Annals of Medicine and Surgery 27 (2018) 17–21

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Pre-hospital National Early Warning Score (NEWS) is associated with in-hospital mortality and critical care unit admission: A cohort study

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ARTICLE INFO

Keywords:
Pre-hospital
Clinical research
Intensive care
Acute care emergency ambulance systems

ABSTRACT

Background: National Early Warning Score (NEWS) is increasingly used in UK hospitals. However, there is only limited evidence to support the use of pre-hospital early warning scores. We hypothesised that pre-hospital NEWS was associated with death or critical care escalation within the first 48 h of hospital stay.

Methods: Planned secondary analysis of a prospective cohort study at a single UK teaching hospital. Consecutive medical ward admissions over a 20-day period were included in the study. Data were collected from ambulance report forms, medical notes and electronic patient records. Pre-hospital NEWS was calculated retrospectively. The primary outcome was a composite of death or critical care unit escalation within 48 h of hospital admission. The secondary outcome was length of hospital stay.

Results: 189 patients were included in the analysis. The median pre-hospital NEWS was 3 (IQR 1–5). 13 patients (6.9%) died or were escalated to the critical care unit within 48 h of hospital admission. Pre-hospital NEWS was associated with death or critical care unit escalation (OR, 1.25; 95% CI, 1.04–1.51; $p = 0.02$), but NEWS on admission to hospital was more strongly associated with this outcome (OR, 1.52; 95% CI, 1.18–1.97, $p < 0.01$). Neither was associated with hospital length of stay.

Conclusion: Pre-hospital NEWS was associated with death or critical care unit escalation within 48 h of hospital admission. NEWS could be used by ambulance crews to assist in the early triage of patients requiring hospital treatment or rapid transport. Further cohort studies or trials in large samples are required before implementation.

1. Introduction

Early warning scores or rapid response systems are commonplace in UK hospitals [1]. They assign weighting to routine clinical measurements and are used to detect patients in need of clinical review or resuscitation [2]. The National Early Warning Score (NEWS), developed by the Royal College of Physicians, is designed to standardise and replace the multiple existing early warning previously used in UK hospitals (Table 1) [3]. NEWS is associated with clinical outcome, including hospital mortality and intensive care unit admission [4–8]. However, early warning scores are not widely used in the pre-hospital setting, reflecting the limited current evidence available to support their use.

Only two studies have evaluated pre-hospital early warning scores. A retrospective review of patients admitted to a single emergency department by ambulance found that modified early warning score (MEWS) – a similar scoring system that pre-dates NEWS - was more sensitive than clinician judgement for identifying critical illness in the community [9]. A prospective cohort study of patients with medical and trauma presentations admitted to a single hospital by ambulance found that NEWS was associated with intensive care unit admission and mortality [10]. However, it is unclear whether these results are generalisable to other populations with different demographics and case mixes. In addition, it is unclear whether a pre-hospital early warning score could be used by hospital staff for inpatient risk stratification. Therefore the importance of ambulance early warning scores to both ambulance crews and hospital physicians remains uncertain.

We hypothesise that NEWS derived from pre-hospital observations

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https://doi.org/10.1016/j.amsu.2018.01.006
Received 6 October 2017; Received in revised form 27 December 2017; Accepted 19 January 2018

Table 1
National early warning score calculation.

National Early Warning Score (NEWS)							
	3	2	1	0	1	2	3
Temperature (°C)	< 35.0		35.1–36.0	36.1–38.0	38.1–39.0	> 39.0	
Heart rate (beats/min)	< 41		41–50	51–90	91–110	111–130	> 130
Systolic BP (mmHg)	< 91	91–100	101–110	111–219			> 219
Respiratory Rate (breaths/min)	< 9		9–11	12–20		21–24	> 25
Oxygen Saturation (%)	< 92	92–93	94–95	> 96			
Supplemental oxygen		Yes		No			
CNS response (AVPU)				A			V, P, U

Each category is graded 0–3. Scores for each category are added together to give a total. Composite scores of greater than 5 (or 3 in any one parameter) trigger an urgent medical review. A score of over 7 triggers a review by a critical care outreach team or medical response team [3,4,11].

is associated with critical care unit escalation or death within 48 h of hospital admission. We further hypothesise that NEWS derived from pre-hospital observations is more strongly associated with the outcome measure than NEWS on admission to hospital.

2. Method

2.1. Study design

This was a planned secondary analysis of data from an observational cohort study of adult patients admitted to a single hospital with acute medical presentations [4,11]. The methods and results of the main study have been published previously [4,11]. All new adult medical admissions to the Acute Assessment Unit (AAU) at the Royal London Hospital between 25th March and 13th April 2013 that were brought to hospital by ambulance were included in this analysis. Patients admitted directly to the critical care unit from the emergency department were not included. The National Research Ethics Service prospectively reviewed and approved this study (12/LO/1985). The study was registered retrospectively with Research Registry (UIN: researchregistry3194). We report the results of this analysis in accordance with the SRTOBE/STROCCS reporting statements [12,13].

2.2. Data collection

The exposures of interest were NEWS calculated from physiological observations obtained by ambulance staff before hospital admission, and NEWS derived from similar observations on admission to hospital. Researchers prospectively collected physiological measurements that were recorded by nurses or healthcare assistants at the point of admission to the Acute Assessment Unit. Researchers retrospectively reviewed ambulance service patient report forms for these patients and recorded the first set of observations measured by the ambulance crew. Data were considered missing if there were no observations recorded on the ambulance patient report form or if there were no observations recorded on the bedside observation chart within 24 h of admission to hospital. Researchers recorded data on paper data collection forms and transferred this to an electronic database. The database was independently checked for accuracy. The outcome measures were determined by checking patient notes, electronic patient records and discharge summaries. We calculated NEWS retrospectively using Microsoft Excel (Microsoft Inc., Redmond WA) [4,11].

2.3. Outcome measures

The primary outcome measure was a composite of critical care unit escalation and death within 48 h of admission to hospital [4,11]. At this centre, critical care consists of level three care (renal replacement therapy, advanced respiratory support or multi-organ support) and level two care ('step down' from a higher level of care, single organ support, high frequency nursing care or invasive monitoring). This primary outcome definition has been used in previous studies and will identify all instances of in-hospital cardiac arrest at our institution [4–6,11,14]. The secondary outcome measure was length of hospital stay [4,11].

2.4. Statistical analysis

Data were analysed using SPSS version 21 (IBM, Armonk, NY). Data were stratified according to the presence or absence of ambulance data. Missing data were handled by list-wise deletion. In order to test for association between NEWS and the primary outcome measure, multivariable logistic regression models were constructed and adjusted for age and gender - a strategy consistent with previous similar research [5,6]. NEWS was firstly considered as a continuous variable. Odds ratios derived from pre-hospital observations (pre-hospital NEWS) and for admission observations (admission NEWS) were calculated and compared. Secondly, NEWS was considered as a categorical variable, with the sample divided according to the recommended risk groups (NEWS 1–4, 5–6, > 7) and the analysis repeated [15]. Thirdly, the correlation between pre-hospital NEWS and admission NEWS was assessed using the Pearson product-moment correlation coefficient. Finally, to test for association between NEWS and the secondary outcome measure (length of hospital stay), a linear regression model was constructed, where length of stay was considered a continuous variable. The r^2 values for pre-hospital NEWS with admission NEWS were compared.

3. Results

453 adult medical patients were admitted during the study period, of which 258 were brought to hospital by ambulance. After excluding cases with missing data, 189 cases were included in the primary analysis and 180 were included in the secondary analysis (Fig. 1). The mean age of the entire cohort was 61 (sd. 22) years, compared to 67 (sd. 21) years for patients admitted by ambulance. There was no difference in the gender distribution for patients admitted by ambulance, compared to entire cohort. 13 patients (6.9%) admitted by ambulance died or were escalated to the critical care unit within 48 h. The median length of stay for patients admitted by ambulance was 4 (IQR 2–8) days. Baseline characteristics are provided in Table 2.

Multivariable logistic regression analysis was used to test for the association between NEWS and the primary outcome measure. When considered as a continuous variable, pre-hospital NEWS and admission NEWS were both associated with the primary outcome measure (OR, 1.25; 95% CI, 1.04–1.51; p = 0.02 and OR, 1.52; 95% CI, 1.18–1.97, p < 0.01 respectively) (Table 3). When considered as a categorical variable, pre-hospital NEWS and admission NEWS were both associated with the primary outcome measure (Table 4).

We identified a moderate correlation between pre-hospital NEWS and admission NEWS (r = 0.44, p < 0.01). Pre-hospital NEWS differed