Original Research Article

EVALUATING EARLY WARNING SCORES FOR PROGNOSTICATION IN EMERGENCY DEPARTMENT PATIENTS WITH SHOCK: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Shock is a critical and potentially fatal condition frequently encountered in the emergency department (ED), necessitating prompt recognition and intervention. Traditional scoring systems may be impractical in emergency settings, prompting the need for rapid assessment tools such as Early Warning Scores (EWS) including MEWS, NEWS, and REMS. **Objective:** This prospective observational study aimed to assess the predictive utility of MEWS, NEWS, and REMS in determining intensive care unit (ICU) admission, in-hospital mortality, need for ventilator support, and hospital length of stay among ED patients presenting with shock.
Materials and Methods: Conducted at Narayana Medical College, Nellore from July 2016 to September 2019, the study included 104 adult patients diagnosed with shock in the ED. Clinical data, laboratory values, and outcomes were recorded and statistically analyzed.
Results: Elevated EWS scores were significantly associated with ICU admissions, with NEWS demonstrating the highest predictive accuracy for ICU transfer. The overall mortality rate was 32.7%, with REMS showing the highest accuracy for mortality prediction (AUC = 0.951). Both MEWS and REMS scores correlated with increased ventilator use and prolonged hospitalization. Shock Index did not significantly predict mortality.
Conclusion: MEWS, NEWS, and REMS are effective tools for early risk stratification in ED shock patients. NEWS is best for ICU triage, while REMS is most predictive of mortality. Study limitations include small sample size.
Keywords: Early Warning Scores, Prognostication, Emergency Department.

INTRODUCTION

Shock is a life-threatening condition marked by inadequate cellular oxygen utilization due to circulatory failure, leading to high morbidity and mortality. It represents a critical state requiring early identification and prompt intervention to improve outcomes. Shock is categorized into four main types: hypovolemic, cardiogenic, obstructive, and distributive, though patients often present with mixed types, such as in sepsis or pancreatitis. Septic shock is the most common in intensive care units, followed by cardiogenic and hypovolemic shock.[1]

Diagnosis involves clinical evaluation and biochemical markers. Hallmarks include hypotension, tachycardia, cool skin, reduced urine output, and altered mental status.[2] Elevated lactate levels indicate tissue hypoperfusion. Emergency departments (ED) demand rapid and simple triage tools, as traditional scoring systems like APACHE and SOFA are impractical due to time constraints.[2,3] Early Warning Systems (EWS) utilize vital signs to identify deterioration. Key systems include MEWS (using five parameters), NEWS (six parameters,

widely adopted in the UK), REMS (a simplified APACHE II for ED use), and Shock Index (heart rate/systolic BP). Despite their utility, early physiological changes in shock are not well-studied. This study evaluates the effectiveness of MEWS, NEWS, and REMS in predicting ICU admission, mortality, and hospital stay in ED patients with shock.[4,5]

MATERIALS AND METHODS

This prospective observational study was conducted between July 2016 and September 2019 in the Emergency Department of Narayana Medical College, Nellore. The study included patients presenting with signs and symptoms suggesting of shock, with evaluation variables assessed at the time of presentation. Patients were excluded if they were under 18 years of age, had been previously hospitalized for more than 48 hours, had experienced trauma, were pregnant, were on corticosteroid therapy equivalent to at least 10 mg of prednisone per day, suffered from malnutrition, or had severe left ventricular dysfunction.

Data Collection

Demographic information, chief complaints, present and past medical history were collected using a pre-prepared proforma. A thorough clinical examination was performed, and signs of shock were observed and noted. All vital signs, including Heart Rate, Respiratory Rate, Blood Pressure, Mean Arterial Pressure (MAP), Temperature, Oxygen Saturation, and Glasgow Coma Scale (GCS) were meticulously recorded. Routine blood investigations, such as

Complete Blood Picture and biochemical parameters (Serum creatinine, CBG, Lactate), were sent, and necessary culture samples for microbial analysis were set up. Radiological investigations like Chest Radiograph and Ultrasound were performed as required. The details of patient outcomes, including ICU transfers, length of hospital stay, and mortality, were documented.

Data analysis was conducted using IBM SPSS Version 24.0 after entry into MS Excel. Categorical variables were expressed as numbers and percentages, with chi-square tests assessing group associations. Continuous variables were shown as mean ± standard deviation, analyzed using Student's t-test for two-group comparisons. Pearson's correlation tested relationships between variables. ANOVA and Kruskal-Wallis tests compared multiple groups, while ROC curves assessed diagnostic performance, with p-values <0.05 considered statistically significant.

RESULTS

A total of 104 patients were included in the study. The majority were male (62.5%) and most were admitted to the ICU (81.7%). Common presenting symptoms included restlessness (67.3%) and weak, rapid pulse (67.3%), followed by cool, clammy skin (28.8%) and confusion (27.9%). In terms of treatment, 71.2% received inotropic support and 46.2% required ventilator support. The overall mortality rate was 32.7%, while 67.3% of patients were discharged (Table 1).

Table 1: Patient Demographics and Clinical Characteristics (n = 104)

Characteristic	Frequency (n = 104)	Percentage (%)
Sex		
Male	65	62.5%
Female	39	37.5%
Presenting Symptoms		
Restlessness	70	67.3%
Weak, rapid pulse	70	67.3%
Cool, clammy skin	30	28.8%
Confusion	29	27.9%
Admission Type		
ICU	85	81.7%
Medical Ward	19	18.3%
Treatment		
Inotropic Support	74	71.2%
Ventilator Support	48	46.2%
Outcome		
Discharged	70	67.3%
Mortality	34	32.7%

The distribution of early warning scores revealed that 87.5% of patients had MEWS ≥5, 94.2% had NEWS ≥7, and the most frequent REMS category was 6–9 (41.3%) followed by 10–11 (22.1%) (Table 2).

Table 2: Early Warning Score Distribution

Score System	Score Range	Number of Patients	Percentage (%)
MEWS	< 5	13	12.5%
	≥ 5	91	87.5%
NEWS	1–4	1	1.0%
	5–6	5	4.8%
	≥ 7	98	94.2%

	0–2	1	1.0%
REMS	3–5	25	24.0%
	6–9	43	41.3%
	10–11	23	22.1%
	12–13	12	11.5%

When comparing mean age across scoring groups, no statistically significant differences were observed for MEWS (p = 1.037), NEWS (p = 0.874), or REMS (p = 0.322). However, patients in the REMS 12–13 group had the highest mean age (62.3 ± 12.01 years), suggesting a trend toward higher scores in older individuals (Table 3).

Table 3: Mean Age Comparison by Score Groups

Score System	Group	N	Mean Age ± SD	P-Value
MEWS	< 5	13	53.55 ± 13.64	1.037
	≥ 5	91	48.54 ± 17.84	
NEWS	1–4	1	57.75 ± 0.00	0.874
	5–6	5	44.18 ± 13.82	
	≥ 7	98	53.83 ± 15.89	
REMS	0–2	1	27.30 ± 0.00	0.322
	3–5	25	51.62 ± 16.29	
	6–9	43	48.17 ± 18.72	
	10–11	23	48.51 ± 15.60	
	12–13	12	62.30 ± 12.01	

Higher early warning scores were significantly associated with ICU admission. Patients with MEWS ≥5 were more likely to be admitted to ICU (86.8%) compared to those with MEWS <5 (46.2%) (p < 0.00011). Similarly, 84.7% of patients with NEWS ≥7 and 100% of those in the REMS 12–13 group were admitted to ICU (p = 0.00105 and p = 0.0451, respectively) (Table 4).

Table 4: ICU Admission and Early Warning Scores

Score System	Score Group	ICU (n = 85)	Non-ICU (n = 19)	P-Value
MEWS	< 5	6 (46.2%)	7 (53.8%)	<0.00011
	≥ 5	79 (86.8%)	12 (13.2%)	
NEWS	1–4	0 (0.0%)	1 (100.0%)	0.00105
	5–6	2 (33.3%)	4 (66.7%)	
	≥ 7	83 (84.7%)	15 (15.3%)	
REMS	0–2	0 (0.0%)	1 (100.0%)	0.0451
	3–5	19 (76.0%)	6 (24.0%)	
	6–9	32 (74.4%)	11 (25.6%)	
	10–11	21 (91.3%)	2 (8.7%)	
	12–13	13 (100.0%)	0 (0.0%)	

Mortality increased with higher early warning scores. Although not statistically significant for MEWS and NEWS (p = 0.109 and p = 0.290, respectively), REMS showed a strong association with mortality. No deaths occurred in the REMS 0–5 group, while mortality reached 91.7% in patients scoring 12–13 (p < 0.00011) (Table 5).

Table 5: Mortality and Early Warning Scores

Score System	Score Group	Mortality (n = 34)	Survival (n = 70)	P-Value
MEWS	< 5	2 (15.4%)	11 (84.6%)	0.109
	≥ 5	32 (35.2%)	59 (64.8%)	
NEWS	1–6	0 (0.0%)	6 (100.0%)	0.290
	≥ 7	34 (34.3%)	65 (65.7%)	
REMS	0–5	0 (0.0%)	26 (100.0%)	<0.00011
	6–9	10 (23.3%)	33 (76.7%)	
	10–11	13 (56.5%)	10 (43.5%)	
	12–13	11 (91.7%)	1 (8.3%)	

Ventilator support was also more common in patients with higher scores. Among those with MEWS ≥5, 50.6% required ventilatory assistance compared to 15.4% in the <5 group (p = 0.0147). All patients with REMS 12–13 required ventilation, while only 3.6% in the REMS ≤5 group did (p < 0.00011). NEWS did not show a statistically significant relationship with ventilator use (p = 0.106) (Table 6).

Table 6: Ventilator Support and Early Warning Scores

Score System	Score Group	Ventilator (n = 48)	No Ventilator (n = 56)	P-Value
MEWS	< 5	2 (15.4%)	11 (84.6%)	0.0147
	≥ 5	46 (50.6%)	45 (49.4%)	
NEWS	1–6	0 (0.0%)	6 (100.0%)	0.106
	≥ 7	48 (48.9%)	50 (51.1%)	
REMS	0–5	1 (3.6%)	26 (96.4%)	<0.00011
	6–9	21 (48.8%)	22 (51.2%)	
	10–11	14 (60.9%)	9 (39.1%)	
	12–13	12 (100.0%)	0 (0.0%)	

Patients with higher MEWS scores had a significantly longer hospital stay (5.3 vs. 3.5 days, p = 0.0021). While length of stay tended to increase with higher NEWS and REMS scores, these trends were not statistically significant (Table 7).

Table 7: Length of Hospital Stay and Early Warning Scores

Score System	Score Group	Mean LOS (Days)	P-Value
MEWS	< 5	3.5	0.0021
	≥ 5	5.3	
NEWS	1–6	3.4	0.109
	≥ 7	5.2	
REMS	0–5	3.7	0.183
	12–13	7.4	

In terms of diagnostic accuracy for mortality prediction, REMS had the highest area under the curve (AUC = 0.951, p < 0.00011), followed by NEWS (AUC = 0.841, p < 0.00011) and MEWS (AUC = 0.777, p = 0.00105). Length of stay showed modest predictive ability (AUC = 0.683, p = 0.0305), whereas shock index was not a significant predictor (AUC = 0.531, p = 0.466) (Table 8).

Table 8: Diagnostic Accuracy (AUC) for Mortality Prediction

Variable	AUC	P-Value	Best Cutoff	95% CI
REMS	0.951	<0.00011	7.4	0.864 – 0.980
NEWS	0.841	<0.00011	12.6	0.720 – 0.902
MEWS	0.777	0.00105	7.4	0.640 – 0.875
Length of Stay	0.683	0.0305	4.6	0.529 – 0.795
Shock Index	0.531	0.466	1.55	0.388 – 0.674

DISCUSSION

Shock is a life-threatening condition commonly encountered in emergency departments (ED) and intensive care units (ICU), requiring early identification and rapid intervention to reduce morbidity and mortality. Traditional scoring systems such as the Acute Physiology and Chronic Health Evaluation II (APACHE II) are widely used but require extensive clinical data, limiting their practicality in time-sensitive emergency settings. In contrast, Early Warning Scores (EWS) like the Modified Early Warning Score (MEWS), National Early Warning Score (NEWS), and Rapid Emergency Medicine Score (REMS) offer simplified, rapid assessment tools. The present study aimed to evaluate the predictive performance of MEWS, NEWS, and REMS in ED patients presenting with shock, focusing on outcomes such as ICU admission, mortality, ventilator support, and length of hospital stay.

A total of 104 patients were included in the present study, comprising 62.5% males and 37.5% females. The most frequent symptoms at presentation were restlessness (67.3%) and weak, rapid pulse (67.3%), followed by cool, clammy skin (28.8%) and confusion (27.9%). No significant gender-based differences in outcomes were observed, consistent with prior findings from Ho le O et al,[6] Corey et al,[7] Xiaohua Xie et al,[8] Burch et al,[9] Juan J. Delgado-Hurtado et al,[10] J. Gardner-Thorpe et al,[11] and Qin Qin et al,[12] who reported that gender was not significantly associated with EWS performance.

Similarly, the present study found no statistically significant association between patient age and score groupings for MEWS (p = 1.037), NEWS (p = 0.874), or REMS (p = 0.322), though patients in the REMS 12–13 group exhibited the highest mean age (62.3 ± 12.01 years). This aligns with Burch et al,[9] who also found no strong correlation between age and outcome but contrasts with Buist et al,[9] who reported a positive correlation between older age and increased in-hospital mortality.

The present study demonstrated a strong association between higher early warning scores and ICU admissions. Among patients with MEWS ≥5, 86.8% required ICU transfer compared to 46.2% for those with MEWS <5 (p < 0.00011). Similarly, 84.7% of patients with NEWS ≥7 were admitted to ICU (p = 0.00105), and REMS scores of 12–13 were associated with 100% ICU admission (p = 0.0451). In terms of diagnostic accuracy, NEWS had the highest Area Under the Receiver Operating Characteristic Curve (AUROC) at 0.856, followed by MEWS (0.835) and REMS (0.712).

These findings are consistent with those reported by Dundar et al,[13] who found MEWS to be highly predictive of ICU admission in geriatric ED patients (AUC = 0.891), and Xiaohua Xie et al,[8] who reported an AUC of 0.759 for MEWS in predicting ICU transfer. Juan J. Delgado-Hurtado et al,[10] also confirmed that higher MEWS scores were associated with ICU admission. However, the performance in the present study surpasses those by Innocenti et al,[14] (AUC = 0.662), Ho le O et al,[6] (AUC = 0.49), and Bulut et al,[15] (AUC = 0.538), who studied general ED populations.

For NEWS, our results corroborate findings by G.B. Smith et al,[16] who reported an AUROC of 0.857 for NEWS in an Acute Medical Care Unit. Other supporting studies include Alam N et al,[17] (AUC = 0.768), Churpek et al,[18] (AUC = 0.77), Corfield et al,[19] (AUC = 0.67), and Keep JW et al,[20] (AUC = 0.78), all of which confirm NEWS's effectiveness in early identification of critical patients requiring ICU care.

REMS also demonstrated prognostic value for ICU admission in the present study, although its AUROC (0.712) was lower than MEWS and NEWS. This result aligns closely with Cattermole et al,[21] who found an AUC of 0.696 for REMS in ED resuscitation patients, and is comparable to Xiaojun Wei et al,[22] (AUC = 0.756). It outperforms the findings by Bulut et al,[15] (AUC = 0.589), highlighting REMS's utility in assessing critically ill shock patients.

The present study observed a 32.7% overall mortality rate. Mortality increased significantly with higher REMS scores (p < 0.00011), with no deaths in the 0–5 score group and mortality peaking at 91.7% in the 12–13 group. REMS showed the highest accuracy in predicting mortality (AUC = 0.951), followed by NEWS (AUC = 0.841) and MEWS (AUC = 0.777). Despite these high AUROC values, MEWS (p = 0.109) and NEWS (p = 0.290) did not reach statistical significance for mortality prediction, possibly due to the sample size or distribution of deaths.

These results for REMS are in agreement with Olsson et al,[23] (AUC = 0.911 in 12,006 non-surgical ED patients), and are higher than values reported by Bulut et al,[15] (AUC = 0.707) and Goodacre et al. For septic ED patients, Nesrin Ghanem-Zoubi et al,[24] (AUC = 0.77) and Howell et al,[25] (AUC = 0.80) also support REMS as a strong predictor of mortality.

In contrast, while MEWS and NEWS showed high AUROC values, their lack of statistical significance in this study diverges from findings by Dundar et al,[13] (MEWS AUC = 0.891), Xiaohua Xie et al,[8] (MEWS AUC = 0.83), and Churpek et al,[18] who all found MEWS to be a significant predictor of mortality. However, Ho le O et al,[6] also found MEWS inadequate for mortality prediction, supporting the present findings.

Similarly, high NEWS performance in other studies—such as G.B. Smith et al,[16] (AUC = 0.894), Keep JW et al,[20] (AUC = 0.94), Brink A et al. (AUC = 0.837), and Alam N et al,[17] (AUC = 0.85)—

contrasts with the lack of statistical significance in the present study, likely reflecting sample limitations. The Shock Index (SI) was not a significant predictor of mortality in the present study (AUC = 0.531, p = 0.466). This aligns with Liu et al,[26] who found SI lacked predictive value in a large cohort, but contradicts Kristensen et al,[27] who found SI to be a significant mortality predictor in specific populations.

Ventilator support was significantly more common in patients with higher MEWS scores (50.6% for MEWS ≥5, p = 0.0147) and REMS (p < 0.00011), especially REMS 12–13 group (100%). In contrast, NEWS did not show statistical significance for ventilator use (p = 0.106), which may limit its utility in predicting respiratory failure.

Length of hospital stay (LOS) was significantly longer in patients with MEWS ≥5 (5.3 vs. 3.5 days, p = 0.0021), confirming findings by Kruisselbrink R et al,[28] (p < 0.0061). However, unlike Alam et al,[17] (NEWS p < 0.001), the present study did not find statistically significant associations between LOS and higher NEWS (p = 0.109) or REMS scores (p = 0.183).

CONCLUSION

The present study confirms that MEWS, NEWS, and REMS are valuable tools for identifying ED patients with shock who are at increased risk of ICU admission. NEWS showed the highest accuracy for ICU transfers, while REMS was the most accurate for predicting in-hospital mortality. MEWS also performed well, particularly in ICU and ventilator predictions. The lack of statistical significance in mortality prediction for MEWS and NEWS highlights the potential limitations due to sample size. REMS emerged as the most reliable score for mortality prognostication in this patient population, while Shock Index was not a useful predictor.

Limitations

This study is limited by its small sample size, short follow-up, single-center design, potential biases, lack of blinding, limited statistical analysis, and absence of broader population-based comparisons or cut-offs.

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