

PREDICTING PATIENT OUTCOMES USING ONE-HOUR ADULT EARLY WARNING SCORE (AEWS)

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Abstract: Early Warning Scores (EWS) are widely utilized tools to predict patient outcomes, particularly in critical care settings and emergency departments (ED). However, while Adult Early Warning Scores (AEWS) have been employed for general patient outcome prediction, the specific utility of a one-hour AEWS in the ED has not been thoroughly explored. Accurate early prediction of patient disposition could enhance clinical decision-making, resource allocation, and patient safety. **Objective:** This study aims to evaluate the effectiveness of one-hour Adult Early Warning Scores (AEWS) in predicting patient disposition (discharge, floor admission, or ICU admission) in the emergency department. **Methods:** A prospective observational study was conducted on 227 patients aged 16 years and above who presented to the ED of Shifa International Hospital, Islamabad, from January 2024 to June 2024. Vital signs, including heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature, were recorded at the one-hour mark post-admission, and the one-hour AEWS was calculated. Patient outcomes were categorized into three groups: discharge, admission to the general floor, or admission to the ICU. Logistic regression was used to determine the relationship between one-hour AEWS and patient disposition. Receiver Operating Characteristic (ROC) curve analysis was performed to assess the predictive power of the AEWS for determining patient outcomes. **Results:** There was a statistically significant correlation between the one-hour AEWS and patient disposition ($p < 0.001$). The ROC curve analysis showed an Area Under the Curve (AUC) of 0.753, demonstrating good predictive accuracy. A cutoff AEWS value of 2.5 was identified, with patients scoring below this threshold being more likely to be discharged, while those scoring above 2.5 were more likely to require hospital admission or ICU care. The sensitivity and specificity of AEWS at this cutoff were 71% and 68%, respectively. **Conclusion:** The one-hour AEWS has proven to be a valuable tool in predicting patient disposition in the emergency department. Its ability to distinguish between patients who can be safely discharged and those requiring further care highlights its potential utility in improving patient triage, optimizing resource use, and enhancing clinical decision-making. Further multicenter studies are needed to validate these findings and assess the integration of AEWS into routine ED practice.

Keywords: AEWS, Early Warning Scoring System, ED disposition, one-hour AEWS

Introduction

The accurate and timely prediction of patient outcomes is a critical component of modern-day healthcare. Early identification of patients at risk of adverse events can enable timely interventions, potentially improving patient care and reducing mortality rates. (1). In recent years, early warning scores have emerged as valuable tools for risk stratification and clinical decision-making. These scores, which are calculated based on vital signs, can provide a rapid assessment of a patient's condition. (2, 3).

One-hour Adult Early Warning Scores (AEWS), a modification of National Early Warning Score (NEWS), are a specific type of scores that is calculated based on vital signs recorded at the one-hour mark of arrival to the emergency department. The rationale behind using this score is that it can reflect the patient's response to initial treatment and aid in deciding if more needs to be done. Studies have previously been carried out on the utility of early warning scores to determine the risk of adverse outcomes in various settings such as ICUs and wards. Pre-hospital EWS and triage EWS have been used for this purpose. However, one-hour early warning scores have not

been investigated in any study in the past to our knowledge. It is postulated that one-hour EWS are a better reflection of the patient's clinical state in the emergency department when deciding their disposition, as their response to emergency treatment is more accurately gauged at this time. This research article aims to investigate the effectiveness of the one-hour AEWS in predicting patient outcomes. By analyzing data from a cohort of patients, we will examine the relationship between one-hour AEWS and the disposition of the patients from ED.

The findings of this research could have significant implications for clinical practice. If this score is shown to be an effective predictor of deciding whether to discharge or admit a patient from the emergency department, it could be incorporated into routine clinical workflows to improve patient safety and optimize resource allocation. The hospital bed management will also be helped with timely notification of a need for a medical or critical care bed, thus easing the workflow. Additionally, our study may provide insights into the development of more accurate and comprehensive risk stratification models.

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Methodology

This study was conducted as a prospective observational study of all patients above the age of 16 years, presenting to the emergency department of Shifa International Hospital, Islamabad over one month. The sample was collected based on convenience. The vital signs and one-hour AEWS were documented and each patient was followed till disposition. The data for AEWS was collected from patients’ charts. We excluded patients less than 16 years of age, patients who were brought in deceased, and patients who left the emergency department in less than 1 hour. The study is a prospective observational cohort in design. Data was collected in Shifa International Hospital by a team of postgraduate residents in the emergency department. The patients were selected mostly through convenient sampling when the data collectors were present to follow the patient in the ED. The vital signs were noted from patient charts at the one-hour mark of the patient’s arrival at the ED. The course of their ED stay was followed until their disposition from the emergency department. The one-hour AEWS was calculated based on patients’ vital signs which included systolic blood pressure, diastolic blood pressure, respiratory rate, oxygen saturation, heart rate, GCS scores, and body temperature. All the vital signs were measured by the emergency department staff upon arrival of the patient. Other potentially confounding variables such as Age, Comorbidity, reason for ED visit and the Length of Stay were also accounted for via statistical analysis. The ethics approval was obtained from the IRB of Shifa International Hospital. Statistical Package for Social Sciences (SPSS) version 27 was used to assess the predictive power of a one-hour AEWS score for the final disposition of patients coming into the emergency department. The logistic Regression Model was applied to assess the correlation between the two variables, and the Receiver Operating Characteristic (ROC) curve was applied to find one-hour AEWS’ predictive power for the final disposition.

Results

A sample size of 227 was collected in one month after having applied the inclusion and exclusion criteria. Out of these, 54.6% of patients were male and 45.4% of patients were female. The median (IQR) age of patients was 51 years; the mean age was 50.64, (standard deviation 19.93). Out of the 227 patients, 147 (64.8%) were discharged, 38 (16.7%) were admitted to the floor and 42 (18.5%) were admitted to the ICU. Upon comparing the means of the three groups, i.e., discharged, admitted to the floor and admitted to critical care, we found a significant difference (i.e., $p < 0.001$) between all three means. The logistic regression analysis between the one-hour AEWS score and the final disposition, where the final disposition was identified as the dependent variable, also showed a significant correlation ($p < 0.001$).

AEWS scores ranged from 0 to 13 in our patient population. A ROC curve was plotted for AEWS scores and the Disposition of the patients. The ROC curve gave an area under the curve (AUC) of 0.786, which signifies a good predictive value of one-hour AEWS in predicting the disposition of patients coming into the emergency department. The most optimal cut-off value was calculated to be 2.

128 patients below or equal to the cutoff value, i.e., 2 were discharged from the emergency department and 37 were admitted to either specialized wards or ICU. Only 19 patients above the cutoff value of 2 were discharged from the emergency department and 43 patients were admitted to either specialized wards or the ICU. The Positive Predictive Value (PPV) was calculated to be 69.35%.

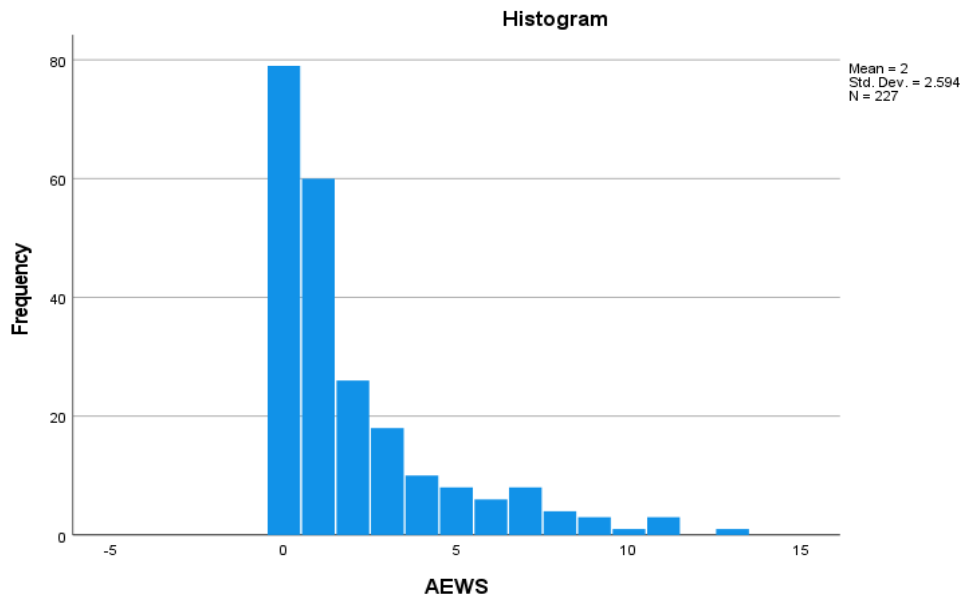


Figure 1: Histogram

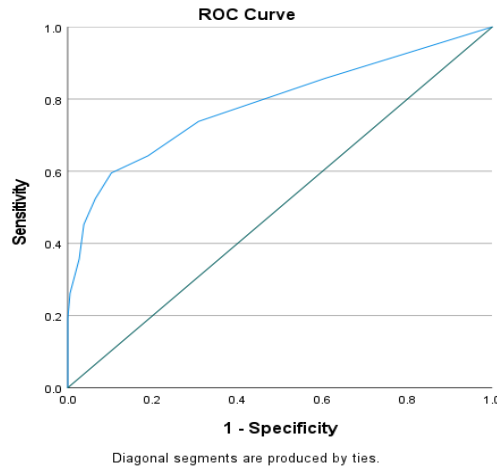


Figure 2 : ROC Curve

Table 1: ROC curve analysis

Area Under the Curve				
Test Result Variable(s): AEWS				
Area	Std. Error	Asymptotic Sig. ^b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.786	.046	.000	.696	.875
The test result variable(s): AEWS has at least one tie between the positive actual state group and the negative actual state group. Statistics may be biased. a. Under the nonparametric assumption b. Null hypothesis: true area = 0.5				

Discussion

There was no significant correlation between the groups in terms of demographics or baseline parameters. Our study was based on a conveniently selected sample of 227 patients coming into the emergency department of our hospital. The Early Warning System (EWS) scores have been used in various hospital settings such as hospital wards, emergency departments and other clinical settings. (3). It has been widely observed that patients’ vital signs undergo noticeable changes before any clinical decision has to be made (4), the EWS scores utilize the vital signs of a patient to build ease in clinical decision-making by predicting any clinical deterioration in advance. The integration of EWS into clinical practice has also been associated with improved patient safety and outcomes. Nurses and other healthcare professionals have reported that these scoring systems enhance their ability to identify deteriorating patients, thereby fostering a culture of safety and vigilance within the ED. (5–7)

The one-hour Adult Early Warning System (AEWS) takes into account the Respiratory Rate, Oxygen Saturation, Systolic and Diastolic Blood Pressures, the Glasgow Coma Scale rating, the Body Temperature and the Heart Rate of the patient to calculate a cumulative score. According to our literature search, the AEWS remains the least studied when it comes to clinical decision-making in the emergency department.

A recent meta-analysis (7) Discovers the predictive abilities of five EWS scores, i.e., National EWS (NEWS), NEWS2, Modified EWS (MEWS), Rapid Acute Physiological Score (RAPS) and Cardiac Arrest Risk Triage (CART). This meta-analysis uncovers that these EWS scores can be a

powerful predictor of clinical deterioration in hospital settings such as hospital wards, emergency departments or ICUs.

Moreover, studies have highlighted the importance of EWS in emergency settings, where rapid assessment and intervention are crucial. For example, in a recent study by Chang et al. (8), the Modified Early Warning Score (MEWS) has been evaluated alongside other scoring systems, such as the Rapid Emergency Medicine Score (REMS) and the Mortality in Emergency Department Sepsis Score (MEDS), in predicting survival outcomes in patients presenting with various conditions, including sepsis and renal abscesses.

However, the potential of use and the predictive power of a one-hour AEWS score in predicting the emergency department disposition remains elusive.

This study was designed to find out the clinical utility and the predictive power of one-hour AEWS for emergency department deteriorations. A sample size of 227 patients, aged 16 years or above was collected. The cumulative score of each patient was compared with their final disposition which was either discharged, admission to floor, or admission to critical care.

With the use of statistical techniques, we found a significant correlation between the one-hour AEWS scores and the final disposition of the patients. We discovered that the one-hour AEWS score held good predictive power in predicting the disposition of patients from the emergency department, with an AUROC curve of 0.753 and a positive predictive value (PPV) of 69.35%. The cutoff value was calculated to be 2.5, meaning that any patient with a one-hour AEWS of 2.5 or less was predicted to be discharged while a patient with a one-hour AEWS of greater than 2.5 was predicted to

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be admitted to either a specialized ward or an ICU. The one-hour AEWS score fails to predict whether the patient is admitted to the ward or the critical care unit.

Before this study, there is no other study that discovers the utility and predictive power of a one-hour AEWS score in emergency department disposition. By validating the one-hour AEWS score's ability to predict patient disposition in the emergency department, this study aims to achieve prompt action for patients who need immediate admission and prevent any unnecessary admission to critical care units to ease the burden of both, the emergency department and the critical care units. The study suggests that more research needs to be done on one-hour AEWS score before it can find its way into clinical utility.

The limitation of this study is its small sample size and single-center study.

Conclusion

The one-hour AEWS score has a good predictive power in predicting the patients' disposition in the emergency department. However, it should be used as a supplement in clinical decision-making instead of being used as a stand-alone criterion of patient disposition.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-SIHISB-0932/23)

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared the absence of a conflict of interest.

Author Contribution

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Coordination of collaborative efforts, study design, review of literature, development of research methodology, study design, data entry, review of manuscript

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Study design, Data acquisition, data entry

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Study design, Data acquisition, data entry

HASNAIN WAJEEH SAQIB (MBBS Student)

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ABDUS SALAM KHAN (Consultant and former director)

Conception of study, critical input, final approval of manuscript

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