 7 (4 days, IQR: 2-7; $p < 0.001$). Mechanical ventilation was required in 89 patients (10.5%), with significantly higher rates in the high NEWS-2 group (22.1% vs. 3.7%, $p < 0.001$). Vasopressor use was documented in 76 patients (9.0%), again more frequent in high-risk patients (18.6% vs. 3.4%, $p < 0.001$).

Discussion

This prospective study demonstrates that NEWS-2 scores calculated at emergency department presentation possess excellent discriminatory ability for predicting both ICU admission and 30-day mortality. Our findings corroborate and extend previous research validating NEWS-2 in acute care settings while providing specific performance metrics relevant to ED-based risk stratification [15].

The observed AUC of 0.847 for ICU admission prediction aligns with findings from Mellhammar and colleagues, who reported similar discriminatory performance in a Scandinavian ED cohort [16]. Importantly, our study demonstrates that a single NEWS-2 assessment at ED arrival provides actionable prognostic information, potentially streamlining triage processes and resource allocation decisions. The strong negative predictive value (95.6%) at the optimal cutoff of ≥ 7 suggests particular utility in identifying patients who can safely be managed in lower-acuity settings [17].

The superior predictive performance for mortality (AUC 0.891) compared to ICU admission likely reflects the direct pathophysiological relationship between physiological derangement captured by NEWS-2 and ultimate survival outcomes [18]. This finding supports the conceptual

framework underlying early warning scores, wherein aggregate physiological parameters serve as proxies for overall homeostatic reserve and illness severity [19].

Our results demonstrate incremental predictive value across NEWS-2 risk categories, with high-risk patients (score ≥ 7) exhibiting nearly nine-fold increased odds of ICU admission compared to low-risk patients. This gradient supports the clinical utility of the established risk stratification thresholds, although ED-specific refinements may warrant consideration [20]. The adjusted analyses confirm that NEWS-2 provides independent prognostic information beyond demographic factors and comorbidity burden, enhancing its value as a readily available bedside tool [21].

Comparison with other scoring systems warrants discussion. While qSOFA has been promoted for sepsis identification, accumulating evidence suggests NEWS-2 demonstrates superior or equivalent performance across broader patient populations [22]. The comprehensive physiological assessment inherent to NEWS-2 likely captures deterioration patterns beyond sepsis-specific pathways, explaining its robust performance in our heterogeneous ED cohort [23].

Several limitations merit acknowledgment. Single-center design may limit generalizability, although our tertiary facility receives diverse patient populations. The 48-hour window for ICU admission, while clinically meaningful, may not capture delayed deterioration. Furthermore, treatment decisions were not protocolized, and knowledge of NEWS-2 scores by treating physicians may have influenced admission decisions, potentially introducing incorporation bias [24].

The clinical implications of our findings are substantial. Implementation of NEWS-2 as a standardized ED triage tool could facilitate objective risk stratification, support disposition decisions, and enable appropriate escalation of care [25]. The high negative predictive values suggest particular utility in resource-constrained settings where identification of low-risk patients may be equally valuable as detecting high-risk individuals.

Future research should explore dynamic NEWS-2 trajectories during ED stays, integration with biomarkers, and development of ED-specific prediction models incorporating NEWS-2 as a foundational element [26]. Machine learning approaches combining NEWS-2 with additional clinical variables represent a promising avenue for enhancing predictive accuracy.

Conclusion

This prospective study provides robust evidence supporting the utility of NEWS-2 scores calculated at emergency department presentation for predicting ICU admission and 30-day mortality. The scoring system demonstrates excellent discriminatory ability, with AUC values of 0.847 and 0.891 for ICU admission and mortality, respectively. A NEWS-2 threshold of ≥ 7 offers optimal balance between sensitivity and specificity for identifying high-risk patients requiring intensive care. The strong negative predictive values support the use of NEWS-2 for identifying patients suitable for lower-acuity care pathways. Implementation of standardized NEWS-2 assessment at ED triage could enhance clinical decision-making, optimize resource allocation, and potentially improve patient outcomes through early identification of those at risk for deterioration. These findings support broader adoption of NEWS-2 as a frontline risk stratification tool in emergency medicine practice.

References

- Pimentel MAF, Redfern OC, Gerry S, et al. A comparison of the ability of the National Early Warning Score and the National Early Warning Score 2 to identify patients at risk of in-hospital mortality: A multi-centre database study. *Resuscitation*. 2019;134:147-156. DOI: 10.1016/j.resuscitation.2018.09.026
- Smith GB, Prytherch DR, Meredith P, et al. The ability of the National Early Warning Score (NEWS) to discriminate patients at risk of early cardiac arrest, unanticipated intensive care unit admission, and death. *Resuscitation*. 2013;84(4):465-470. DOI: 10.1016/j.resuscitation.2012.12.016
- Subbe CP, Kruger M, Rutherford P, et al. Validation of a modified Early Warning Score in medical admissions. *QJM*. 2001;94(10):521-526. DOI: 10.1093/qjmed/94.10.521
- Royal College of Physicians. National Early Warning Score (NEWS): Standardising the assessment of acute-illness severity in the NHS. London: RCP; 2012. PMID: 25340239
- Royal College of Physicians. National Early Warning Score (NEWS) 2: Standardising the assessment of acute-illness severity in the NHS. London: RCP; 2017. Available from: <https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2>
- Kovacs C, Jarvis SW, Prytherch DR, et al. Comparison of the National Early Warning Score in non-elective medical and surgical patients. *Br J Surg*. 2016;103(10):1385-1393. DOI: 10.1002/bjs.10267
- Alam N, Hobbelink EL, van Tienhoven AJ, et al. The impact of the use of the Early Warning Score (EWS) on patient outcomes: A systematic review. *Resuscitation*. 2014;85(5):587-594. DOI: 10.1016/j.resuscitation.2014.01.013
- Churpek MM, Yuen TC, Winslow C, et al. Multicenter comparison of machine learning methods and conventional regression for predicting clinical deterioration on the wards. *Crit Care Med*. 2016;44(2):368-374. DOI: 10.1097/CCM.0000000000001571
- Silcock DJ, Corfield AR, Gowens PA, et al. Validation of the National Early Warning Score in the prehospital setting. *Resuscitation*. 2015;89:31-35. DOI: 10.1016/j.resuscitation.2014.12.029
- Spångfors M, Arvidsson L, Karlsson V, et al. The National Early Warning Score: Translation, testing and prediction in a Swedish setting. *Intensive Crit Care Nurs*. 2016;37:62-67. DOI: 10.1016/j.iccn.2016.05.007
- Goulden R, Hoyle MC, Monis J, et al. qSOFA, SIRS and NEWS for predicting inhospital mortality and ICU admission in emergency admissions treated as sepsis. *Emerg Med J*. 2018;35(6):345-349. DOI: 10.1136/emered-2017-207120
- Bilben B, Grandal L, Søvik S. National Early Warning Score (NEWS) as an emergency department predictor of disease severity and 90-day survival in the acutely dyspneic patient—a prospective observational study. *Scand J Trauma Resusc Emerg Med*. 2016;24:80. DOI: 10.1186/s13049-016-0273-9
- Brink A, Alsmas J, Verdonchot RJCG, et al. Predicting mortality in patients with suspected sepsis at the emergency department; A retrospective cohort study comparing qSOFA, SIRS and National Early Warning Score. *PLoS One*. 2019;14(1):e0211133. DOI: 10.1371/journal.pone.0211133
- Churpek MM, Snyder A, Han X, et al. Quick sepsis-related organ failure assessment, systemic inflammatory response syndrome, and early warning scores for detecting clinical deterioration in infected patients outside the intensive care unit. *Am J Respir Crit Care Med*. 2017;195(7):906-911. DOI: 10.1164/rccm.201604-0854OC
- Abbott TEF, Cron N, Vaid N, et al. Pre-hospital National Early Warning Score (NEWS) is associated with in-hospital mortality and critical care unit admission: A cohort study. *Ann Med Surg*. 2018;27:17-21. DOI: 10.1016/j.amsu.2018.01.006
- Mellhammar L, Linder A, Tverring J, et al. NEWS2 is superior to qSOFA in detecting sepsis with organ dysfunction in the emergency department. *J Clin Med*. 2019;8(8):1128. DOI: 10.3390/jcm8081128
- Keep JW, Messmer AS, Sladden R, et al. National early warning score at Emergency Department triage may allow earlier identification of patients with severe sepsis and septic shock: a retrospective observational study. *Emerg Med J*. 2016;33(1):37-41. DOI: 10.1136/emered-2014-204465
- Fernando SM, Fox-Robichaud AE, Engel J, et al. Prognostic accuracy of the Quick Sequential Organ Failure Assessment for mortality in patients with suspected infection: A systematic review and meta-analysis. *Ann Intern Med*. 2018;168(4):266-275. DOI: 10.7326/M17-2820

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DISSERTATION

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