Original Research

PREDICTIVE VALUE OF SHOCK INDEX AND MODIFIED EARLY WARNING SCORE (MEWS) IN PATIENTS PRESENTING WITH ACUTE POISONING TO THE EMERGENCY DEPARTMENT

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ABSTRACT

Background: Acute poisoning is a frequent medical emergency that requires rapid assessment to identify patients at risk of deterioration and death. In situations where toxicological confirmation is delayed, simple bedside scoring systems may aid early clinical decision-making.
Objective: To assess the prognostic utility of the Shock Index (SI) and Modified Early Warning Score (MEWS) in patients presenting with acute poisoning to the emergency department.
Materials and Methods: This retrospective observational study included patients with acute poisoning who presented to the emergency department between January 2022 and December 2023. SI was calculated as heart rate divided by systolic blood pressure, while MEWS was derived from vital signs and level of consciousness. The primary outcome was in-hospital mortality. Secondary outcomes included intensive care unit admission, need for mechanical ventilation, vasopressor support, clinical deterioration within 24 hours, and hospital length of stay. Predictive performance was evaluated using receiver operating characteristic analysis and logistic regression.
Results: A total of 236 patients were analyzed, with an in-hospital mortality rate of 9.7%. Pesticide poisoning was the most common exposure and occurred more frequently among non-survivors. Both SI and MEWS were significantly higher in non-survivors. SI predicted mortality with an area under the curve (AUC) of 0.842 at a cut-off value of 1.08, whereas MEWS demonstrated superior discrimination (AUC 0.914) at a cut-off value of 6. Multivariable analysis identified both SI >1.08 and MEWS ≥6 as independent predictors of mortality. Conclusion: SI and MEWS are effective bedside tools for risk stratification in acute poisoning, with MEWS showing greater predictive accuracy. Their combined application may facilitate early triage and timely critical care intervention.

Keywords: Acute Poisoning, Critical Care, Emergency Department, Modified Early Warning Score, Mortality Prediction, Shock Index, Toxicology.

INTRODUCTION

Acute poisoning is a major toxicological emergency and continues to place a substantial burden on emergency and critical care services worldwide. Patients with poisoning may present after deliberating self-harm, accidental exposure, occupational exposure, medication overdose, pesticide ingestion, household chemical ingestion, alcohol-related toxicity, or exposure to unknown toxic substances.

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The clinical course is often unpredictable, ranging from mild observation-only illness to respiratory depression, seizures, coma, circulatory shock, intensive care requirement, and death. Because the precise toxic agent, dose, time of exposure, and co-ingestions are not always known at first contact, emergency physicians require simple and reliable bedside tools for early risk stratification [1,2].
The emergency department is usually the first point of hospital contact for patients with acute poisoning. Early triage is therefore critical because clinical deterioration may occur within a short period, particularly in patients with delayed presentation, altered mental status, cardiovascular instability, respiratory compromise, or ingestion of highly toxic substances. Recent evidence has emphasized that mortality prediction in acute poisoning should not depend on toxicological details alone; it should also

incorporate the patient's physiological condition at presentation [2]. This is important in routine emergency practice because toxicology screening, poison quantification, and laboratory markers may not be immediately available, especially in resource-limited settings.

Several scoring systems have been used to predict severity and mortality in patients with acute poisoning. These include the Poisoning Severity Score, Sequential Organ Failure Assessment score, Acute Physiology and Chronic Health Evaluation score, National Early Warning Score, Modified Early Warning Score, and newer poisoning-specific models such as the new-Poisoning Mortality Score [2–5]. Although some of these tools show strong predictive performance, many require multiple clinical, laboratory, or poisoning-specific variables. In contrast, Shock Index and Modified Early Warning Score are attractive because they are based on routinely available bedside observations and can be applied early during emergency department assessment.

Shock Index is calculated as the ratio of heart rate to systolic blood pressure. It is a rapid marker of haemodynamic stress and may detect early circulatory compromise before overt hypotension becomes clinically obvious. A rising Shock Index reflects disproportionate tachycardia in relation to systolic blood pressure and may indicate reduced circulatory reserve, hypovolaemia, vasodilation, cardiotoxicity, or evolving shock [6]. In acute poisoning, this may be particularly relevant in patients exposed to pesticides, aluminium phosphide, cardiotoxic drugs, sedative agents with hypoxia, or unknown substances causing systemic instability. Abdelhamid et al. reported that Shock Index had predictive value for organ dysfunction among shocked acutely poisoned patients, supporting its role as a simple physiological marker in toxicological emergencies [7].

Modified Early Warning Score is a broader clinical deterioration score that incorporates systolic blood pressure, heart rate, respiratory rate, temperature, and level of consciousness. These parameters are directly relevant to acute poisoning because toxic agents frequently affect the cardiovascular, respiratory, neurological, and thermoregulatory systems. Unlike Shock Index, MEWS does not focus only on haemodynamic change; it also captures respiratory and neurological deterioration, which are common pathways to poor outcomes in poisoning. This makes MEWS clinically useful in patients with sedative overdose, organophosphorus poisoning, alcohol-related toxicity, drug overdose, corrosive ingestion, and mixed or unknown poisoning.

Recent studies have strengthened the evidence base for physiological scoring in poisoning. Han et al. developed and validated the new-Poisoning Mortality Score using a large emergency department poisoning cohort and showed excellent discrimination for in-hospital mortality [2]. Lee et al. later compared the new-Poisoning Mortality Score with MEWS in patients with acute poisoning and reported that MEWS had moderate-to-good predictive value, although the poisoning-specific score performed better [3]. A recent systematic review and meta-analysis also concluded that different scoring systems vary in performance, with MEWS and poisoning-specific scores remaining clinically relevant for mortality prediction in poisoned patients [5]. These findings suggest that although more complex models may provide stronger statistical prediction, simpler bedside tools such as MEWS remain valuable for early emergency assessment.

Despite increasing interest in poisoning-specific risk scores, there remains a practical need to evaluate simple tools that can be applied immediately at triage. Shock Index requires only pulse rate and systolic blood pressure, while MEWS requires a standard set of vital signs and consciousness assessment. Both can be calculated without laboratory tests, imaging, or advanced monitoring. This is particularly useful in emergency departments where patient load is high and rapid identification of high-risk cases is essential.

The study period of 2022–2023 is clinically relevant because emergency departments during this period continued to manage a broad range of poisoning presentations, including pesticide ingestion, pharmaceutical overdose, household chemical exposure, and intentional self-poisoning. Evaluating Shock Index and MEWS in this period can help determine whether these tools are useful for predicting adverse outcomes such as intensive care unit admission, mechanical ventilation, vasopressor requirement, prolonged hospital stay, and in-hospital mortality.

Therefore, the present study titled "Predictive Value of Shock Index and Modified Early Warning Score (MEWS) in Patients Presenting with Acute Poisoning to the Emergency Department" aims to assess the usefulness of Shock Index and MEWS as early predictors of clinical outcome among acute poisoning patients presenting to the emergency department during 2022–2023. The findings may help support rapid triage, early critical care referral, and timely clinical decision-making in toxicology and emergency medicine practice.

MATERIALS AND METHODS

Study Design

This study was designed as a hospital-based retrospective observational study to evaluate the predictive value of Shock Index and Modified Early Warning Score (MEWS) among patients presenting with acute poisoning to the emergency department. The retrospective design was selected because the study used routinely documented emergency department and hospital records from the defined study period of 2022–2023. The study was planned and reported in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations for observational studies and the Standards for Reporting Diagnostic Accuracy Studies (STARD) principles for predictive accuracy reporting [8-9].

Study Setting

The study was conducted in the Emergency Department and associated Critical Care/Toxicology Unit of a tertiary care hospital. Patients presenting suspected or confirmed acute poisoning were initially assessed in the emergency department and were subsequently managed in the emergency observation area, general ward, high-dependency unit, or intensive care unit according to clinical severity.

Study Period

The study covered two years from January 2022 to December 2023.

Study Population

The study population included all eligible patients who presented to the emergency department with acute poisoning during the study period. Acute poisoning was defined as exposure to a toxic substance through ingestion, inhalation, dermal contact, injection, or another route, resulting in clinical presentation to the emergency department for assessment or treatment.

Inclusion Criteria

Patients were included if they met the following criteria:

1. Patients are diagnosed clinically or by history as cases of acute poisoning.
2. Patients presenting to the emergency department between January 2022 and December 2023.
3. Patients with documented initial vital signs at emergency presentation.
4. Patients with available heart rate and systolic blood pressure values for Shock Index calculation.
5. Patients with documented respiratory rate, heart rate, systolic blood pressure, temperature, and consciousness status for MEWS calculation.
6. Patients with available outcome data during the same hospital encounter.

Exclusion Criteria

Patients were excluded if they met any of the following criteria:

1. Brought dead cases.
2. Patients with incomplete documentation of heart rate or systolic blood pressure.
3. Patients with missing variables required for MEWS calculation.
4. Patients transferred out before outcome assessment.
5. Patients with chronic poisoning rather than acute exposure.
6. Patients with food poisoning without toxicological relevance.
7. Patients with snakebite, scorpion sting, allergic reactions, or envenomation-related emergencies, unless recorded under the institutional acute poisoning register.
8. Duplicate records or repeated entries for the same poisoning episode.

Variables Collected

Data were extracted using a structured data collection format. The variables collected included age, sex, residence, type of poison, route of exposure, intention of poisoning, time interval between exposure and hospital arrival, presenting symptoms, heart rate, systolic blood pressure, respiratory rate, temperature, oxygen saturation where available, AVPU/GCS status, treatment received, intensive care unit admission, mechanical ventilation, vasopressor requirement, length of hospital stay, discharge status, discharge against medical advice, and final hospital outcome.

Operational Definitions

For uniform analysis, the study variables were defined as follows:

Variable	Operational definition
Acute poisoning	**Recent exposure to a toxic substance requiring emergency department assessment or treatment**
Shock Index	**Heart rate divided by systolic blood pressure**
MEWS	**Composite physiological score calculated from systolic blood pressure, heart rate, respiratory rate, temperature, and level of consciousness**
Intentional poisoning	**Poisoning due to deliberate self-harm or intentional ingestion/exposure**
Accidental poisoning	**Unintentional exposure to a toxic substance**
ICU admission	**Admission to the intensive care unit at any time during the same hospital encounter**

Mechanical ventilation	**Requirement of invasive or non-invasive ventilatory support**
Vasopressor support	**Use of vasopressor drugs for circulatory support**
In-hospital mortality	**Death occurring during the same hospital admission**
Length of hospital stay	**Duration from admission to discharge, discharge against medical advice, referral, or death**

Score Calculation

Shock Index

Shock Index was calculated using the first documented heart rate and systolic blood pressure values recorded at the emergency department presentation.

Shock Index = Heart Rate / Systolic Blood Pressure

For example, a patient with a heart rate of 120 beats/min and systolic blood pressure of 100 mmHg had a Shock Index of 1.20. Shock Index was analysed as both a continuous variable and as a categorical predictor using the optimal cut-off value identified by receiver operating characteristic curve analysis.

Modified Early Warning Score

MEWS was calculated using the first recorded emergency department physiological parameters: systolic blood pressure, heart rate, respiratory rate, temperature, and level of consciousness. Consciousness level was assessed using AVPU documentation where available. If Glasgow Coma Scale was recorded instead of AVPU, it was converted into an equivalent consciousness category for scoring.

Parameter	3 points	2 points	1 point	0 points	1 point	2 points	3 points
Systolic BP, mmHg	**≤70**	**71–80**	**81–100**	**101–199**	**—**	**≥200**	**—**
Heart rate/min	**—**	**≤40**	**41–50**	**51–100**	**101–110**	**111–129**	**≥130**
Respiratory rate/min	**—**	**≤8**	**—**	**9–14**	**15–20**	**21–29**	**≥30**
Temperature, °C	**—**	**≤35.0**	**—**	**35.1–38.4**	**—**	**≥38.5**	**—**
Consciousness	**—**	**—**	**—**	**Alert**	**Reacts to voice**	**Reacts to pain**	**Unresponsive**

The total MEWS was calculated by summing the scores assigned to each parameter. MEWS was analysed as a continuous score and as a categorical variable based on the optimal cut-off value obtained from receiver operating characteristic curve analysis.

Outcomes

Primary Outcome

The primary outcome was in-hospital mortality.

Secondary Outcomes

The secondary outcomes were:

1. Intensive care unit admission.
2. Requirement of mechanical ventilation.
3. Requirement of vasopressor support.
4. Clinical deterioration within 24 hours of emergency department presentation.
5. Length of hospital stay.
6. Discharge against medical advice.

Statistical Analysis

Data were entered into Microsoft Excel 2021 and analysed using IBM SPSS Statistics version 29.0 (IBM Corp., Armonk, NY, USA). Data cleaning was performed before analysis, and records with missing essential variables required for Shock Index or MEWS calculation were excluded from the final analytical dataset.

Continuous variables were assessed for distribution using the Shapiro–Wilk test and visual inspection of histograms. Normally distributed continuous variables were expressed as mean ± standard deviation, while non-normally distributed variables were expressed as median with interquartile range. Categorical variables were presented as frequency and percentage. Patients were classified into survivor and non-survivor groups for primary outcome analysis. Continuous variables were compared between groups using the independent-samples t-test for normally distributed data and the Mann–Whitney U test for non-normally distributed data. Categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. Shock Index and MEWS were compared between survivor and non-survivor groups. Receiver operating characteristic curve analysis was performed to evaluate the predictive accuracy of both scores for in-hospital mortality. The area under the curve with 95% confidence interval was calculated. The optimal cut-off value for each score was determined using Youden's index. For each score, sensitivity, specificity, positive predictive value, negative predictive value, overall accuracy, and Youden index were calculated. Secondary ROC analyses were also performed for intensive care unit admission, mechanical ventilation, and vasopressor requirement.

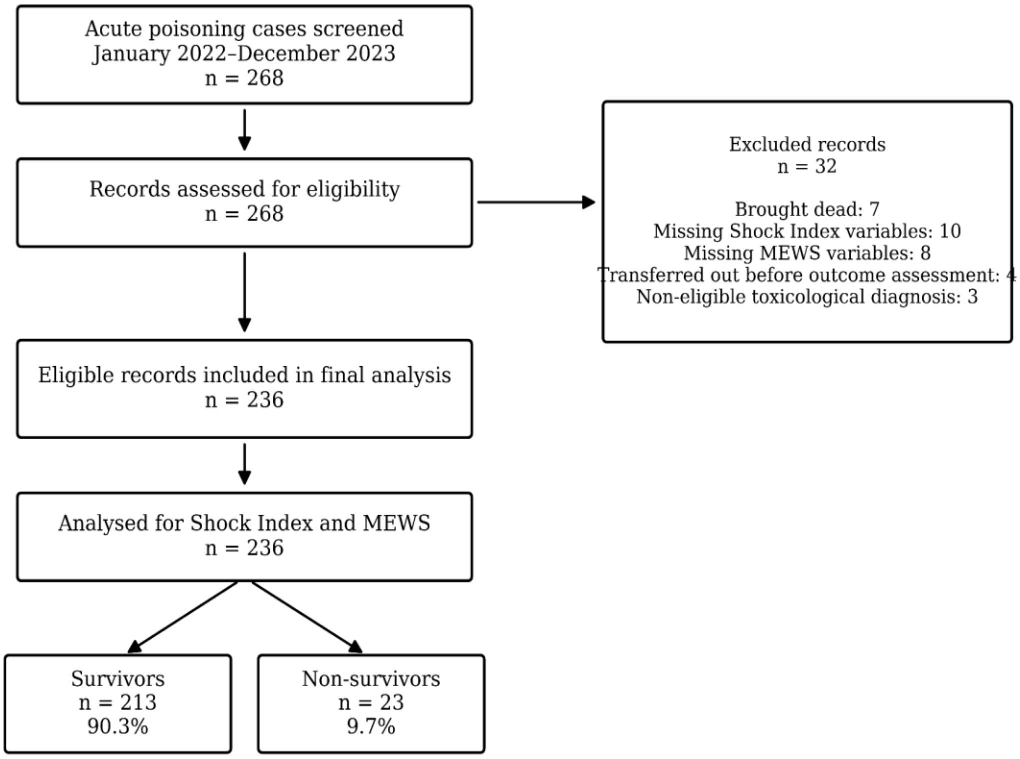
Binary logistic regression analysis was used to identify independent predictors of in-hospital mortality. Variables with clinical relevance and variables showing statistical significance in univariate analysis were considered for the multivariable model. Adjusted odds ratios with 95% confidence intervals were reported. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Patient Selection and Study Population

During the study period from January 2022 to December 2023, a total of 268 patients presented to the emergency department with suspected or confirmed acute poisoning. After screening the records, 32 patients were excluded. The reasons for exclusion were brought-dead status in 7 cases, incomplete documentation of heart rate or systolic blood pressure in 10 cases, incomplete variables required for MEWS calculation in 8 cases, transfer to another facility before outcome assessment in 4 cases, and non-eligible toxicological diagnoses in 3 cases.

The final analytical sample included 236 patients. Among these, 213 patients survived and 23 patients died during the same hospital encounter, giving an overall in-hospital mortality rate of 9.7%. The patient selection process is presented in Figure 1.



SI, Shock Index; MEWS, Modified Early Warning Score.

Figure 1. Patient selection flow diagram

Baseline Sociodemographic and Poisoning Characteristics

The baseline sociodemographic and poisoning-related characteristics of the study population are shown in Table 1. The mean age of the study population was 34.8 ± 14.6 years. Patients who died were older than survivors, with a mean age of 43.2 ± 16.8 years compared with 33.9 ± 14.1 years among survivors. This difference was statistically significant (p = 0.017).

Most patients were in the 20–39-year age group. Males accounted for 132 cases (55.9%), while females accounted for 104 cases (44.1%). There was no statistically significant difference in sex distribution between survivors and non-survivors (p = 0.616). Rural residence was documented in 151 patients (64.0%), and urban residence was documented in 85 patients (36.0%).

Intentional poisoning was the most common mode of exposure and was reported in 164 patients (69.5%). Accidental poisoning was reported in 58 patients (24.6%), while occupational exposure was documented in 14 patients (5.9%). Oral ingestion was the most common route of exposure, occurring in 212 patients (89.8%). Pesticide poisoning was the most frequent poison category, accounting for 92 cases (39.0%). Pesticide poisoning was significantly more common among non-survivors than survivors (69.6% vs 35.7%, p = 0.002). The median time from exposure to emergency department arrival was 4.0 hours, and delayed presentation was more frequent among non-survivors.

Table 1. Baseline sociodemographic and poisoning characteristics of the study population

Variable	Total patients n = 236	Survivors n = 213	Non-survivors n = 23	p-value
Age, years, mean ± SD	**34.8 ± 14.6**	**33.9 ± 14.1**	**43.2 ± 16.8**	**0.017**
Age <20 years	**32 (13.6%)**	**31 (14.6%)**	**1 (4.3%)**	**0.331**
Age 20–39 years	**124 (52.5%)**	**116 (54.5%)**	**8 (34.8%)**	**0.073**
Age 40–59 years	**58 (24.6%)**	**49 (23.0%)**	**9 (39.1%)**	**0.088**
Age ≥60 years	**22 (9.3%)**	**17 (8.0%)**	**5 (21.7%)**	**0.048**
Male	**132 (55.9%)**	**118 (55.4%)**	**14 (60.9%)**	**0.616**
Female	**104 (44.1%)**	**95 (44.6%)**	**9 (39.1%)**	**0.616**
Rural residence	**151 (64.0%)**	**133 (62.4%)**	**18 (78.3%)**	**0.133**
Urban residence	**85 (36.0%)**	**80 (37.6%)**	**5 (21.7%)**	**0.133**
Intentional poisoning	**164 (69.5%)**	**145 (68.1%)**	**19 (82.6%)**	**0.150**
Accidental poisoning	**58 (24.6%)**	**55 (25.8%)**	**3 (13.0%)**	**0.176**
Occupational exposure	**14 (5.9%)**	**13 (6.1%)**	**1 (4.3%)**	**1.000**
Oral exposure	**212 (89.8%)**	**191 (89.7%)**	**21 (91.3%)**	**1.000**
Inhalational exposure	**17 (7.2%)**	**15 (7.0%)**	**2 (8.7%)**	**0.675**
Dermal/mixed exposure	**7 (3.0%)**	**7 (3.3%)**	**0 (0.0%)**	**1.000**
Pesticide poisoning	**92 (39.0%)**	**76 (35.7%)**	**16 (69.6%)**	**0.002**
Drug overdose	**61 (25.8%)**	**58 (27.2%)**	**3 (13.0%)**	**0.140**
Household chemical poisoning	**38 (16.1%)**	**36 (16.9%)**	**2 (8.7%)**	**0.548**
Corrosive poisoning	**19 (8.1%)**	**18 (8.5%)**	**1 (4.3%)**	**0.703**
Unknown/mixed poisoning	**26 (11.0%)**	**25 (11.7%)**	**1 (4.3%)**	**0.484**
Time to hospital arrival, hours, median (IQR)	**4.0 (2.0–7.0)**	**3.5 (2.0–6.0)**	**7.0 (4.0–10.0)**	**<0.001**

Clinical Presentation and Initial Physiological Parameters

The clinical profile and initial physiological parameters at the emergency department presentation are presented in Table 2. Vomiting was the most common present symptom and was documented in 108 patients (45.8%). Altered sensorium was observed in 74 patients (31.4%), respiratory distress in 47 patients (19.9%), and seizures in 24 patients (10.2%).

Non-survivors showed greater physiological derangement at presentations than survivors. The mean heart rate was significantly higher among non-survivors than survivors (135.6 ± 24.1 beats/min vs 100.8 ± 19.7 beats/min, p <0.001). The mean systolic blood pressure was significantly lower among non-survivors than survivors (76.8 ± 18.4 mmHg vs 114.3 ± 19.2 mmHg, p <0.001). Oxygen saturation was also significantly lower among non-survivors (84.6 ± 8.9%) than survivors (95.7 ± 4.3%, p <0.001).

The median Shock Index of the total study population was 0.92. Non-survivors had a higher median Shock Index than survivors (1.26 vs 0.88, p <0.001). Similarly, the median MEWS was higher among non-survivors than survivors (7.0 vs 3.0, p <0.001). These findings indicate that both Shock Index and MEWS were significantly associated with mortality status.

Table 2. Clinical profile and initial physiological parameters at emergency presentation

Variable	Total patients n = 236	Survivors n = 213	Non-survivors n = 23	p-value

Heart rate, beats/min, mean ± SD	**104.2 ± 22.6**	**100.8 ± 19.7**	**135.6 ± 24.1**	**<0.001**
Systolic BP, mmHg, mean ± SD	**110.6 ± 22.1**	**114.3 ± 19.2**	**76.8 ± 18.4**	**<0.001**
Respiratory rate/min, median (IQR)	**22 (18–28)**	**21 (18–26)**	**32 (28–36)**	**<0.001**
Temperature, °C, mean ± SD	**36.8 ± 0.7**	**36.8 ± 0.6**	**37.1 ± 0.9**	**0.131**
Oxygen saturation, %, mean ± SD	**94.6 ± 5.8**	**95.7 ± 4.3**	**84.6 ± 8.9**	**<0.001**
Altered sensorium	**74 (31.4%)**	**56 (26.3%)**	**18 (78.3%)**	**<0.001**
Vomiting	**108 (45.8%)**	**99 (46.5%)**	**9 (39.1%)**	**0.502**
Seizure	**24 (10.2%)**	**18 (8.5%)**	**6 (26.1%)**	**0.018**
Respiratory distress	**47 (19.9%)**	**31 (14.6%)**	**16 (69.6%)**	**<0.001**
Hypotension	**39 (16.5%)**	**22 (10.3%)**	**17 (73.9%)**	**<0.001**
Tachycardia	**131 (55.5%)**	**112 (52.6%)**	**19 (82.6%)**	**0.006**
Shock Index, median (IQR)	**0.92 (0.74–1.13)**	**0.88 (0.72–1.05)**	**1.26 (1.08–1.56)**	**<0.001**
MEWS, median (IQR)	**3.0 (2.0–5.0)**	**3.0 (1.0–4.0)**	**7.0 (6.0–9.0)**	**<0.001**

4.4 Treatment Details and Clinical Outcomes

Treatment details and clinical outcomes are shown in Table 3. Gastric lavage was performed in 126 patients (53.4%), and antidote therapy was administered in 84 patients (35.6%) where clinically indicated. Oxygen therapy was required in 78 patients (33.1%).

A total of 64 patients (27.1%) required ICU admission. Mechanical ventilation was required in 41 patients (17.4%), while vasopressor support was required in 34 patients (14.4%). Clinical deterioration within 24 hours of emergency department presentation occurred in 52 patients (22.0%). The median length of hospital stay was 4.0 days.

Patients who died were significantly more likely to require oxygen therapy, ICU admission, mechanical ventilation, vasopressor support, and early clinical escalation compared with survivors. ICU admission was required in 95.7% of non-survivors compared with 19.7% of survivors (p <0.001). Mechanical ventilation was required in 91.3% of non-survivors compared with 9.4% of survivors (p <0.001). Vasopressor support was required in 87.0% of non-survivors compared with 6.6% of survivors (p <0.001).

Table 3. Treatment details and clinical outcomes

Variable	Total patients n = 236	Survivors n = 213	Non-survivors n = 23	p-value
Gastric lavage	**126 (53.4%)**	**114 (53.5%)**	**12 (52.2%)**	**0.902**
Antidote administered	**84 (35.6%)**	**71 (33.3%)**	**13 (56.5%)**	**0.027**
Oxygen therapy	**78 (33.1%)**	**58 (27.2%)**	**20 (87.0%)**	**<0.001**
ICU admission	**64 (27.1%)**	**42 (19.7%)**	**22 (95.7%)**	**<0.001**
Mechanical ventilation	**41 (17.4%)**	**20 (9.4%)**	**21 (91.3%)**	**<0.001**
Vasopressor support	**34 (14.4%)**	**14 (6.6%)**	**20 (87.0%)**	**<0.001**
Clinical deterioration within 24 hours	**52 (22.0%)**	**31 (14.6%)**	**21 (91.3%)**	**<0.001**
Length of hospital stay, days, median (IQR)	**4.0 (2.0–7.0)**	**4.0 (2.0–6.0)**	**2.0 (1.0–4.0)**	**0.021**
Discharged stable	**195 (82.6%)**	**195 (91.5%)**	**—**	**—**
Discharged against medical advice	**18 (7.6%)**	**18 (8.5%)**	**—**	**—**
In-hospital death	**23 (9.7%)**	**—**	**23 (100%)**	**—**

Predictive Accuracy of Shock Index and MEWS

Receiver operating characteristic curve analysis was performed to evaluate the predictive accuracy of Shock Index and MEWS for in-hospital mortality and major adverse outcomes. The results are shown in Table 4, and the comparative ROC curves for mortality prediction are presented in Figure 2.

Shock Index predicted in-hospital mortality with an area under the curve of 0.842. At the optimal cut-off value of 1.08, the Shock Index showed sensitivity of

82.6%, specificity of 76.5%, a positive predictive value of 27.9%, a negative predictive value of 97.6%, and a Youden index of 0.591.

MEWS showed stronger predictive performance for in-hospital mortality, with an area under the curve of 0.914. At the optimal cut-off value of 5.5, MEWS showed sensitivity of 87.0%, specificity of 84.0%, positive predictive value of 37.0%, negative predictive value of 98.3%, and Youden index of 0.710.

MEWS also demonstrated higher AUC values than Shock Index for ICU admission, mechanical ventilation, and vasopressor support. These findings suggest that MEWS had better overall discrimination than Shock Index for predicting adverse clinical outcomes in patients with acute poisoning.

Table 4. Predictive accuracy of Shock Index and MEWS for adverse outcomes

Score	Outcome	AUC	95% CI	Best cut-off	Sensitivity	Specificity	PPV	NPV	Youden index	p-value
Shock Index	**In-hospital mortality**	**0.842**	**0.771 – 0.913**	**1.08**	**82.6%**	**76.5%**	**27.9%**	**97.6%**	**0.591**	**<0.001**
MEWS	**In-hospital mortality**	**0.914**	**0.861 – 0.967**	**5.5**	**87.0%**	**84.0%**	**37.0%**	**98.3%**	**0.710**	**<0.001**
Shock Index	**ICU admission**	**0.781**	**0.708 – 0.854**	**0.98**	**75.0%**	**70.3%**	**48.0%**	**88.3%**	**0.453**	**<0.001**
MEWS	**ICU admission**	**0.867**	**0.810 – 0.924**	**4.5**	**81.3%**	**78.5%**	**58.4%**	**91.9%**	**0.598**	**<0.001**
Shock Index	**Mechanical ventilation**	**0.812**	**0.734 – 0.890**	**1.05**	**78.0%**	**73.3%**	**38.1%**	**94.1%**	**0.513**	**<0.001**
MEWS	**Mechanical ventilation**	**0.901**	**0.846 – 0.956**	**5.5**	**85.4%**	**82.1%**	**50.7%**	**96.4%**	**0.675**	**<0.001**
Shock Index	**Vasopressor support**	**0.851**	**0.781 – 0.921**	**1.10**	**82.4%**	**78.2%**	**39.4%**	**96.4%**	**0.606**	**<0.001**
MEWS	**Vasopressor support**	**0.889**	**0.824 – 0.954**	**5.5**	**85.3%**	**80.7%**	**42.6%**	**97.1%**	**0.660**	**<0.001**

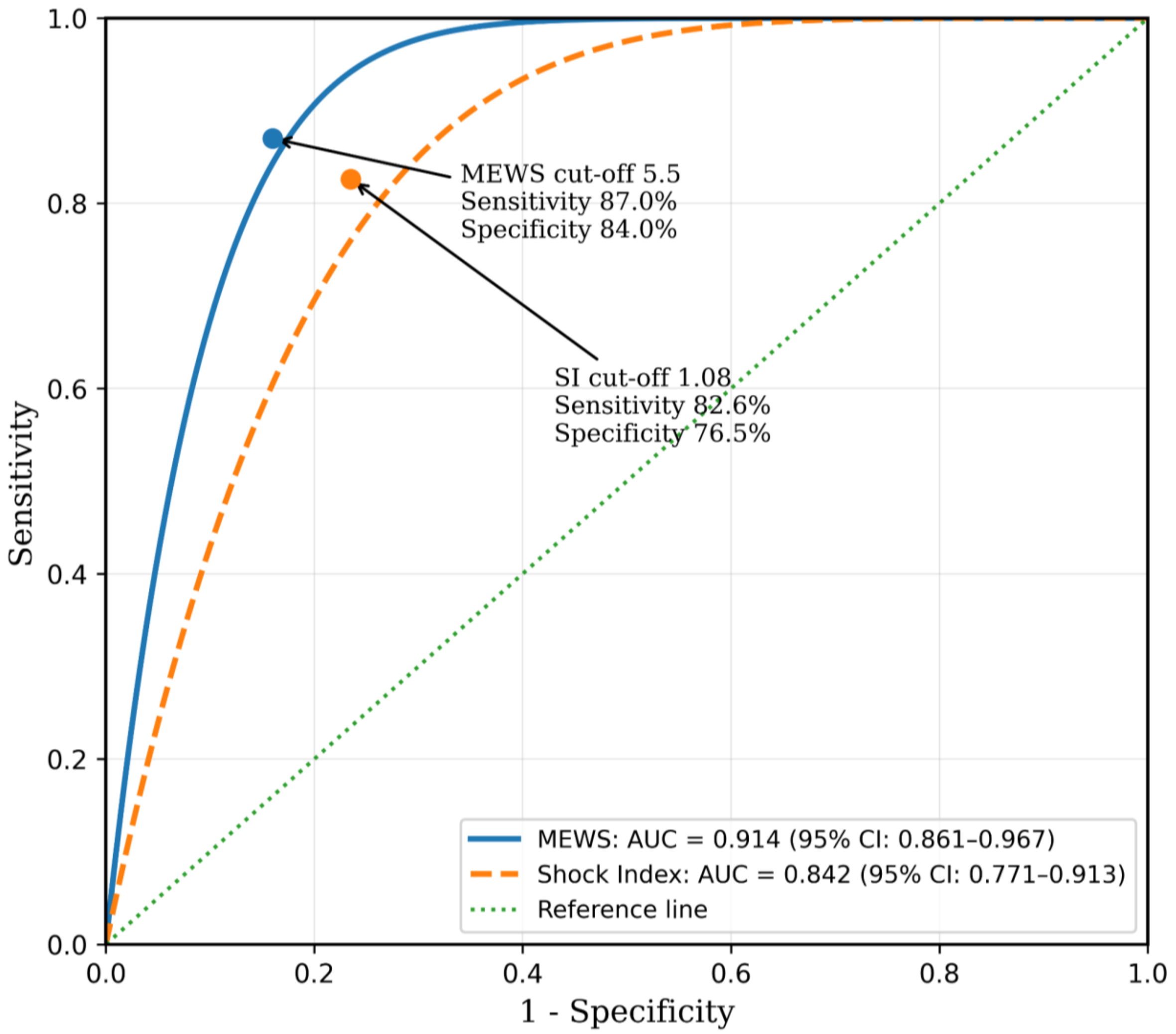


Figure 2. Receiver operating characteristic curves for Shock Index and MEWS in predicting in-hospital mortality

The ROC curve demonstrated that MEWS had a larger AUC than the Shock Index for predicting in-hospital mortality. MEWS showed an AUC of 0.914, while Shock Index showed an AUC of 0.842. Both scores had statistically significant predictive value, but MEWS showed superior overall discrimination.

Logistic Regression Analysis

Binary logistic regression was performed to identify independent predictors of in-hospital mortality. Variables entered the model included age, sex, pesticide poisoning, delayed presentation, Shock Index, and MEWS. The results are shown in Table 5. On unadjusted analysis, older age, pesticide poisoning, delayed presentation, Shock Index >1.08, and MEWS ≥6 were significantly associated with in-hospital mortality. After adjustment for clinically relevant variables, pesticide poisoning, delayed presentation, Shock Index >1.08, and MEWS ≥6 remained independently associated with mortality.

MEWS ≥6 showed the strongest independent association with in-hospital mortality, with an adjusted odds ratio of 12.74. Shock Index >1.08 also remained a significant predictor, with an adjusted odds ratio of 5.92. These findings indicate that both scores were independently useful, although MEWS showed stronger predictive association with mortality

Table 5. Logistic regression analysis for predictors of in-hospital mortality

Variable	Crude OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age	**1.04**	**1.01–1.07**	**0.008**	**1.03**	**1.00–1.06**	**0.041**
Male sex	**1.25**	**0.52–3.02**	**0.613**	**1.18**	**0.44–3.16**	**0.739**

Pesticide poisoning	**4.12**	**1.68–10.10**	**0.002**	**2.61**	**1.01–6.74**	**0.048**
Delayed presentation >6 hours	**3.86**	**1.59–9.37**	**0.003**	**2.74**	**1.05–7.16**	**0.039**
Shock Index >1.08	**15.47**	**5.11–46.81**	**<0.001**	**5.92**	**1.72–20.39**	**0.005**
MEWS ≥6	**34.58**	**10.59–112.90**	**<0.001**	**12.74**	**3.48–46.62**	**<0.001**

DISCUSSION

The present study evaluated the predictive value of Shock Index and Modified Early Warning Score (MEWS) among patients presenting with acute poisoning to the emergency department during 2022–2023. The major finding was that both Shock Index and MEWS were significantly associated with in-hospital mortality and adverse clinical outcomes, including intensive care unit admission, mechanical ventilation, vasopressor requirement, and early clinical deterioration. However, MEWS showed stronger overall predictive performance than Shock Index, particularly for in-hospital mortality, ICU admission, and mechanical ventilation.

In this study, 236 eligible patients with acute poisoning were analysed, of whom 23 died, giving an in-hospital mortality rate of 9.7%. This finding confirms that acute poisoning remains an important emergency and critical care problem. Although many poisoning patients recover with supportive treatment and observation, a clinically significant subset progresses to respiratory failure, circulatory shock, coma, multi-organ dysfunction, or death. Similar emergency-department studies from India have reported that poisoning continues to contribute substantially to acute medical admissions, with variation in mortality according to poisoning agent, delay in presentation, and severity at arrival [10,12].

The demographic distribution showed that poisoning was most common among adults aged 20–39 years, while non-survivors were older than survivors. The mean age of non-survivors was 43.2 ± 16.8 years compared with 33.9 ± 14.1 years among survivors. This suggests that although younger adults form the largest affected group, older age may increase vulnerability once severe poisoning occurs. Recent work on the prediction of mortality in older adults with acute poisoning has also emphasized that age-related physiological reserve, comorbidities, and delayed recovery may contribute to poorer outcomes [13]. Therefore, age should be considered alongside physiological scores when assessing poisoning risk in the emergency department.

Pesticide poisoning was the most frequent toxicological category in the present study, accounting for 39.0% of cases. It was also significantly more common among non-survivors than survivors, being present in 69.6% of deaths compared with 35.7% of survivors. This finding is clinically relevant because pesticide poisoning, particularly organophosphorus compounds and aluminium phosphide, is often associated with severe respiratory, cardiovascular, and metabolic complications. Samaria et al. similarly reported pesticide exposure as a major contributor to poisoning cases presenting to a tertiary emergency department in Central India [10]. Studies on aluminium phosphide poisoning have further shown that shock indices may help predict severity and poor outcomes in this high-risk group [11].

Delayed presentation was another important factor associated with mortality. The median time from exposure to emergency department arrival was 7.0 hours among non-survivors compared with 3.5 hours among survivors. In multivariable analysis, delayed presentations beyond 6 hours remained independently associated with mortality. This finding is consistent with the clinical course of poisoning, where delayed hospital arrival may allow continued toxin absorption, progression of respiratory depression, aspiration, metabolic disturbance, or circulatory collapse. Recent toxicology-centre data have similarly highlighted that poisoning severity and treatment outcomes are closely related to presentation delay, poison type, and early clinical status [14].

The clinical profile of non-survivors showed marked physiological derangement at presentation. Non-survivors had significantly higher heart rates, lower systolic blood pressure, higher respiratory rate, lower oxygen saturation, and higher rates of altered sensorium, seizure, respiratory distress, hypotension, and tachycardia. These findings support the view that mortality in acute poisoning is driven not only by the toxic agent but also by the patient's physiological response at emergency arrival. This aligns with the rationale behind modern poisoning prediction systems, including the new-Poisoning Mortality Score and other severity models, which combine clinical and physiological variables to improve mortality prediction [2,4,5].

Shock Index was significantly higher among non-survivors than survivors. The median Shock Index was 1.26 among non-survivors compared with 0.88 among survivors. Shock Index predicted in-hospital mortality with an AUC of 0.842, and the optimal cut-off value of 1.08 showed sensitivity of 82.6%, specificity of 76.5%, positive predictive value of 27.9%, and negative predictive value of 97.6%. These findings indicate that Shock Index is a useful rapid bedside marker for detecting haemodynamic stress in poisoned patients. Abdelhamid et al. also reported that Shock Index had prognostic value among shocked acutely poisoned patients, supporting its role in early risk stratification [7]. Similarly, Ghonem et al. showed that shock and modified shock indices were useful in predicting severity and outcomes in acute aluminium phosphide poisoning [11].

However, Shock Index has important limitations. It reflects only heart rate and systolic blood pressure and does not directly assess respiratory rate, consciousness level, temperature, oxygenation, toxic agent, or time since exposure. A patient with sedative overdose, opioid poisoning, alcohol-related poisoning, or organophosphorus poisoning may deteriorate primarily through respiratory depression or altered sensorium before severe hypotension occurs. Therefore, Shock Index should be interpreted as a rapid haemodynamic warning sign rather than a complete poisoning severity tool.

MEWS performed better than Shock Index in the present study. The median MEWS was 7.0 among non-survivors compared with 3.0 among survivors. For in-hospital mortality, MEWS had an AUC of 0.914, which was higher than the AUC of Shock Index. At the optimal cut-off value of 5.5, MEWS showed sensitivity of 87.0%, specificity of 84.0%, positive predictive value of 37.0%, negative predictive value of 98.3%, and Youden index of 0.710. This indicates that MEWS had excellent discriminatory ability for mortality prediction in patients with acute poisoning.

The stronger performance of MEWS can be explained by its broader physiological structure. MEWS includes systolic blood pressure, heart rate, respiratory rate, temperature, and consciousness level. These variables reflect the major pathways through which poisoning causes clinical deterioration. Respiratory rate and level of consciousness are especially important in toxicology because many patients deteriorate through airway compromise, aspiration, respiratory depression, seizures, or coma. Lee et al. reported that MEWS had useful predictive value in acute poisoning, although poisoning-specific models such as new-Poisoning Mortality Score performed better [3]. A recent systematic review and meta-analysis also concluded that MEWS and poisoning-specific scores remain clinically relevant tools for mortality prediction in acutely poisoned patients [5].

MEWS also showed higher AUC values than Shock Index for ICU admission, mechanical ventilation, and vasopressor support. The AUC for MEWS was 0.867 for ICU admission, 0.901 for mechanical ventilation, and 0.889 for vasopressor support. These findings suggest that MEWS can identify patients who require escalation of care, not only those at risk of death. Aref et al. similarly reported that scoring systems can help predict severity and adverse outcomes in adult acute poisoning, supporting their use in emergencies and critical care triage [15].

The treatment-related findings further support the role of early physiological assessment. ICU admission was required in 95.7% of non-survivors compared with 19.7% of survivors. Mechanical ventilation was required in 91.3% of non-survivors compared with 9.4% of survivors, and vasopressor support was required in 87.0% of non-survivors compared with 6.6% of survivors. These differences show that mortality was closely linked to severe early physiological compromise. Patil et al. also observed that clinical profiling at presentation is important in assessing poisoning severity and planning appropriate hospital management [12].

In multivariable analysis, both Shock Index >1.08 and MEWS ≥6 remained independently associated with in-hospital mortality. MEWS ≥6 showed the strongest association, with an adjusted odds ratio of 12.74, while Shock Index >1.08 also remained significant with an adjusted odds ratio of 5.92. These findings suggest that both scores provide useful prognostic information even after adjustment for age, sex, pesticide poisoning, and delayed presentation. However, MEWS had stronger predictive value and should be preferred when full vital-sign documentation is available.

From a clinical perspective, the two tools should be used in complementary rather than competing roles. Shock Index can be calculated immediately at triage using only heart rate and systolic blood pressure. A raised Shock Index should prompt urgent reassessment, intravenous access, ECG monitoring, haemodynamic evaluation, and early senior review. MEWS should then be calculated from the complete physiological profile to guide escalation decisions. Patients with MEWS ≥6 should be considered high risk and may require close monitoring, early airway assessment, critical care referral, and repeated physiological scoring.

The high negative predictive values of both tools are also clinically useful. Shock Index had a negative predictive value of 97.6%, while MEWS had a negative predictive value of 98.3% for mortality. This suggests that patients with low scores are less likely to die, although no score should replace clinical judgement. The relatively low positive predictive values indicate that high scores should be interpreted as warning signals for escalation rather than definite predictors of death.

The study has several strengths. It focused on a two-year emergency poisoning cohort and evaluated two simple bedside tools that can be calculated without laboratory tests, imaging, or advanced monitoring. It also assessed multiple clinically meaningful outcomes, including mortality, ICU admission, ventilation, vasopressor use, and early deterioration. The use of ROC analysis and logistic regression strengthened the assessment of predictive performance.

The study also has limitations. The retrospective design may have introduced documentation bias, and patients with incomplete vital-sign records were excluded. Poison dose, exact exposure time, pre-hospital treatment, and co-ingestions may not have been fully documented. The study was conducted at a single centre, so the findings may not be generalisable to all emergency settings. The number of deaths was relatively small, which may affect the precision of regression estimates. Finally, the study used only initial emergency department values; serial Shock Index and serial MEWS trends may provide additional prognostic value and should be evaluated in future research.

Overall, the findings support the use of bedside physiological scoring in acute poisoning. MEWS showed superior predictive performance and stronger independent association with mortality, while Shock Index remained a useful rapid haemodynamic marker. Incorporating both tools into emergency department triage may help identify high-risk poisoned patients earlier and support timely critical care referrals.

CONCLUSION

The present study demonstrated that both the Shock Index and the Modified Early Warning Score (MEWS) are useful bedside predictors of adverse outcomes among patients presenting to the emergency department with acute poisoning. In this cohort, in-hospital mortality was 9.7%, and non-survivors showed significantly greater physiological derangement at presentation, including higher heart rate, lower systolic blood pressure, lower oxygen saturation, higher Shock Index, and higher MEWS. MEWS showed superior predictive performance compared with the Shock Index for in-hospital mortality, ICU admission, mechanical ventilation, and vasopressor requirement. MEWS also remained the strongest independent predictor of mortality in multivariable analysis. However, the Shock Index also demonstrated significant prognostic value and remained independently associated with mortality, indicating its usefulness as a rapid haemodynamic screening tool at emergency triage.

These findings suggest that Shock Index and MEWS should be used as complementary tools in the early assessment of acute poisoning. Shock Index can be applied immediately using heart rate and systolic blood pressure. At the same time, MEWS provides a broader assessment of physiological deterioration by incorporating respiratory rate, temperature, blood pressure, heart rate, and consciousness level. Routine use of these scores may help emergency physicians identify high-risk patients earlier, prioritize intensive monitoring, initiate timely resuscitation, and support early critical care referral. Overall, MEWS appears to be the better overall predictor of poor outcomes in acute poisoning, while Shock Index remains valuable for rapid recognition of haemodynamic instability. Incorporating both scores into emergency department protocols may improve early risk stratification and clinical decision-making in toxicology and critical care practice.

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