



Strengths and limitations of early warning scores: A systematic review and narrative synthesis



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ABSTRACT

Background: Early warning scores are widely used to identify deteriorating patients. Whilst their ability to predict clinical outcomes has been extensively reviewed, there has been no attempt to summarise the overall strengths and limitations of these scores for patients, staff and systems. This review aims to address this gap in the literature to guide improvements for the optimization of patient safety.

Methods: A systematic review was conducted of MEDLINE[®], PubMed, CINAHL and The Cochrane Library in September 2016. The citations and reference lists of selected studies were reviewed for completeness. Studies were included if they evaluated vital signs monitoring in adult human subjects. Studies regarding the paediatric population were excluded, as were studies describing the development or validation of monitoring models. A narrative synthesis of qualitative, quantitative and mixed- methods studies was undertaken.

Findings: 232 studies met the inclusion criteria. Twelve themes were identified from synthesis of the data: Strengths of early warning scores included their prediction value, influence on clinical outcomes, cross-specialty application, international relevance, interaction with other variables, impact on communication and opportunity for automation. Limitations included their sensitivity, the need for practitioner engagement, the need for reaction to escalation and the need for clinical judgment, and the intermittent nature of recording.

Early warning scores are known to have good predictive value for patient deterioration and have been shown to improve patient outcomes across a variety of specialties and international settings. This is partly due to their facilitation of communication between healthcare workers.

There is evidence that the prediction value of generic early warning scores suffers in comparison to specialty-specific scores, and that their sensitivity can be improved by the addition of other variables. They are also prone to inaccurate recording and user error, which can be partly overcome by automation.

Conclusions: Early warning scores provide the right language and environment for the timely escalation of patient care. They are limited by their intermittent and user-dependent nature, which can be partially overcome by automation and new continuous monitoring technologies, although clinical judgment remains paramount.

What is already known about the topic?

- Early warning scores are widely used to identify deteriorating patients
- Early warning scores have strengths and limitations which influence their effectiveness

What this paper adds

- Early warning scores can be used across a range of specialties and international settings

- Early warning scores facilitate communication by providing a common language
- They are limited by their intermittent and user-dependent nature, which must be taken into account when interpreting them.

1. Introduction

The early warning score system is predicated on the idea that derangements in simple physiological observations can identify hospital inpatients at high risk of deterioration (Goldhill and McNarry, 2004). Prodromal warning signs such as increased respiratory rate or

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Table 1
Summary of relevant articles within each ‘Strength’ theme.

Theme (Strengths)	Publications identified within theme	Setting	Methodology	Participants	Early warning score	Outcome measure/s	Findings
Prediction value	Kovacs et al. (2016)	Hospital inpatients at a single NHS Trust	Real-time observational study	Medical and surgical admissions (n = 87 399)	NEWS via VitalPAC	Cardiac arrest, death and unanticipated ICU admission	High prediction rates for death and ICU admission; lower for cardiac arrest
	Churpek et al. (2012)	Hospital inpatients at a single centre	Nested case-control study	Ward patients who experienced cardiac arrest (n = 88) and matched controls (n = 352)	MEWS	Maximum MEWS, individual component vital signs and other predictors	By 48 h prior to cardiac arrest, the MEWS was higher in cases (P = 0.005) than controls
	Lee and Choi (2014)	General wards at a single centre	Retrospective observational study	General ward patients with severe sepsis or septic shock (n = 100)	MEWS	ICU transfer	MEWS is an effective predictor of ICU transfer with optimum cutoff value 6
	Reini et al. (2012)	A tertiary care general ICU in a single centre	Prospective observational study	Patients admitted to ICU (n = 518)	MEWS	Mortality, length of stay, readmission to ICU	MEWS = > 6 is an independent predictor of mortality and length of ICU stay, but not readmission.
	Alrawi et al. (2013)	Acute Medical Assessment Unit at a single centre	Real-time observational study	Acute medical admissions from nursing homes (n = 314)	MEWS	In-patient mortality at 7 days	Admission MEWS of 4–5 was associated with 12 times the odds of death; MEWS > 6 had 21 times the odds of death compared with those with a score of < 1.
	Armagan et al. (2008)	Emergency Department (ED) at a single centre	Prospective observational study	Patients presenting to the Emergency Department (n = 309)	MEWS	Death, hospital admission, intensive care unit (ICU) admission	Patients with MEWS > 4 were 35 times more likely to die in ED and 14 times more likely to die in hospital than those presenting with a low-risk score. Those with MEWS = > 5 were 1.95 times more likely to be admitted to ICU
	Stark et al. (2015)	Surgical wards at a single university hospital	Retrospective observational study	All surgical patients who experienced a “Code Blue” event (n = 85)	MEWS	Death	Maximum MEWS remained associated with death after multivariate analysis
	Cei et al. (2009)	64-bedded medical ward in a public, non-teaching Hospital	Prospective, single centre, cohort study	All patients consecutively admitted over a seven-month period (n = 1107)	MEWS	In-hospital mortality, a combined outcome of death and transfer to a higher level of care, length of stay	The risk of death was incremental among all the MEWS categories, as well as the risk of the combined outcome of death and transfer. The difference between length of stay was non-significant.
	Christensen et al. (2011)	Emergency Department (ED) at a single centre	Retrospective observational study	A random sample of emergency patients (n = 300)	Bispebjerg Early Warning Score (BEWS)	Admission to ICU and death within 48 h of arrival at the ED	A BEWS > 5 is associated with a significantly increased risk of ICU admission and death within 48 h of arrival.
	Peris et al. (2012)	Surgical unit at a single centre	Retrospective cohort study	Emergency surgical patients admitted before MEWS introduction (controls, n = 604) and after MEWS introduction (intervention group, n = 478)	MEWS before and after surgical procedure	Admission rates to ICU and HDU (Patients with a MEWS 3 or 4 were transferred to HDU, patients with MEWS > = 5 were admitted to ICU), mortality.	After MEWS introduction, HDU admissions significantly increased and ICU admissions significantly decreased. Mortality rate did not differ.

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