Performance of 21 Early Warning System scores in predicting in-hospital deterioration among undifferentiated admitted patients managed by ambulance services

Gigi Guan [1,2] Crystal Man Ying Lee,[3] Stephen Begg,[4] Angela Crombie,[5] George Mnatzaganian[1]

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[1]Rural Department of Community Health, La Trobe University, Bendigo, Victoria, Australia
[2]Department of Rural Health, The University of Melbourne, Melbourne, Victoria, Australia
[3]School of Population Health, Curtin University, Perth, Western Australia, Australia
[4]Violet Vines Marshman Centre for Rural Health Research, La Trobe University, Bendigo, Victoria, Australia
[5]Research & Innovation, Bendigo Health, Bendigo, Victoria, Australia

Correspondence to
Mr Gigi Guan, Rural Department of Community Health, La Trobe University, Bendigo, Victoria, Australia; gigiaus@gmail.com

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ABSTRACT

Background The optimal Early Warning System (EWS) scores for identifying patients at risk of clinical deterioration among those transported by ambulance services remain uncertain. This retrospective study compared the performance of 21 EWS scores to predict clinical deterioration using vital signs (VS) measured in the prehospital or emergency department (ED) setting.

Methods Adult patients transported to a single ED by ambulances and subsequently admitted to the hospital between 1 January 2019 and 18 April 2019 were eligible for inclusion. The primary outcome was 30-day mortality; secondary outcomes included 3-day mortality, admission to intensive care or coronary care units, length of hospital stay and emergency call activations. The discriminative ability of the EWS scores was assessed using the area under the receiver operating characteristic curve (AUROC). Subanalyses compared the performance of EWS scores between surgical and medical patient types.

Results Of 1414 patients, 995 (70.4%) (53.1% male, mean age 68.7±17.5 years) were included. In the ED setting, 30-day mortality was best predicted by VitalPAC EWS (AUROC 0.71, 95% CI (0.65 to 0.77)) and National Early Warning Score (0.709 (0.65 to 0.77)). All EWS scores calculated in the prehospital setting had AUROC <0.70. Rapid Emergency Medicine Score (0.83 (0.73 to 0.92)) and New Zealand EWS (0.88 (0.81 to 0.95)) best predicted 3-day mortality in the prehospital and ED settings, respectively. EWS scores calculated using either prehospital or ED VS were more effective in predicting 3-day mortality in surgical patients, whereas 30-day mortality was best predicted in medical patients. Among the EWS scores that achieved AUROC ≥0.70, no statistically significant differences were detected in their discriminatory abilities to identify patients at risk of clinical deterioration.

Conclusions EWS scores better predict 3-day as opposed to 30-day mortality and are more accurate when estimated using VS measured in the ED. The discriminatory performance of EWS scores in identifying patients at higher risk of clinical deterioration may vary by patient type.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The current body of research has not extensively investigated the efficacy of Early Warning System (EWS) scores in prehospital and ED settings for predicting patient deterioration. While certain EWS scores have been investigated, there remains uncertainty regarding the most effective ones for identifying patients at risk of clinical deterioration among those transported and treated by ambulance services.

WHAT THIS STUDY ADDS

⇒ This retrospective study evaluated the performance of 21 EWS scores for predicting poor outcomes in undifferentiated admitted patients transported by ambulance to a single ED in Victoria, Australia. Most scores had good discriminatory ability to identify patients at risk of 3-day mortality, whether based on vital signs (VS) taken in the prehospital or ED setting. Prediction of 30-day mortality was poor when based on VS taken from the prehospital setting. When based on VS measured in the ED, VitalPAC EWS (VIEWS) and National Early Warning Score (NEWS) best predicted 30-day mortality.

⇒ The discriminatory ability of the EWS scores to identify patients at risk of clinical deterioration varied between surgical and medical patients.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study highlights the ability of most EWS scores to predict 3-day mortality, regardless of whether the VS are obtained from prehospital or ED settings. VIEWS and NEWS based on ED VS were the best performers in identifying patients at risk of 30-day mortality.

INTRODUCTION

Early Warning System (EWS) scores are predefined parameters that track patients' clinical trajectories using vital signs. Heart rate (HR), respiratory rate (RR), peripheral capillary oxygen saturation (SpO_2), systolic/diastolic BP (SBP/DBP) and consciousness levels are the typical vital signs used to calculate the EWS score. Since altered vital signs often occur before clinical deterioration, EWS scores can provide a trigger for early intervention, which can improve patient outcomes. Although EWS scores have been used in in-hospital settings for decades, their application in prehospital and ED settings is less common.[1]

The earliest EWS score was the Modified Early Warning Score (MEWS).[2] First introduced in the intensive care unit (ICU) setting, its application quickly became more common in other settings, such as preoperative and postoperative care in medical and surgical wards. This led to the development of other EWS scores that aimed to predict clinical deterioration in specific targeted patient populations, such as those presenting in prehospital or ED settings. Several EWS scores are used in the ED settings, and even fewer are employed in prehospital settings, with limited understanding of their effectiveness in identifying patients at risk of clinical deterioration.[1 3 4]

In this study, we compared the performance of 21 commonly used EWS scores, applied in either prehospital or ED settings, on the same group of undifferentiated patients managed in both settings. The aim of the study was to identify scores with the highest predictive ability for 3-day and 30-day mortality, length of hospital stay (LOS), admission to an ICU or a critical care unit (CCU), activation of Medical Emergency Team (MET) for clinical review, as well as patients experiencing cardiac or respiratory arrest, referred to as code blue (CB), during hospital admission.

MATERIALS AND METHODS

Study design and setting

This retrospective cohort study was conducted at Bendigo Health (BH), Victoria, Australia.

Study setting

BH is a tertiary hospital in regional Victoria, Australia, and is the largest healthcare centre outside the Melbourne metropolitan region, with 724 inpatient beds. It serves a large catchment area comprising 10 local governments spanning 26% of Victoria's land mass. BH has more than 52 000 emergency presentations each year and 49 000 hospital admissions. At the time of this study, BH was not a major trauma centre.[5]

In Victoria, Australia, prehospital care is centrally provided by the government through Ambulance Victoria (AV). AV comprises various levels of prehospital care clinicians, with the most advanced clinicians being mobile intensive care (MICA) paramedics, followed by ALS paramedics, non-emergency patient transport (NEPT) officers, and occasionally accompanied by doctors and nurses.[6] Ambulances in this study's region are staffed with varying configurations, including dual ALS or MICA paramedics, single ALS or MICA paramedics, dual NEPT clinicians and occasionally a mix of MICA/ALS paramedics, subject to paramedic availability. Additionally, Helicopter Emergency Medical Services are often manned by flight MICA paramedics or flight ALS paramedics. ALS paramedics can administer medications such as opioid analgesia, resuscitation medications, antiemetics, and antibiotics and perform advanced airway procedures like using a laryngeal mask airway. MICA and flight MICA paramedics can perform advanced interventions such as intubation, complex airway procedures, inotropic infusions, external pacing and procedural sedation.[7]

Participants

Adult patients (≥18 years old) transported to the ED by ambulance and subsequently admitted to the hospital from 1 January 2019 were sequentially included in the study, continuing until the sample size necessary for adequate statistical power, as determined by initial power calculations, was achieved on 18 April 2019. Admission wards included medical, surgical and orthopaedic wards; ICU/CCU; cardiac catheterisation laboratories; and day operation of surgery admission. Readmission within 24 hours following discharge from a hospital ward was considered a continuation of the index admission. Patients who died in the ED were also included in this study.

Patients without at least one complete set of vital signs in the prehospital or ED settings were excluded. Patients with obstetric-related presentations, palliative or advanced care plans (ACP), patients with a recorded not-for-resuscitation (NFR) status on admission or those admitted to the mental health unit were also excluded because clinical deterioration in such patients could have been better predicted using validated specific EWS scores that were not investigated in this study.[8 9] Patients directly admitted to hospital wards without being managed in the ED (eg, interhospital transfers from other healthcare facilities and direct percutaneous coronary intervention admissions) were similarly excluded.

Sample size estimation for study's main outcome: 30-day mortality

Using a two-sided α of 0.05, a power of 0.8, and a prevalence of cardiac arrest or death among patients brought by ambulance services of 0.8%,[10] the lowest estimate of the area under the receiver operating characteristic curve (AUROC) of 0.74, a sample size of 977 with complete patient records was required to predict the primary outcome of 30-day mortality.

Key outcome measures

The primary study outcome was 30-day mortality following presentation to the ED. Secondary outcomes included 3-day mortality, activation of CB/MET, admission to the ICU/CCU and LOS.

EWS scores selection

In prehospital and ED environments, patients frequently present with unclear clinical symptoms, making it difficult to determine diagnoses, decide management strategies and predict prognoses with confidence. Similar to other researchers,[11] we evaluated the effectiveness of the scores among undifferentiated patients, regardless of the patient's presentation (eg, medical vs surgical or trauma patients). The rationale for incorporating trauma-specific or condition-specific EWS scores stemmed from previous findings suggesting that such EWS scores could accurately predict outcomes of interest in undifferentiated patients despite having been initially designed for specific patient cohorts.[11] The 21 included EWS scores and the parameters used to estimate them are shown in figure 1 and online supplemental appendix A.

Data collection

The study's start date was selected immediately after the participating hospital had completed updating its system using electronic health records, which improved the data collection process. All information was extracted from the electronic medical records of the ED, which contained both prehospital and ED patient care records. Data collected by author GG and cross-checked by coauthor GM included patient age, sex, residential postcode, LOS (days), time and date of admission, discharge and/or death, admission to the ICU/CCU and first-time CB/MET activation time. The first set of vital signs was collected from both prehospital and ED settings and included HR, RR, SpO_2, SBP, DBP, tympanic body temperature, blood glucose level, and for neurological status GCS (minimum score of 3 and maximum of 15)

Early Warning Scores	Abbreviations
Abbreviated VIEWS	ABBVIEWS
Bispebjerg Early Warning Score	BEWS
Cardiac Arrest Risk Triage	CART
GCS, Age, and Systolic Blood Pressure	GAP
Goodacre Score	GOODACRE
Groarke Score	GS
Modified Early Warning Score	MEWS
Modified EWS with GCS	MEWSGCS
National Early Warning Score	NEWS
NHS Foundation Trust Early Warning Score	NHS
New trauma score	NTS
New Zealand Early Warning Score	NZEWS
Prehospital risk score	PRS
Quick Sequential Organ Failure Assessment	QSOFA
Rapid Acute Physiology Score	RAPS
Rapid Emergency Medicine Score	REMS
Revised Trauma Score	RTS
Standardised early warning score	SEWS
Vital Sign Groups	VSG
Vital-PAC Early Warning Score	VIEWS
Worthing Physiological Score	WPS

Figure 1 21 included Early Warning System scores and abbreviations.

or Alert, and Verbally responsive, Painful responsive and Unresponsive (AVPU). As patient consciousness level can be assessed by either GCS or AVPU, to have a consistent estimation of the consciousness state, the AVPU measures were converted to GCS using the following guidelines: A=GCS 15/14, V=GCS 9–13, P=GCS 4–8, U=GCS 3.[12] If supplemental oxygen and/or body temperature were not recorded, they were assumed to have been within the normal range for calculation of the EWS.

Statistical analysis

The patients' vital signs in the prehospital and ED settings were coded against the predefined parameters of each of the 21 EWS scores, with the total EWS scores for the prehospital and ED settings for each patient obtained separately. The EWS scores in the two settings for the same individuals were compared using the Wilcoxon signed-rank test. The outcome measures of in-hospital mortality, admission to ICU/CCU and CB/MET call activations were coded as dichotomous variables. ICU/CCU and hospital LOS were expressed as days of hospital stay from the time of presentation to the ED, with the median used to estimate the study outcome. An AUROC between (0.60–0.69), (0.70–0.79), (0.80–0.89) and (0.90–1.0) indicated poor, acceptable, good and excellent discriminatory ability for the outcome, respectively.[13] Differences between AUROCs estimated by using the different EWS scores for 3-day and 30-day mortality in either the ED or prehospital setting were assessed using Delong's test.[14]

In this study, for each EWS score and outcome in both settings, an AUROC of 0.7 was used as a cut-off threshold to determine optimal performance for each EWS score. Statistical significance was set at $p \leq 0.05$. The analyses were performed using Stata/SE V.17.0.

A subanalysis was conducted to compare the performance of the three highest performing EWS scores according to medical or surgical patient type for 3-day and 30-day mortality in both settings. Due to a lack of a universal definition of what constitutes a medical or surgical patient, the admitting ward was used to stratify patients. Patients admitted to medical wards were classified as medical patients. Patients admitted to all non-medical wards were classified as surgical. Patients admitted to the ICU were classified as medical or surgical, depending on the diagnosis as illustrated in online supplemental appendix B.

Patient and public involvement

Patients were not involved in the design or study objectives.

RESULTS

During the study period, 1414 patients consecutively transported by ambulance to the ED were evaluated for eligibility. Of these, 419 (29.6%) were excluded due to: missing patient records from the treating paramedics (n=214), missing ED vital signs (n=73) and having an NFR or ACP recorded for the patients before presenting to the ED (n=132). The patients excluded due to missing data did not show any statistically significant differences in outcomes of interest compared with those included in the analysis (online supplemental appendix C). The final sample included 995 undifferentiated patients (53.1% males, mean age 68.7±17.5 years) (table 1). The total hospital LOS ranged from 1 to 39 days (median, 3 days). In addition, CB/MET calls were required by 126 (12.7%) patients, and 82 (8.2%) patients were admitted to the ICU/CCU; 13 (1.3%) patients died within 3 days of ED presentation and/or hospital admission, and 65 (6.5%) died within 30 days. No statistically significant differences in age, sex, admission to ICU/CCU, LOS and in-hospital mortality were

Table 1 Characteristics and clinical information of participants on hospital admission

Characteristic	All	Prehospital	ED	P value
Male sex, n (%)	528 (53.1)	–	–	–
Age, median (IQR)	72 (59–81)	–	–	–
Length of stay, median (IQR)	3 (2–5)	–	–	–
ICU/CCU admission, n (%)	82 (8.2)	–	–	–
CB/MET activation (%)	126 (12.7)	–	–	–
HR beats/min, median (IQR), (minimum–maximum)	–	87 (72–100), (40–178)	80 (70–90), (38–180)	<0.001
RR/min, median (IQR), (minimum–maximum)	–	18 (16–20), (8–60)	19 (15–20), (12–75)	<0.001
Systolic BP (mm Hg), median (IQR), (minimum–maximum)	–	135 (117–153), (70–270)	130 (120–150), (46–248)	<0.001
Diastolic BP (mm Hg), median (IQR), (minimum–maximum)	–	76 (67–86), (40–150)	70 (60–80), (16–148)	<0.001
Mean arterial pressure, median (IQR), (minimum–maximum)	–	97 (85–107), (63–230)	93 (81–103), (37–181)	<0.001

CB, code blue; CCU, critical care unit; ICU, intensive care unit; MET, Medical Emergency Team.

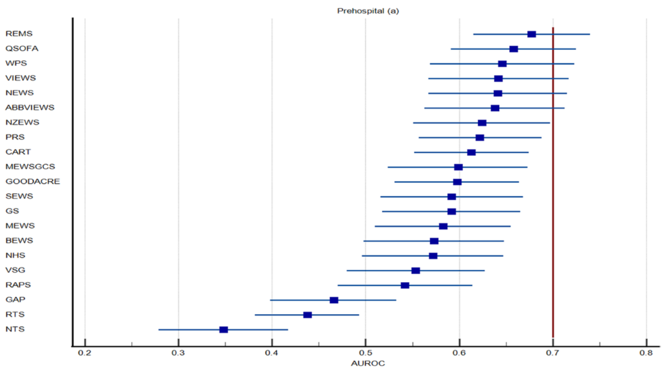

Figure 2 Area under the receiver operating characteristic curve (AUROC) estimates with 95% CIs by Early Warning System (EWS) score in prehospital setting: 30-day mortality following hospital admission EWS scores are shown in descending order by AUROC. ABBVIEWS, Abbreviated VIEWS; BEWS, Bispebjerg Early Warning Score; CART, Cardiac Arrest Risk Triage; GAP, GCS, Age, and Systolic BP; GOODACRE, Goodacre Score; GS, Groarke Score; MEWS, Modified Early Warning Score; MEWSGCS, Modified EWS with GCS; NEWS, National Early Warning Score; NHS, NHS Foundation Trust Early Warning Score; NTS, New Trauma Score; NZEWS, New Zealand Early Warning Score; PRS, Prehospital Risk Score; QSOFA, Quick Sequential Organ Failure Assessment; RAPS, Rapid Acute Physiology Score; REMS, Rapid Emergency Medicine Score; RTS, Revised Trauma Score; SEWS, Standardised Early Warning Score; VIEWS, VitalPAC Early Warning Score; VSG, Vital Sign Groups; WPS, Worthing Physiological Score.

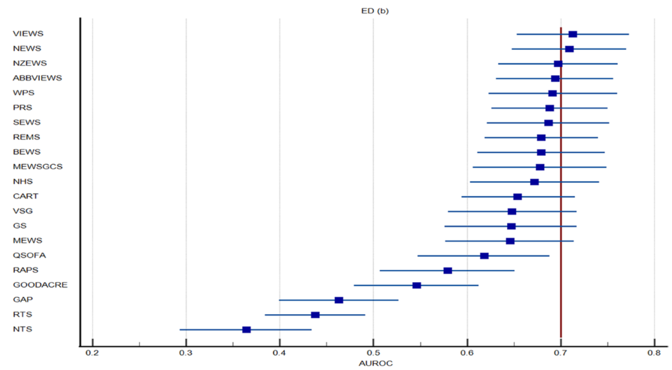

Figure 3 Area under the receiver operating characteristic curve (AUROC) estimates with 95% CIs by Early Warning System (EWS) score in ED setting: 30-day mortality following hospital admission EWS scores are shown in descending order by AUROC. ABBVIEWS, Abbreviated VIEWS; BEWS, Bispebjerg Early Warning Score; CART, Cardiac Arrest Risk Triage; GAP, GCS, Age, and Systolic BP; GOODACRE, Goodacre Score; GS, Groarke Score; MEWS, Modified Early Warning Score; MEWSGCS, Modified EWS with GCS; NEWS, National Early Warning Score; NHS, NHS Foundation Trust Early Warning Score; NTS, New Trauma Score; NZEWS, New Zealand Early Warning Score; PRS, Prehospital Risk Score; QSOFA, Quick Sequential Organ Failure Assessment; RAPS, Rapid Acute Physiology Score; REMS, Rapid Emergency Medicine Score; RTS, Revised Trauma Score; SEWS, Standardised Early Warning Score; VIEWS, VitalPAC Early Warning Score; VSG, Vital Sign Groups; WPS, Worthing Physiological Score.

found between patients excluded due to missing vital signs and those included in the study. First measured vital signs, including HR, RR, SBP and DBP, were found to be significantly different between the ED and prehospital settings (p≤0.05) (table 1).

The discriminatory ability of 21 different EWS scores to distinguish between patients at high risk and those at low risk of clinically deteriorating

30-day mortality

When assessing 30-day mortality, none of the EWS scores achieved an AUROC ≥0.70 based on the prehospital parameters (figure 2 and online supplemental appendix D). Two crossed the threshold of 0.70 among the ED-based parameters EWS scores: VitalPAC EWS (VIEWS) (AUROC 0.71, 95% CI (0.65 to 0.77)) and National Early Warning Score (NEWS) (0.709 (0.65 to 0.77)) (figure 3 and online supplemental appendix D). No statistically significant difference was found between VIEWS and NEWS (p=0.582) (online supplemental appendix E).

Three-day mortality

For predicting 3-day mortality from parameters obtained in the prehospital setting, Rapid Emergency Medicine Score (REMS) had the highest AUROC of 0.83 (0.73 to 0.92), followed by VIEWS with an AUROC of 0.81 (0.68 to 0.93) and NEWS (0.79 (0.67 to 0.92)). The Abbreviated VIEWS (ABBVIEWS), New Zealand EWS (NZEWS), Standardised Early Warning Score, Prehospital Risk Score, New Trauma Score (NTS), Groarke Score (GS), Bispebjerg Early Warning Score (BEWS), NHS Foundation Trust Early Warning Score, MEWS, Modified EWS with GCS (MEWSGCS), Vital Sign Groups and Cardiac Arrest Risk Triage scores also obtained AUROC scores above 0.70. All remaining scores performed poorly, with AUROCs less than 0.70 (figure 4 and online supplemental appendix F). When evaluating EWS scores with an AUROC ≥0.70, no statistically significant differences were detected between the REMS and other EWS scores including ABBVIEWS, Quick Sequential Organ Failure Assessment (QSOFA), NZEWS and MEWS (online supplemental appendix G).

In the ED setting, the majority (16 of 21) of EWS scores calculated had AUROC ≥0.70, with NZEWS having the highest AUROC of 0.88 (0.81 to 0.95), considered having a good discriminatory ability. QSOFA, Goodacre Score, GCS, Age, and Systolic BP, Revised Trauma Score and NTS had lower discrimination with AUROC <0.70 (figure 5 and online supplemental appendix F). When evaluating EWS scores with an AUROC of 0.70 or higher, no statistically significant differences were observed between the NZEWS and other EWS scores including MEWS, MEWSGCS, GS and BEWS (online supplemental appendix H).

Other secondary outcomes

None of the 21 EWS achieved an AUROC of 0.70 for predicting ICU/CCU admission using prehospital or ED parameters (online supplemental appendix I). With the highest AUROC (0.67 in prehospital and 0.66 in ED settings), the same pattern was observed when the EWS scores were used to predict CB/MET (online supplemental appendix J). An AUROC ≤0.6 rendered all EWS scores, regardless of which vital signs were applied, insufficient to distinguish whether the LOS would be lower or higher than the median of 3 days (online supplemental appendix K).

Subanalysis by medical and surgical patient type

Subanalysis by type of patient (ie, medical or surgical) was conducted using the three best performers in each of the settings as shown in table 2. In both settings, short-term mortality was better predicted by EWS scores in surgical patients than in medical patients. In both prehospital and ED settings, 3-day mortality was better predicted among surgical patients (AUROCs

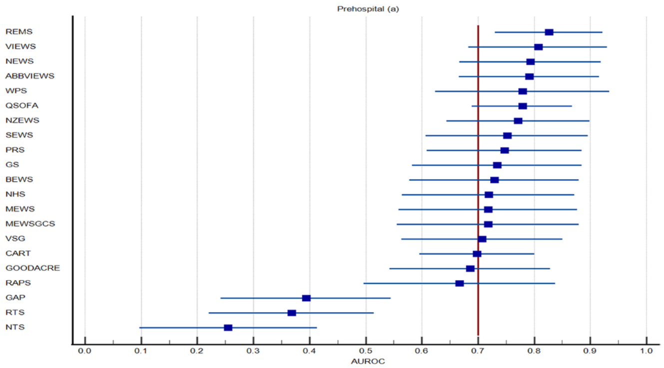

Figure 4 Area under the receiver operating characteristic curve (AUROC) estimates with 95% CIs by Early Warning System (EWS) score in prehospital setting: 3-day mortality following hospital admission EWS scores are shown in descending order by AUROC. ABBVIEWS, Abbreviated VIEWS; BEWS, Bispebjerg Early Warning Score; CART, Cardiac Arrest Risk Triage; GAP, GCS, Age, and Systolic BP; GOODACRE, Goodacre Score; GS, Groarke Score; MEWS, Modified Early Warning Score; MEWSGCS, Modified EWS with GCS; NEWS, National Early Warning Score; NHS, NHS Foundation Trust Early Warning Score; NTS, New Trauma Score; NZEWS, New Zealand Early Warning Score; PRS, Prehospital Risk Score; QSOFA, Quick Sequential Organ Failure Assessment; RAPS, Rapid Acute Physiology Score; REMS, Rapid Emergency Medicine Score; RTS, Revised Trauma Score; SEWS, Standardised Early Warning Score; VIEWS, VitalPAC Early Warning Score; VSG, Vital Sign Groups; WPS, Worthing Physiological Score.

ranging from 0.92 to 0.97) than medical patients (AUROCs ranging from 0.73 to 0.84). The opposite trend (except for REMS in the prehospital setting) was observed when assessing 30-day mortality, with EWS scores better predicting 30-day mortality in medical patients (table 2). The AUROC estimates

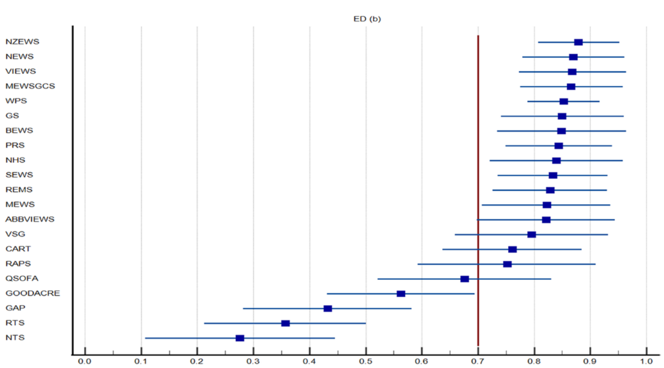

Figure 5 Area under the receiver operating characteristic curve (AUROC) estimates with 95% CIs by Early Warning System (EWS) score in ED setting: 3-day mortality following hospital admission EWS scores are shown in descending order by AUROC. ABBVIEWS, Abbreviated VIEWS; BEWS, Bispebjerg Early Warning Score; CART, Cardiac Arrest Risk Triage; GAP, GCS, Age, and Systolic BP; GOODACRE, Goodacre Score; GS, Groarke Score; MEWS, Modified Early Warning Score; MEWSGCS, Modified EWS with GCS; NEWS, National Early Warning Score; NHS, NHS Foundation Trust Early Warning Score; NTS, New Trauma Score; NZEWS, New Zealand Early Warning Score; PRS, Prehospital Risk Score; QSOFA, Quick Sequential Organ Failure Assessment; RAPS, Rapid Acute Physiology Score; REMS, Rapid Emergency Medicine Score; RTS, Revised Trauma Score; SEWS, Standardised Early Warning Score; VIEWS, VitalPAC Early Warning Score; VSG, Vital Sign Groups; WPS, Worthing Physiological Score.

of all EWS scores to predict 3-day and 30-day mortality in both settings were compared, as shown in online supplemental appendices E, G, H and L.

DISCUSSION

We assessed the discriminatory value of 21 EWS scores for predicting 3-day and 30-day mortality using EWS scores calculated from either prehospital or ED vital signs and other parameters. The EWS scores from both the prehospital and ED settings were better at predicting 3-day mortality than 30-day mortality. The majority of EWS scores calculated based on prehospital parameters failed to predict 30-day mortality, admission to ICU/CCU and activation of the CB/MET. Short-term deterioration was best predicted in surgical patients and 30-day deterioration was best predicted in medical patients.

Although EWS scores ranged from acceptable to good in discriminating 3-day mortality in prehospital and ED settings, their ability to predict 30-day mortality was more limited. Identifying long-term deterioration using EWS scores is an ongoing challenge because studies have indicated that initial vital signs can often be deranged and not sufficiently capable or reliable to predict 30-day mortality.[15] Understandably, the prediction of long-term deterioration, including mortality, involves multiple factors not often reflected in the initial vital signs that form the EWS scores, such as intensified acute illness, administered treatments, comorbidities, genetics, physiological conditions, functional status and other unknown factors, including psychological and socioeconomic factors.[16] Recent studies suggest that integrating non-physiological parameters, such as the frequency of prior healthcare use, burden of chronic diseases and frailty scores, into EWS scores may enhance their ability to accurately predict 30-day mortality.[17]

It is unclear why, for the same patients, vital signs measured in the prehospital and ED settings had different abilities to predict patient outcomes. This finding is supported by a recent systematic review,[1] which indicated that EWS scores demonstrate lower predictability when applied to patients in prehospital settings compared with those in in-hospital or ED settings. The substantial differences between the prehospital and ED settings may explain this finding. In the former, vital signs are often recorded in less controlled environments, with factors such as temperature, noise and patient positioning potentially affecting the accuracy of the recorded vital signs.[18] Variations in the equipment used in the prehospital and ED settings may also lead to differences in vital signs documentation. Another plausible explanation relates to the temporal changes in the patient's clinical status during transport, with vital signs differing between the prehospital and ED settings when patients deteriorate or clinically improve. Similarly, treatments administered by paramedics or medical staff in the ED may alter the patient's vital signs, thus affecting the accuracy of the EWS scores.[4] A recent study showed that MEWS calculated from vital signs obtained in the ED exhibits superior predictive ability compared with vital signs collected in the prehospital settings for patients transported by ambulance. However, an increase in MEWS during ED admission is indicative of clinical deterioration. Thus, the ongoing utilisation of MEWS, or by extension, selected EWS scores alongside monitoring patients' trends and trajectory, holds potential to prevent clinical deterioration.[19]

Prior studies on EWS scores have not determined whether EWS scores perform differently in different patient types. We found that EWS scores were better at short-term prediction in surgical patients than in medical patients. Prediction of

Table 2 Subanalyses by medical and surgical patient categorisation: using top three performing EWS scores, AUROC estimates

3-day mortality prediction								30-day mortality prediction							
Prehospital setting				ED setting				Prehospital setting				ED setting			
EWS scores	All	Medical	Surgical	EWS scores	All	Medical	Surgical	EWS scores	All	Medical	Surgical	EWS scores	All	Medical	Surgical
REMS	0.83	0.76	0.97	NZEWS	0.88	0.84	0.95	REMS	0.68	0.63	0.75	VIEWS	0.71	0.71	0.69
VIEWS	0.81	0.74	0.94	NEWS	0.87	0.84	0.94	QSOFA	0.66	0.66	0.63	NEWS	0.71	0.71	0.67
NEWS	0.79	0.73	0.92	VIEWS	0.87	0.84	0.93	WPS	0.65	0.65	0.58	NZEWS	0.70	0.70	0.65

AUROC, area under the receiver operating characteristic curve; EWS, Early Warning System; NEWS, National Early Warning Score; NZEWS, New Zealand Early Warning Score; QSOFA, Quick Sequential Organ Failure Assessment; REMS, Rapid Emergency Medicine Score; VIEWS, VitalPAC Early Warning Score; WPS, Worthing Physiological Score.

short-term deterioration in surgical patients suggests a value for using EWS scores in these patients. In our study, surgical patients were more likely to deteriorate in the short term. Surgical patients, particularly those who require major interventions, such as those with multiple traumas, are often unstable and prone to rapid deterioration if not promptly treated.[20] Similarly, surgical patients may show higher immediate risk and elevated EWS scores because of their critical conditions, whereas medical patients might initially stabilise but deteriorate later because of disease progression.[21 22] Such differences in disease trajectories necessitate a more nuanced approach to using EWS scores. It may be necessary to adjust the optimal cut-off threshold of the EWS components based on admission type.

In line with previous research findings, we observed that EWS scores show limited ability to predict admissions to ICU/CCU and activation of CB/MET.[23 24] The decision to admit a patient to the ICU/CCU typically relies on clinical judgement and the availability of critical care services and thus may not align as well with EWS.[25] Severely ill patients requiring higher levels of care may be temporarily managed in the ED before experiencing adverse outcomes, potentially impacting the study results. Furthermore, the absence of standardised criteria for escalation and admission to the ICU/CCU may introduce variability in study outcomes. At the time of study, the participating hospital relied on a single-parameter approach for MET activation; however, this could have also influenced the study findings.

While the EWS scores may assist in the rapid identification of clinically unwell patients and promote timely intervention, it has been argued that directing interventions toward high-risk patients may involve a flawed assumption.[26] Patients identified as unwell are those who have generally deteriorated despite treatment; thus, using EWS scores may focus attention on those who will deteriorate; however, it is not clear that the interventions will affect outcomes in these patients.[26] EWS scores may overlook individuals with stable vital signs at the time of presentation requiring intervention, resulting in delayed management and subsequent clinical deterioration that is more likely to be reversible.

This study indicates that clinical deterioration can be predicted using some of the included EWS scores, but it is crucial to acknowledge that clinical decision-making should not solely rely on the EWS scores. While current EWS scores aim for the rapid identification of unwell patients during initial assessment, there is room for improvement in predicting clinical deterioration. Patients' pre-existing conditions or comorbidities are often overlooked when calculating EWS scores; however, these factors can significantly impact clinical management and decision-making, including admission to the ICU/CCU. Incorporating artificial intelligence in conjunction with real-time vital sign monitoring and tracking of clinical management may enhance EWS score prediction abilities.[27]

Strengths and limitations

A strength of our study was the consecutive inclusion of presenting patients, which mitigated selection bias; however, this resulted in the inclusion of generally less critically ill patients. Although some patients were excluded, there was no evidence that sicker patients were more likely to be excluded. Another strength was the use of the EWS score for the same patients measured at two separate times in two different settings, which is first on its own.

There are several limitations. This is a single-centre study. Critically ill trauma patients may have bypassed this regional hospital to a trauma centre and thus may have reduced the total number of unwell patients in this study. A lack of universal methods to categorise medical and surgical patients led us to stratify patients based on admitting ward, a method which has not been validated. Further research is needed to devise a better method of patient classification.

CONCLUSION

In this single-centre study, we found that EWS scores better predict 3-day mortality in both prehospital and ED settings. Among the EWS scores that achieved AUROC ≥0.70, no statistically significant differences were detected in their discriminatory abilities to identify patients at risk of clinical deterioration. 30-day mortality prediction was limited in both settings, with only VIEWS and NEWS in the ED achieving AUROC ≥0.70. This study also highlights potential distinctions in the EWS score utility between medical and surgical patients. These differences necessitate a more nuanced approach to using EWS scores and encourage the exploration of modified EWS scores for surgical and medical patients separately.

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accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines, terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

ORCID iD
Gigi Guan http://orcid.org/0000-0003-1575-6794

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Appendix A. Components of the Early Warning System scores included in the study.

Abbreviations	EWS Scores	HR	BP	RR	SpO_2	APUV	GCS	Temp	Age	Supplement O_2	Target study population	Outcomes predicted
ABBVIEWS	Abbreviated VIEWS	Y	Y	Y	Y	N	N	Y	N	Y	Medical and Surgical admissions[1]	48-hour mortality
BEWS	Bispebjerg Early Warning Score	Y	Y	Y	N	Y	N	Y	N	N	Emergency triage [2]	Inhospital mortality, ICU admission
CART	Cardiac Arrest Risk Triage	Y	Y	Y	N	N	N	N	Y	N	In hospital cardiac arrest patients[3]	Cardiac arrest
GAP	GCS, Age, and Systolic Blood Pressure	N	Y	N	N	N	Y	N	Y	N	Trauma patients[4]	Inhospital mortality
GOODACRE	Goodacre Score	N	N	N	Y	N	Y	N	Y	N	Emergency medical admissions[5]	Inhospital mortality
GS	Groarke Score	Y	Y	Y	Y	Y	N	Y	N	N	Emergency medical admissions[6]	Admission to ICU, cardiac arrest, length of stay, inhospital mortality
MEWS	Modified Early Warning Score	Y	Y	Y	Y	Y	N	Y	N	N	Medical admissions[7]	ICU admission
MEWSGCS	Modified EWS with GCS	Y	Y	Y	N	N	Y	Y	N	N	Medical admissions[8]	Admission to ICU or HDU, cardiac arrest, survival and discharge at 60 days, inhospital mortality
NEWS	National Early Warning Score	Y	Y	Y	Y	Y	N	Y	N	Y	Medical admissions[9]	Admission to ICU, cardiac arrest, 24- hour mortality
NHS	NHS Foundation Trust Early Warning Score	Y	Y	Y	N	Y	N	Y	N	N	All admissions[10]	Inhospital mortality
NTS	New Trauma Score	N	Y	N	Y	N	Y	N	N	N	Trauma admission[11]	Inhospital mortality
NZEWS	New Zealand Early Warning Score	Y	Y	Y	Y	Y	N	Y	N	Y	Medical and Surgical admissions[12]	EMT activation, Inhospital mortality
PRS	Prehospital Risk Score	Y	Y	Y	Y	N	Y	N	Y	N	None-traumatic patients[13]	Inhospital mortality, ICU admission
QSOFA	Quick Sequential Organ Failure Assessment	N	Y	Y	N	Y	N	N	N	N	Septic patients[14]	Inhospital mortality, ICU admission
RAPS	Rapid Acute Physiology Score	Y	Y	Y	N	N	Y	N	N	N	Critical care transports[15]	Inhospital mortality
REMS	Rapid Emergency Medicine Score	Y	Y	Y	Y	N	Y	N	Y	N	Nonsurgical patients in the ED[16]	Length of stay, inhospital mortality
RTS	Revised Trauma Score	N	Y	Y	N	N	Y	N	N	N	Trauma patients[17]	Inhospital mortality
SEWS	Standardised Early Warning Score	Y	Y	Y	Y	Y	N	Y	N	N	Medical and surgical patients[18]	Inhospital mortality
VSG	Vital Sign Groups	Y	Y	Y	Y	N	Y	Y	N	N	Medical and Surgical admissions[19]	Admission to hospital, MET calls, inhospital mortality
VIEWS	Vital-PAC Early Warning Score	Y	Y	Y	Y	Y	N	Y	N	Y	Medical admissions[20]	24-hour mortality/30 days mortality
WPS	Worthing Physiological Score	Y	Y	Y	Y	Y	N	Y	N	N	Medical and Surgical admissions[21]	Inhospital mortality

HR, heart rate; BP, blood pressure; RR, respiratory rate; SpO_2, oxygen saturation; AVPU = Alert, Voice, Pain, Unresponsive; GCS = Glasgow Coma Scale; Temp, temperature; Y, yes; N, no. The references of the original EWS populations are shown in Appendix F

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Appendix B. Medical and surgical patient classification of intensive care unit patients based on main diagnoses.

Medical	Surgical
A4151- Sepsis due to Escherichia coli	Z13.8-Encounter for screening for other specified diseases and disorders* A419- Sepsis, unspecified
A419- Sepsis, unspecified	Z48.8-Encounter for other specified postprocedural aftercare* I499- Bacterial infection, unspecified
E1011- Type 1 diabetes mellitus with ketoacidosis, without coma	Z98.6- Angioplasty status^ I210- Acute transmural myocardial infarction of anterior wall
E875- Hyperkalaemia	Z98.6- Angioplasty status^ I211- Acute transmural myocardial infarction of inferior wall
G410- Grand mal status epilepticus	Z98.6- Angioplasty status^ I213- ST elevation AMI (STEMI)
I10- Hypertension	I313- Pericardial effusion
I214- Non STEMI (non ST elevation AMI)	Z98.6- Angioplasty status^ I441- Atrioventricular block, second degree
I2511- Atherosclerotic heart disease, of native coronary artery	Z98.6- Angioplasty status^ I460- Cardiac arrest with successful resuscitation
I441- Atrioventricular block, second degree	Z98.61- Angioplasty status^ I490- Ventricular fibrillation and flutter
I453- Trifascicular block	I629- Intracranial haemorrhage (non traumatic)
I472- Ventricular tachycardia	I713- Abdominal aneurysm with rupture
I500- Congestive heart failure	Z53.31-Laparoscopic surgical procedure converted to open procedure* K5731- Diverticulosis of large intestine without perforation or abscess, with haemorrhage
I501- Left ventricular failure	Z53.31-Laparoscopic surgical procedure converted to open procedure* K830- Cholangitis
I652- Occlusion and stenosis of carotid artery, G819- Hemiparesis	Z53.31-Laparoscopic surgical procedure converted to open procedure K859- Acute pancreatitis, unspecified*
J051- Acute epiglottitis	K922- Gastrointestinal haemorrhage, unspecified
J122- Parainfluenza virus pneumonia	L0313- Cellulitis of lower limb
J189- Pneumonia, unspecified	M8098- Unspecified osteoporosis with pathological fracture, other site
J440- Chronic obstructive pulmonary disease with acute lower respiratory infection	S2241- Multiple rib fractures, involving first rib
J441- Chronic obstructive pulmonary disease with acute exacerbation, unspecified	S2243- Multiple rib fractures, involving three ribs
J448- Other specified chronic obstructive pulmonary disease	S2244- Multiple rib fractures involving four or more ribs
J459- Asthma, unspecified	S270- Traumatic pneumothorax
J9691- Respiratory failure unspecified, type II	S271- Traumatic haemothorax
K311- Pyloric stenosis (excludes infantile pyloric stenosis: Q400)	S6263- Fracture of distal phalanx
K704- Alcoholic hepatic failure	S7204- Fracture of mid-cervical section of femur

N179- Acute kidney failure, unspecified	
N390- Urinary tract infection, site not specified	
T390- Salicylates, T510- Ethanol	
T402- Other opioids	
T4121- Gamma hydroxybutyrate	
T420- Hydantoin derivatives	
T424- Benzodiazepines	
T426- Other antiepileptic and sedative-hypnotic drugs	
T430- Tricyclic and tetracyclic antidepressants	
T435- Other and unspecified antipsychotics and neuroleptics	
T452- Vitamins, not elsewhere classified	
T486- Antiasthmatics, not elsewhere classified	
T510- Ethanol, T407- Cannabis (derivatives)	

*Patients who underwent procedures or investigations completed in theatre were classified as surgical patients.

^Patients underwent cardiac/coronary care procedures.

Appendix C. Comparison of participants included and excluded due to missing vital signs by age, sex, length of hospital stay, admission to ICU/CCU, and in-hospital mortality

	Included N=995	Excluded N=287	P value
Age categories, n (%)			0.188
<30	37 (3.7)	17 (5.9)	
30-39	44 (4.4)	13 (4.5)	
40-49	59 (5.9)	22 (7.7)	
50-59	120 (12.1)	42 (14.6)	
≥60	735 (73.9)	193 (67.3)	
Male, n (%)	528 (53.1)	165 (57.5)	0.185
Length of stay, mean, median [IQR]	4.3 (4.5), 3 [2, 5]	4.9 (5.8), 3 [2, 5]	0.465
Admission to ICU/CCU, n (%)	82 (8.2%)	33 (11.5)	0.090
In-hospital mortality, n (%)	66 (6.6)	14 (4.9)	0.279

Appendix D. 30-day mortality prediction

	Prehospital setting			Emergency Department setting		
EWS scores	AUROC	LCI	UCI	AUROC	LCI	UCI
ABBVIEWS	0.638	0.563	0.713	0.694	0.631	0.756
BEWS	0.573	0.498	0.648	0.679	0.611	0.747
CART	0.613	0.552	0.674	0.654	0.594	0.715
GAP	0.466	0.398	0.533	0.463	0.399	0.527
GOODACRE	0.598	0.531	0.664	0.546	0.479	0.612
GS	0.592	0.518	0.665	0.647	0.576	0.717
MEWS	0.583	0.510	0.655	0.646	0.577	0.714
MEWSGCS	0.599	0.524	0.673	0.678	0.606	0.749
NEWS	0.641	0.567	0.715	0.709	0.648	0.770
NHS	0.572	0.496	0.647	0.672	0.603	0.741
NTS	0.348	0.279	0.417	0.364	0.293	0.434
NZEWS	0.624	0.551	0.697	0.697	0.633	0.761
PRS	0.622	0.557	0.688	0.688	0.626	0.750
QSOFA	0.658	0.591	0.725	0.618	0.547	0.688
RAPS	0.542	0.470	0.614	0.579	0.507	0.651
REMS	0.677	0.615	0.740	0.679	0.619	0.740
RTS	0.438	0.382	0.493	0.438	0.384	0.491
SEWS	0.592	0.516	0.668	0.687	0.621	0.752
VSG	0.553	0.480	0.627	0.648	0.580	0.717
VIEWS	0.642	0.567	0.717	0.713	0.653	0.773
WPS	0.646	0.569	0.723	0.691	0.623	0.760

AUROC = area under the receiver operating characteristic curve; LCI = lower confidence interval; UCI = upper confidence interval

Appendix E. Comparison of the area under the receiver operating characteristic curves (AUROC) of the different scores for 30-day mortality in the Emergency Department setting.

EWS scores	ABBVIEWS	BEWS	CART	GAP	GOODACRE	GS	MEWS	MEWSGCS	NEWS	NHS	NTS	NZEWS	PRS	QSOFA	RAPS	REMS	RTS	SEWS	VSG	VIEWS
BEWS	0.610																			
CART	0.238	0.439																		
GAP	**<0.001**	**<0.001**	**0.000**																	
GOODACRE	**0.005**	**0.008**	**0.017**	0.078																
GS	0.128	0.232	0.849	**0.001**	0.071															
MEWS	0.126	0.055	0.779	**0.001**	0.511	0.956														
MEWSGCS	0.647	0.952	0.475	**<0.001**	**0.013**	0.203	0.105													
NEWS	0.283	0.191	0.090	**<0.001**	**0.001**	**0.009**	**0.008**	0.283												
NHS	0.455	0.114	0.586	**<0.001**	**0.013**	0.349	0.114	0.804	0.116											
NTS	**<0.001**	**<0.001**	**<0.001**	**0.002**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**										
NZEWS	0.854	0.526	0.190	**<0.001**	**0.005**	**0.046**	**0.041**	0.542	0.312	0.385	**<0.001**									
PRS	0.856	0.733	0.252	**<0.001**	**0.003**	0.143	0.065	0.649	0.416	0.539	**<0.001**	0.724								
QSOFA	**0.040**	0.063	0.365	**0.011**	0.160	0.438	0.409	0.078	**0.006**	0.095	**<0.001**	**0.024**	**0.022**							
RAPS	**0.002**	**<0.001**	0.057	**0.034**	0.493	0.050	**0.017**	**0.005**	**<0.001**	**0.002**	**<0.001**	**<0.001**	**0.001**	0.332						
REMS	0.700	0.989	0.456	**<0.001**	**<0.001**	0.360	0.295	0.960	0.368	0.818	**<0.001**	0.608	0.779	0.117	**<0.001**					
RTS	**<0.001**	**<0.001**	**<0.001**	0.454	**0.016**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**0.016**	**<0.001**	**<0.001**	**<0.001**	**0.013**	**<0.001**				
SEWS	0.793	0.757	0.355	**<0.001**	**0.012**	0.073	0.067	0.771	0.248	0.540	**<0.001**	0.574	0.962	**0.047**	**<0.001**	0.835	**<0.001**			
VSG	0.146	0.186	0.864	**<0.001**	0.050	0.949	0.896	0.256	**0.015**	0.292	**<0.001**	0.076	0.145	0.444	**0.015**	0.327	**<0.001**	0.099		
VIEWS	0.098	0.145	0.065	**<0.001**	**<0.0016**	**0.016**	**0.009**	0.248	0.582	0.084	**<0.001**	0.264	0.342	**0.004**	**0.000**	0.296	**<0.001**	0.231	**0.015**	
WPS	0.942	0.702	0.340	**<0.001**	**0.009**	0.052	0.132	0.663	0.388	0.552	**<0.001**	0.794	0.911	0.054	**0.005**	0.772	**<0.001**	0.835	0.130	0.130

Appendix F. 3-day mortality prediction

	Prehospital setting			Emergency Department setting		
EWS scores	AUROC	LCI	UCI	AUROC	LCI	UCI
ABBVIEWS	0.791	0.666	0.916	0.821	0.698	0.944
BEWS	0.729	0.578	0.880	0.849	0.734	0.964
CART	0.698	0.596	0.800	0.761	0.637	0.885
GAP	0.394	0.242	0.545	0.432	0.282	0.582
GOODACRE	0.686	0.543	0.828	0.563	0.431	0.694
GS	0.734	0.583	0.885	0.850	0.741	0.960
MEWS	0.718	0.559	0.877	0.822	0.707	0.936
MEWSGCS	0.718	0.556	0.880	0.866	0.775	0.958
NEWS	0.793	0.667	0.919	0.870	0.779	0.961
NHS	0.719	0.565	0.872	0.840	0.721	0.958
NTS	0.255	0.097	0.413	0.276	0.107	0.445
NZEWS	0.771	0.644	0.899	0.879	0.807	0.952
PRS	0.747	0.609	0.885	0.844	0.749	0.939
QSOFA	0.779	0.689	0.868	0.676	0.522	0.830
RAPS	0.667	0.496	0.838	0.752	0.593	0.910
REMS	0.826	0.730	0.922	0.828	0.726	0.930
RTS	0.368	0.221	0.515	0.357	0.213	0.501
SEWS	0.752	0.607	0.896	0.833	0.735	0.931
VSG	0.707	0.564	0.851	0.795	0.659	0.932
VIEWS	0.807	0.683	0.930	0.868	0.773	0.964
WPS	0.779	0.624	0.934	0.853	0.788	0.917

AUROC = area under the receiver operating characteristic curve; LCI = lower confidence interval; UCI = upper confidence interval

Appendix G. Comparison of the area under the receiver operating characteristic curves (AUROC) of the different scores evaluating 3-day mortality in the prehospital setting.

EWS scores	ABBVIEWS	BEWS	CART	GAP	GOODACRE	GS	MEWS	MEWSGCS	NEWS	NHS	NTS	NZEWS	PRS	QSOFA	RAPS	REMS	RTS	SEWS	VSG	VIEWS
BEWS	0.294																			
CART	0.126	0.679																		
GAP	**0.001**	**0.013**	**0.002**																	
GOODACRE	0.289	0.686	0.887	**0.023**																
GS	0.256	0.861	0.603	**0.013**	0.608															
MEWS	0.288	0.665	0.785	**0.018**	0.771	0.743														
MEWSGCS	0.256	0.638	0.783	**0.024**	0.763	0.615	0.984													
NEWS	0.937	0.171	0.101	**0.001**	0.234	0.121	0.179	0.131												
NHS	0.231	**<0.001**	0.784	**0.017**	0.761	0.633	0.987	0.969	0.124											
NTS	**<0.001**	**<0.001**	**<0.001**	**0.029**	**0.002**	**0.001**	**0.001**	**0.001**	**<0.001**	**0.001**										
NZEWS	0.579	0.373	0.216	**0.003**	0.343	0.409	0.301	0.269	**0.031**	0.282	**<0.001**									
PRS	0.469	0.712	0.361	**0.008**	0.501	0.754	0.619	0.445	0.355	0.572	**<0.001**	0.636								
QSOFA	0.780	0.499	0.108	**<0.001**	0.216	0.499	0.437	0.403	0.732	0.426	**<0.001**	0.877	0.602							
RAPS	0.067	0.327	0.742	**0.046**	0.872	0.411	0.368	0.491	0.078	0.411	**0.003**	0.076	0.388	0.216						
REMS	0.520	**0.034**	**0.045**	**<0.001**	0.080	**0.045**	0.057	**0.044**	**0.039**	**0.024**	**<0.001**	0.197	0.125	0.361	**0.021**					
RTS	**<0.001**	**0.010**	**0.001**	0.738	**0.001**	**0.007**	**0.014**	**0.015**	**<0.001**	**0.013**	0.178	**0.001**	**<0.001**	**<0.001**	**0.047**	**0.000**				
SEWS	0.825	0.446	0.419	**0.008**	0.478	0.158	0.468	0.289	0.243	0.295	**<0.001**	0.652	0.904	0.666	0.291	0.059	**0.003**			
VSG	0.236	0.508	0.875	**0.016**	0.830	0.356	0.787	0.743	**0.029**	0.732	**0.001**	0.180	0.321	0.256	0.614	**0.009**	**0.008**	**0.042**		
VIEWS	0.774	0.123	0.074	**0.001**	0.186	0.092	0.140	0.101	0.154	0.089	**<0.001**	0.085	0.254	0.487	**0.048**	0.621	**<0.001**	0.184	**0.031**	
WPS	0.375	0.305	0.245	**0.006**	0.265	0.116	0.304	0.195	0.722	0.234	**<0.001**	0.876	0.538	0.997	0.199	0.331	**0.001**	0.265	**0.048**	**0.048**

Appendix H. Comparison of the area under the receiver operating characteristic curve (AUROC) of the different scores for 3-day mortality in the Emergency Department setting.

EWS scores	ABBVIEWS	BEWS	CART	GAP	GOODACRE	GS	MEWS	MEWSGCS	NEWS	NHS	NTS	NZEWS	PRS	QSOFA	RAPS	REMS	RTS	SEWS	VSG	VIEWS
BEWS	0.638																			
CART	0.465	0.228																		
GAP	**<0.001**	**0.001**	**0.000**																	
GOODACRE	**0.006**	**<0.001**	**0.018**	0.266																
GS	0.688	0.980	0.291	**0.001**	**0.001**															
MEWS	0.310	0.225	0.382	**0.001**	**0.002**	0.529														
MEWSGCS	0.441	0.367	0.131	**<0.001**	**<0.001**	0.661	0.054													
NEWS	0.178	0.505	0.102	**<0.001**	**<0.001**	0.704	0.169	0.894												
NHS	0.758	**0.002**	0.288	**0.001**	**0.001**	0.840	0.415	0.174	0.364											
NTS	**<0.001**	**<0.001**	**<0.001**	**0.015**	**0.017**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**										
NZEWS	0.225	0.404	**0.045**	**<0.001**	**<0.001**	0.534	0.065	0.628	0.679	0.289	**<0.001**									
PRS	0.701	0.810	0.210	**<0.001**	**<0.001**	0.882	0.159	0.249	0.326	0.863	**<0.001**	0.148								
QSOFA	0.161	**0.012**	0.456	0.090	0.216	**0.006**	**0.045**	**0.003**	**0.014**	**0.019**	**0.006**	**0.010**	**0.013**							
RAPS	0.459	0.072	0.915	**0.016**	0.064	0.211	0.120	0.057	0.090	0.102	**<0.001**	**0.049**	0.066	0.428						
REMS	0.923	0.604	0.285	**<0.001**	**<0.001**	0.684	0.833	0.313	0.383	0.774	**<0.001**	0.181	0.592	0.064	**0.038**					
RTS	**<0.001**	**<0.001**	**<0.001**	0.292	0.055	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	0.295	**<0.001**	**<0.001**	**0.007**	**0.004**	**<0.001**				
SEWS	0.862	0.741	0.298	**<0.001**	**0.001**	0.638	0.724	0.382	0.410	0.888	**<0.001**	0.147	0.730	**0.046**	0.142	0.875	**<0.001**			
VSG	0.728	0.165	0.635	**0.003**	**0.004**	0.385	0.470	0.082	0.122	0.245	**<0.001**	0.059	0.225	0.186	0.481	0.429	**0.001**	0.472		
VIEWS	0.149	0.556	0.113	**<0.001**	**<0.001**	0.752	0.226	0.949	0.777	0.409	**<0.001**	0.669	0.420	**0.019**	0.100	0.421	**<0.001**	0.473	0.134	
WPS	0.607	0.948	0.203	**<0.001**	**<0.001**	0.959	0.559	0.741	0.670	0.818	**<0.001**	0.482	0.839	**0.017**	0.225	0.655	**<0.001**	0.669	0.389	0.389

Appendix I. Intensive care unit/ cardiac care unit (ICU/CCU) admission prediction

	Prehospital setting			Emergency Department setting		
EWS scores	AUROC	LCI	UCI	AUROC	LCI	UCI
ABBVIEWS	0.671	0.610	0.733	0.661	0.601	0.722
BEWS	0.675	0.613	0.738	0.654	0.593	0.715
CART	0.537	0.467	0.607	0.536	0.466	0.606
GAP	0.380	0.314	0.445	0.400	0.334	0.466
GOODACRE	0.453	0.385	0.520	0.432	0.366	0.498
GS	0.657	0.592	0.722	0.631	0.564	0.698
MEWS	0.671	0.608	0.734	0.657	0.595	0.719
MEWSGCS	0.667	0.602	0.731	0.652	0.585	0.718
NEWS	0.672	0.609	0.735	0.678	0.618	0.738
NHS	0.668	0.604	0.731	0.652	0.590	0.714
NTS	0.387	0.314	0.461	0.421	0.348	0.493
NZEWS	0.686	0.623	0.749	0.680	0.618	0.743
PRS	0.622	0.558	0.686	0.607	0.540	0.673
QSOFA	0.613	0.552	0.673	0.627	0.567	0.687
RAPS	0.634	0.569	0.699	0.643	0.579	0.708
REMS	0.546	0.472	0.620	0.545	0.471	0.618
RTS	0.376	0.321	0.431	0.424	0.375	0.472
SEWS	0.654	0.590	0.719	0.655	0.590	0.721
VSG	0.637	0.575	0.700	0.614	0.550	0.678
VIEWS	0.684	0.622	0.746	0.686	0.626	0.745
WPS	0.640	0.574	0.705	0.618	0.549	0.687

AUROC = area under the receiver operating characteristic curve; LCI = lower confidence interval; UCI = upper confidence interval

Appendix J. Code blue/ medical emergency team (CB/MET) activation prediction

	Prehospital setting			Emergency Department setting		
EWS scores	AUROC	LCI	UCI	AUROC	LCI	UCI
ABBVIEWS	0.561	0.508	0.614	0.614	0.565	0.662
BEWS	0.543	0.493	0.592	0.571	0.522	0.619
CART	0.546	0.496	0.596	0.597	0.548	0.646
GAP	0.504	0.457	0.551	0.519	0.471	0.566
GOODACRE	0.534	0.482	0.587	0.525	0.470	0.579
GS	0.544	0.492	0.595	0.577	0.526	0.628
MEWS	0.534	0.485	0.582	0.563	0.515	0.611
MEWSGCS	0.546	0.496	0.595	0.577	0.526	0.628
NEWS	0.554	0.502	0.606	0.601	0.553	0.649
NHS	0.540	0.490	0.589	0.567	0.517	0.616
NTS	0.439	0.387	0.491	0.454	0.403	0.504
NZEWS	0.546	0.493	0.598	0.599	0.548	0.651
PRS	0.573	0.526	0.619	0.595	0.550	0.640
QSOFA	0.574	0.526	0.622	0.553	0.505	0.600
RAPS	0.500	0.450	0.551	0.476	0.425	0.527
REMS	0.529	0.477	0.580	0.535	0.483	0.586
RTS	0.479	0.444	0.514	0.479	0.446	0.511
SEWS	0.550	0.499	0.601	0.595	0.545	0.645
VSG	0.503	0.453	0.552	0.526	0.478	0.574
VIEWS	0.558	0.506	0.611	0.607	0.559	0.655
WPS	0.550	0.497	0.603	0.578	0.527	0.629

AUROC = area under the receiver operating characteristic curve; LCI = lower confidence interval; UCI = upper confidence interval

Appendix K. Length of hospital stay (LOS) prediction

	Prehospital setting			Emergency Department setting		
EWS scores	AUROC	LCI	UCI	AUROC	LCI	UCI
ABBVIEWS	0.552	0.516	0.587	0.553	0.516	0.589
BEWS	0.527	0.493	0.562	0.521	0.487	0.555
CART	0.578	0.544	0.612	0.594	0.560	0.627
GAP	0.552	0.518	0.586	0.556	0.522	0.591
GOODACRE	0.540	0.505	0.576	0.533	0.498	0.569
GS	0.538	0.503	0.573	0.535	0.499	0.570
MEWS	0.528	0.494	0.563	0.518	0.485	0.551
MEWSGCS	0.524	0.489	0.560	0.531	0.496	0.566
NEWS	0.544	0.508	0.579	0.547	0.511	0.583
NHS	0.532	0.498	0.567	0.518	0.484	0.552
NTS	0.469	0.435	0.504	0.464	0.429	0.498
NZEWS	0.539	0.503	0.574	0.559	0.523	0.595
PRS	0.535	0.503	0.567	0.566	0.534	0.597
QSOFA	0.532	0.501	0.564	0.532	0.500	0.564
RAPS	0.500	0.466	0.535	0.464	0.429	0.498
REMS	0.571	0.535	0.606	0.550	0.515	0.586
RTS	0.488	0.465	0.511	0.508	0.488	0.528
SEWS	0.534	0.499	0.568	0.551	0.517	0.586
VSG	0.524	0.490	0.558	0.505	0.472	0.537
VIEWS	0.544	0.509	0.580	0.546	0.510	0.582
WPS	0.540	0.505	0.575	0.533	0.497	0.568

AUROC = area under the receiver operating characteristic curve; LCI = lower confidence interval; UCI = upper confidence interval

Appendix M. Comparison of the area under the receiver operating characteristic curve (AUROC) of the different scores for 30-day mortality in the prehospital setting.

EWS scores	ABBVIEWS	BEWS	CART	GAP	GOODACRE	GS	MEWS	MEWSGCS	NEWS	NHS	NTS	NZEWS	PRS	QSOFA	RAPS	REMS	RTS	SEWS	VSG	VIEWS
BEWS	**0.009**																			
CART	0.475	0.200																		
GAP	**0.005**	0.077	**0.001**																	
GOODACRE	0.471	0.642	0.717	**0.004**																
GS	**0.015**	0.340	0.514	**0.035**	0.906															
MEWS	**0.034**	0.359	0.319	**0.048**	0.774	0.654														
MEWSGCS	0.127	0.077	0.629	**0.029**	0.986	0.705	0.302													
NEWS	0.758	**0.003**	0.423	**0.005**	0.427	**0.005**	**0.014**	0.067												
NHS	**0.008**	0.833	0.185	0.080	0.626	0.303	0.226	0.054	**0.002**											
NTS	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**										
NZEWS	0.312	**0.040**	0.743	**0.010**	0.624	0.090	0.087	0.288	0.078	**0.029**	**<0.001**									
PRS	0.595	0.089	0.750	**0.007**	0.588	0.273	0.182	0.330	0.504	0.084	**<0.001**	0.946								
QSOFA	0.524	**0.004**	0.144	**0.001**	0.207	**0.034**	**0.015**	**0.035**	0.568	**0.004**	**<0.001**	0.265	0.204							
RAPS	**0.018**	0.356	0.063	0.147	0.219	0.187	0.201	0.105	**0.010**	0.365	**0.001**	**0.024**	**0.031**	**0.008**						
REMS	0.367	**0.006**	**0.036**	**<0.001**	**0.024**	**0.032**	**0.012**	**0.038**	0.389	**0.005**	**<0.001**	0.192	0.116	0.635	**<0.001**					
RTS	**0.001**	**0.024**	**0.001**	0.462	**<0.001**	**0.009**	**0.015**	**0.007**	**0.001**	**0.027**	**0.015**	**0.002**	**0.001**	**<0.001**	0.074	**<0.001**				
SEWS	**0.020**	0.307	0.526	**0.042**	0.912	0.988	0.613	0.733	**0.004**	0.234	**<0.001**	0.081	0.255	**0.032**	0.175	**0.028**	**0.011**			
VSG	**0.001**	0.314	**0.038**	0.140	0.393	0.076	0.122	**0.021**	**<0.001**	0.305	**0.001**	**0.003**	**0.010**	**<0.001**	0.756	**0.001**	0.052	**0.022**		
VIEWS	0.628	**0.004**	0.409	**0.005**	0.415	**0.007**	**0.017**	0.066	0.728	**0.002**	**<0.001**	0.065	0.478	0.599	**0.009**	0.405	**0.001**	**0.005**	**<0.001**	
WPS	0.703	**0.004**	0.353	**0.004**	0.358	**0.001**	**0.013**	**0.024**	0.752	**0.002**	**<0.001**	0.245	0.421	0.709	**0.009**	0.461	**<0.001**	**0.003**	**<0.001**	**<0.001**

Arabic

خلفية

لا تزال النتائج المثالية لنظام الإنذار المبكر (EWS) لتحديد المرضى المعرضين لخطر التدهور السريري بين أولئك الذين يتم نقلهم بواسطة خدمات الإسعاف غير مؤكدة. قارنت هذه الدراسة بأثر رجعي أداء 21 درجة من درجات EWS للتنبؤ بالتدهور السريري باستخدام العلامات الحيوية (VS) المقاسة في قسم ما قبل المستشفى أو قسم الطوارئ.

أساليب إحصائية

كان المرضى البالغون الذين تم نقلهم إلى قسم طوارئ واحد بواسطة سيارات الإسعاف وتم إدخالهم بعد ذلك إلى المستشفى في الفترة ما بين 19/1/1 و19/4/18 مؤهلين للإدراج. وكانت النتيجة الأولية الوفيات لمدة 30 يوما. وشملت النتائج الثانوية الوفيات لمدة 3 أيام، والقبول في وحدات العناية المركزة أو العناية التاجية، ومدة الإقامة في المستشفى، وتنشيط مكالمات الطوارئ. تم تقييم القدرة التمييزية لدرجات EWS باستخدام المنطقة الواقعة تحت منحنى خاصية تشغيل المتلقي (AUROC). قارنت التحليلات الفرعية أداء درجات EWS بين أنواع المرضى الجراحية والطبية.

نتائج

من بين 1414 مريضًا، تم تضمين 995 (70.4%) [53.1% ذكور، متوسط العمر 68.7 ± 17.5 سنة]. في قسم الطوارئ، كان أفضل توقع للوفيات لمدة 30 يومًا هو VitalPAC EWS (AUROC 0.71، 95٪ CI (0.65-0.77)) ودرجة الإنذار المبكر الوطنية (0.709 (0.65-0.77)). جميع درجات EWS المحسوبة في إعداد ما قبل المستشفى كانت AUROC <0.70. النتيجة السريعة لطب الطوارئ (0.83، (0.73-0.92)) ونيوزيلندا EWS (0.88 (0.81-0.95)) أفضل توقع للوفيات لمدة 3 أيام في قسم ما قبل المستشفى والطوارئ، على التوالي. كانت درجات EWS المحسوبة باستخدام قسم ما قبل المستشفى أو قسم الطوارئ أكثر فعالية في التنبؤ بالوفيات لمدة 3 أيام في المرضى الجراحيين، في حين كان من الأفضل التنبؤ بالوفيات لمدة 30 يومًا في المرضى الطبيين. من بين درجات EWS التي حققت AUROC≥0.70، لم يتم اكتشاف فروق ذات دلالة إحصائية في قدراتهم التمييزية لتحديد المرضى المعرضين لخطر التدهور السريري.

الاستنتاجات

تتنبأ نتائج EWS بشكل أفضل بالوفيات لمدة 3 أيام بدلاً من 30 يومًا وتكون أكثر دقة عند تقديرها باستخدام VS المقاسة في قسم الطوارئ. قد يختلف الأداء التمييزي لدرجات EWS في تحديد المرضى الأكثر عرضة لخطر التدهور السريري حسب نوع المريض.

Armenian

Նախապատմություն

Շտապօգնության ծառայությունների միջոցով տեղափոխվողների շրջանում կլինիկական վատթարացման վտանգի տակ գտնվող հիվանդներին հայտնաբերելու համար վաղ նախազգուշացման համակարգի (EWS) օպտիմալ միավորները մնում են անորոշ: Այս հետահայաց ուսումնասիրությունը համեմատեց 21 EWS միավորների կատարումը՝ կանխատեսելու կլինիկական վատթարացումը՝ օգտագործելով նախահիվանդանոցային կամ շտապ օգնության բաժանմունքում չափված կենսական նշանները (VS):

Մեթոդներ

Շտապօգնության մեքենաներով մեկ շտապօգնության բաժանմունք տեղափոխված չափահաս հիվանդները և հետագայում հիվանդանոց ընդունվել 1/1/19-ից մինչև 18/4/19-ն ընկած ժամանակահատվածում, իրավասու էին ներառվել: Առաջնային արդյունքը 30-օրյա մահացությունն էր. Երկրորդական արդյունքները ներառում էին 3-օրյա մահացություն, ինտենսիվ թերապիայի կամ կորոնար խնամքի բաժանմունք ընդունվելը, հիվանդանոցում մնալու տևողությունը և շտապ օգնության կանչերի ակտիվացումները: EWS միավորների տարբերակիչ կարողությունը գնահատվել է՝ օգտագործելով ընդունիչի գործառնական բնութագրիչ կորի (AUROC) տակ գտնվող տարածքը: Ենթավերլուծությունները համեմատել են EWS գնահատականների կատարողականը վիրաբուժական և բժշկական հիվանդների տեսակների միջև:

Արդյունքներ

1414 հիվանդներից 995-ը (70,4%) [53,1% տղամարդ, միջին տարիքը՝ 68,7±17,5 տարի] ներառվել են: Արտակարգ իրավիճակների բաժանմունքում 30-օրյա մահացությունը լավագույնս կանխատեսվել է VitalPAC EWS-ի (AUROC 0.71 95% CI (0.65-0.77)) և Ազգային վաղ նախազգուշացման միավորի (0.709 (0.65-0.77)) կողմից: Նախահիվանդանոցում հաշվարկված բոլոր EWS միավորներն ունեցել են AUROC<0.70: Արագ շտապ օգնության բժշկության միավորը (0.83, (0.73-0.92)) և Նոր Զելանդիայի EWS (0.88 (0.81-0.95)) լավագույնս կանխատեսել են 3-օրյա մահացությունը համապատասխանաբար նախահիվանդանոցային և շտապ օգնության բաժանմունքում: Նախահիվանդանոցային կամ շտապ օգնության բաժանմունքի միջոցով հաշվարկված EWS միավորներն ավելի արդյունավետ էին վիրաբուժական հիվանդների 3-օրյա մահացության կանխատեսման համար, մինչդեռ 30-օրյա մահացությունը լավագույնս կանխատեսվում էր բժշկական հիվանդների մոտ: AUROC≥0.70 ստացած EWS միավորների մեջ վիճակագրորեն նշանակալի տարբերություններ չեն հայտնաբերվել կլինիկական վատթարացման վտանգի տակ գտնվող հիվանդներին նույնականացնելու նրանց խտրական կարողությունների մեջ:

Եզրակացություններ

EWS-ի միավորներն ավելի լավ են կանխատեսում 3-օրյա մահացությունը, ի տարբերություն 30-օրյա մահացության և ավելի ճշգրիտ են, երբ գնահատվում են շտապ օգնության բաժանմունքում չափված VS-ի միջոցով: EWS գնահատականների խտրական կատարումը կլինիկական վատթարացման ավելի բարձր ռիսկի ենթարկված հիվանդների նույնականացման հարցում կարող է տարբեր լինել՝ կախված հիվանդի տեսակից:

21 个预警系统评分在预测救护车服务管理的未分化入院患者院内病情恶化方面的表现

摘要

背景

在救护车服务转运的患者中，用于识别其中存在临床恶化风险患者的最佳早期预警系统 (EWS) 评分仍尚未确定。本项回顾性研究比较了 21 个 EWS 评分的表现，以使用院前或急诊科 (ED) 环境中测量的生命体征 (VS) 来预测临床恶化状况。

方法

纳入标准为 2019 年 1 月 1 日至 4 月 18 日期间被救护车送往单一急诊室并随后入院的成年患者。主要结果指标为 30 天死亡率；次要结果包括 3 天死亡率、入住重症监护室 (ICU)或冠心病监护室 (CCU)、住院时间 (LOS)和触发紧急呼叫 (Code Blue/MET call activation)。使用受试者工作特征曲线下面积 (AUROC) 对 EWS 评分的辨别能力进行评估。子分析比较了外科和内科患者类型之间 EWS 评分的表现。

结果

在 1414 名患者中，纳入 995 名 (70.4%) (53.1%为男性，平均年龄 68.7±17.5 岁)。在急诊情况下, VitalPAC EWS (AUROC 0.71 95% CI (0.65-0.77)) 和 National Early Warning Score (0.709 (0.65-0.77)) 可以最好地预测 30 天死亡率。30 天死亡率在院前环境中计算的所有 EWS 评分的 AUROC 全部小于 0.70。Rapid Emergency Medicine Score（0.83，（0.73-0.92））和 New Zealand EWS（0.88（0.81-0.95））分别最好地预测了院前和急诊室的 3 天死亡率。使用院前或急诊 VS 计算的 EWS 评分对于预测手术患者的 3 天死亡率更为有效，而对于预测内科患者的 30 天死亡率效果最佳。在达到 AUROC≥0.70 的 EWS 评分中，在识别有临床恶化风险的患者的辨别能力方面没有检测到显著统计学差异。

结论

与 30 天死亡率相比，EWS 评分可以更好地预测 3 天死亡率，并且在使用急诊中测量的 VS 进行估计时更加准确。EWS 评分在识别临床恶化风险较高的患者方面的差异性表现可能因患者类型而异。

关键词：院前，急诊，早期预警系统评分，死亡率，AUROC。

21 個預警系統評分在預測救護車服務管理的未分化入院患者院內病情惡化方面的表現

摘要

背景

在救護車服務轉運的患者中，用於識別其中存在臨床惡化風險患者的最佳早期預警系統 (EWS) 評分仍尚未確定。本項回顧性研究比較了 21 個 EWS 評分的表現，以使用院前或急診科 (ED) 環境中測量的生命體徵 (VS) 來預測臨床惡化狀況。

方法

納入標準為 2019 年 1 月 1 日至 4 月 18 日期間被救護車送往單一急診室並隨後入院的成年患者。主要結果指標為 30 天死亡率；次要結果包括 3 天死亡率、入住重症監護室 (ICU)或冠心病監護室 (CCU)、住院時間 (LOS)和觸發緊急呼叫 (Code Blue/MET call activation) 。使用受試者工作特徵曲線下面積 (AUROC) 對 EWS 評分的辨別能力進行評估。子分析比較了外科和內科患者類型之間 EWS 評分的表現。

結果

在 1414 名患者中，納入 995 名 (70.4%) (53.1%為男性，平均年齡 68.7±17.5 歲)。在急診情況下 VitalPAC EWS (AUROC 0.71 95% CI (0.65-0.77)) 和 National Early Warning Score (0.709 (0.65-0.77)) 可以最好地預測 30 天死亡率。30 天死亡率在院前環境中計算的所有 EWS 評分的 AUROC 全部小於 0.70。Rapid Emergency Medicine Score（0.83，（0.73-0.92））和 New Zealand EWS（0.88（0.81-0.95））分別最好地預測了院前和急診室的 3 天死亡率。使用院前或急診 VS 計算的 EWS 評分對於預測手術患者的 3 天死亡率更為有效，而對於預測內科患者的 30 天死亡率效果最佳。在達到 AUROC≥0.70 的 EWS 評分中，在識別有臨床惡化風險的患者的辨別能力方面沒有檢測到顯著統計學差異。

結論

與 30 天死亡率相比，EWS 評分可以更好地預測 3 天死亡率，並且在使用急診中測量的 VS 進行估計時更加準確。EWS 評分在識別臨床惡化風險較高的患者方面的差異性表現可能因患者類型而異。

關鍵詞：院前，急診，早期預警系統評分，死亡率，AUROC。

French

Arrière-plan

Les scores optimaux du système d’alerte précoce (EWS) pour identifier les patients présentant un risque de détérioration clinique parmi ceux transportés par les services d’ambulance restent incertains. Cette étude rétrospective a comparé les performances de 21 scores EWS pour prédire la détérioration clinique à l'aide des signes vitaux mesurés en service préhospitalier ou aux urgences.

Méthodes

Les patients adultes transportés vers un seul service d'urgence par ambulance puis admis à l'hôpital entre le 1/1/19 et le 18/4/19 étaient éligibles à l'inclusion. Le critère de jugement principal était la mortalité à 30 jours ; les critères de jugement secondaires comprenaient la mortalité sur 3 jours, l'admission dans des unités de soins intensifs ou de soins coronariens, la durée du séjour à l'hôpital et l'activation des appels d'urgence. La capacité discriminante des scores EWS a été évaluée à l’aide de l’aire sous la courbe caractéristique de fonctionnement du récepteur (AUROC). Les sous-analyses ont comparé les performances des scores EWS entre les types de patients chirurgicaux et médicaux.

Résultats

Sur 1 414 patients, 995 (70,4 %) [53,1 % d'hommes, âge moyen 68,7 ± 17,5 ans] ont été inclus. Aux urgences, la mortalité à 30 jours était mieux prédite par VitalPAC EWS (AUROC 0,71 IC à 95 % (0,65-0,77)) et le National Early Warning Score (0,709 (0,65-0,77)). Tous les scores EWS calculés en préhospitalier avaient AUROC <0,70. Le score rapide de médecine d'urgence (0,83, (0,73-0,92)) et l'EWS néo-zélandais (0,88 (0,81-0,95)) prédisaient le mieux la mortalité sur 3 jours dans les services préhospitaliers et d'urgence, respectivement. Les scores EWS calculés en préhospitalier ou au service des urgences étaient plus efficaces pour prédire la mortalité à 3 jours chez les patients chirurgicaux, alors que la mortalité à 30 jours était mieux prédite chez les patients médicaux. Parmi les scores EWS ayant atteint AUROC ≥0,70, aucune différence statistiquement significative n'a été détectée dans leurs capacités discriminatoires à identifier les patients présentant un risque de détérioration clinique.

Conclusions

Les scores EWS prédisent mieux la mortalité sur 3 jours plutôt que sur 30 jours et sont plus précis lorsqu’ils sont estimés à l’aide des signes vitaux mesurés au service des urgences. La performance discriminatoire des scores EWS dans l’identification des patients présentant un risque plus élevé de détérioration clinique peut varier selon le type de patient.

Hebrew

רקע כללי

הציונים האופטימליים של מערכת האזהרה המוקדמת (EWS) לזיהוי חולים בסיכון להידרדרות קלינית בקרב אלה שהוסעו על ידי שירותי אמבולנס נותרו לא ברורים. מחקר רטרוספקטיבי זה השווה את הביצועים של 21 ציוני EWS כדי לחזות הידרדרות קלינית באמצעות סימנים חיוניים (VS) שנמדדו במסגרת טרום-אשפוז או במחלקה דחופה (ED).

שיטות

חולים מבוגרים שהועברו למיון יחיד באמבולנסים ולאחר מכן אושפזו בבית החולים בין ה-1/1/19 ל-18/4/19 היו זכאים להכללה. התוצא העיקרי היה תמותה של 30 יום; התוצאים המשניים כללו תמותה של 3 ימים, אשפוז ביחידות לטיפול נמרץ או טיפול כלילי, משך האשפוז והפעלת שיחות חירום. יכולת ההבחנה של ציוני ה-EWS הוערכה באמצעות השטח מתחת לעקומת המאפיין ההפעלה של המקלט (AUROC). תת-אנליזות השוו את הביצועים של ציוני EWS בין סוגי מטופלים כירורגיים ורפואיים.

תוצאות

מתוך 1414 מטופלים, 995 (70.4%) [53.1% גברים, גיל ממוצע 17.5±68.7 שנים] נכללו. בהגדרת ED, תמותה של 30 יום נחזה בצורה הטובה ביותר על ידי VitalPAC (AUROC 0.71 95% CI (0.65-0.77) וציון National Early Warning Score(0.709 (0.65-0.77)). כל ציוני ה-EWS שחושבו במסגרת הקדם-אשפוזית היו עם AUROC>0.70. Rapid Emergency Medicine Score (0.83, (0.73-0.92)) ו-EWS של ניו זילנד (0.88 (0.81-0.95)) חזו בצורה הטובה ביותר תמותה של 3 ימים בהגדרות טרום-אשפוז ו-ED, בהתאמה. ציוני EWS שחושבו באמצעות טרום-אשפוז או ED VS היו יעילים יותר בניבוי תמותה של 3 ימים בחולים כירורגיים, בעוד שתמותה של 30 יום נחזתה בצורה הטובה ביותר בחולים רפואיים. בין ציוני ה-EWS שהשיגו AUROC≥0.70, לא זוהו הבדלים מובהקים סטטיסטית ביכולות ההפליה שלהם לזהות חולים בסיכון להידרדרות קלינית.

מסקנות

ציוני EWS מנבאים טוב יותר תמותה של 3 ימים לעומת 30 יום והם מדויקים יותר כאשר הם מוערכים באמצעות VS שנמדד ב-ED. הביצועים המפלים של ציוני EWS בזיהוי חולים בסיכון גבוה יותר להידרדרות קלינית עשויים להשתנות לפי סוג חולה.