

Physiological Scoring: An Aid to Emergency Medical Services Transport Decisions?

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Abbreviations:

AMPDS = Advanced Medical Priority Dispatch System
AUROC = Area Under the Receiver Operating Characteristic Curve
EMS = emergency medical services
NHS = National Health Service
PMEWS = physiological-social score
PRF = Patient Report Forms

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Abstract

Introduction: Attendance at UK emergency departments is rising steadily despite the proliferation of alternative unscheduled care providers. Evidence is mixed on the willingness of emergency medical services (EMS) providers to decline to transport patients and the safety of incorporating such an option into EMS provision. Physiologically based Early Warning Scores are in use in many hospitals and emergency departments, but not yet have been proven to be of benefit in the prehospital arena.

Hypothesis: The use of a physiological-social scoring system could safely identify patients calling EMS who might be diverted from the emergency department to an alternative, unscheduled, care provider.

Methods: This was a retrospective, cohort study of patients with a presenting complaint of "shortness of breath" or "difficulty breathing" transported to the emergency department by EMS. Retrospective calculation of a physiological-social score (PMEWS) based on first recorded data from EMS records was performed. Outcome measures of hospital admission and need for physiologically stabilizing treatment in the emergency department also were performed.

Results: A total of 215 records were analyzed. One hundred thirty-nine (65%) patients were admitted from the emergency department or received physiologically stabilizing treatment in the emergency department. Area Under the Receiver Operating Characteristic Curve (AUROC) for hospital admission was 0.697 and for admission or physiologically stabilizing treatment was 0.710. No patient scoring <2 was admitted or received stabilizing treatment.

Conclusions: Despite significant over-triage, this system could have diverted 79 patients safely from the emergency department to alternative, unscheduled, care providers.

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Introduction

During the past 10 years, the number of people attending hospital emergency departments in the United Kingdom has increased by almost two million, or >16%.¹ New ways of working to improve access to healthcare and reduce the demand on emergency departments include the introduction of National Health Service (NHS) Direct (providing telephone assessment and advice), NHS walk-in centers, nurse-led minor injury units, and expansion of the commercial pharmacist's role, with the aim of patients only attending emergency departments when clearly indicated.²

A preliminary study in London and the West Midlands for "non-serious" emergency ambulance calls identified through a Computer Aided Dispatch system demonstrated that the vast majority could be managed safely without sending an ambulance.³ However, dispatch categorization (using Advanced Medical Priority Dispatch System (AMPDS)) in Yorkshire was not helpful in predicting the eventual disposition of emergency medical services (EMS) patients.⁴ Recent qualitative research among UK paramedics demonstrated a level of support for "treat and leave" or "treat and refer" policies provided a robust risk management structure to support these decisions exists.⁵ However, these policies

Date: _____

Time: _____

Pandemic Flu Symptoms:

As set by WHO e.g. (tick) Fever > 38°C Sore Throat

Cough Myalgia

SOB Watery Diarrhoea

P-MEWS

Admission Algorithm

Patient ID label or:

Name: _____

Age/dob: _____

Address: _____

GP: _____

Practice: _____

PLUS

Physiological Data (MEWS)

Ring 1 value for each factor

SCORE	3	2	1	0	1	2	3
Resp Rate	≤ 8			9-18	19-25	26-29	≥ 30
O2 Sat	< 90	90-93	94-96	> 96			
Heart Rate	≤ 40	41-50	51-100	101-110	111-129	≥ 130	
Systolic BP	≤ 70	71-90	91-100	> 100			
Temp		≤ 35.0	35.1-36	36.1-37.9	38-38.9	≥ 39	
Neuro			Alert	Confused	Agitated	Voice	Pain Uncon

Total P-MeWS = _____

Boxes completed by local health economy to determine admission criteria

Admission advised if:

- Mews ≥ □ and Patient ≥ □

OR

- Mews ≥ □

Patient Data

Score 1 for each factor

Age > 65 ...

Social Isolation ... OR ...
Lives alone/No fixed abode

Chronic Disease ... OR ...
Respiratory, cardiac, renal, immunosuppressed, DM

Performance Status > 2 ...
Normal activity without restriction 1
Strenuous activity limited, can do light 2
Limited activity but capable of self care 3
Limited activity, limited self care 4
Confined to bed/chair, no self care 5

Name of assessor: _____

Grade: _____

Signature: _____

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Figure 1—PMEWS score (derived from Subbe *et al*)

currently are not available to EMS personnel, and it has been suggested that a significant proportion of patients not transported to the hospital following EMS advice are coded inaccurately as “refused to travel”.⁶

Physiologically based triage systems and Early Warning Scores recently have been demonstrated to be valuable for use in the emergency department.⁷ However, no physiological scoring system is available to prehospital EMS personnel to support the decision to not transport a patient. Therefore, the aim of this study was to analyze whether a similar physiological-social system would support prehospital decision-making.

Methods

The hospital in this study is an 855-bed, tertiary referral center that also provides secondary care services to a mixed urban and suburban population of approximately 350,000. Approximately 82,000 patients present to the emergency department per year. The emergency department receives EMS transports via the North West Ambulance Service. Emergency medical service vehicles are crewed by a paramedic-technician pairing or a twin technician team.

Patients eligible for inclusion were those with a presenting complaint of shortness of breath or difficulty in breathing who were transported by ambulance to the emergency department from 12 July to 11 September 2006. These patients were identified retrospectively from the emergency department triage system, with manual searching of ambulance Patient Report Forms (PRFs) when the triage used was unclear. The ambulance service computer system, in place at that time, made searching of ambulance service records by AMPDS dispatch system category unavailable. Emergency department treatment, admission, and discharge were at the discretion of the treating clinician.

Patient Report Forms were analyzed and data on age, ventilatory rate, oxygen saturation, heart rate, systolic blood

pressure, and AVPU status (level of consciousness: alert, verbal, pain, or unresponsive⁸) were extracted. Temperature was extracted if recorded on the PRF (Mersey Regional area) but for the Greater Manchester area (that did not record prehospital temperature), the first temperature recording made in the emergency department was taken as a proxy. Data on social isolation (living alone or having no fixed abode), chronic disease, and performance status were identified from the emergency department notes. These factors were combined to produce a modified early warning score (Figure 1) derived from Subbe *et al*.⁹ Where one or two variables were missing, these were assumed to be normal. Where three or more variables were missing, the patient was excluded from analysis.

It was recognized that some patients eventually discharged from the emergency department might have received physiologically stabilizing interventions that allowed for their discharge. Therefore, secondary analysis according to treatments administered in the emergency department was performed. For the purposes of this analysis, patients were considered to require emergency department attendance if they were admitted from the emergency department or if they required any intravenous treatment. Oral treatment and nebulizers routinely are provided by the EMS and primary care personnel and therefore, could be managed in the community.

Ethical approval was waived by the Local Research Ethics Committee given that no additional patient contact was required. Data were held and processed using SPSS v10.5 (SPSS Inc., Chicago, IL).

Results

A total of 3,157 adult patients presented to the emergency department by ambulance during the two-month study period (Figure 2). Of these, 242 had an EMS presenting complaint of shortness of breath, difficulty breathing, or asthma. The non-included patients represented the spec-

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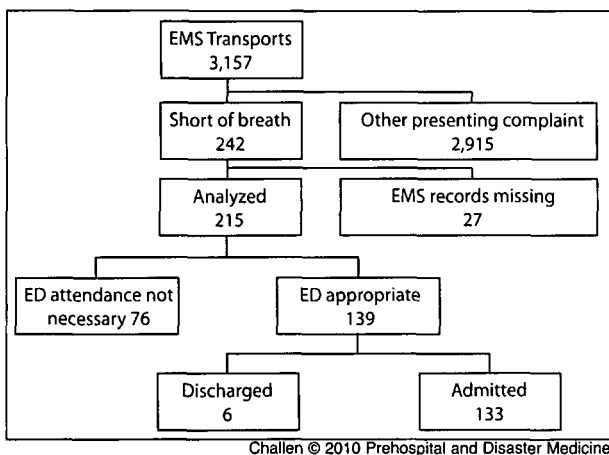


Figure 2—Cohort diagram

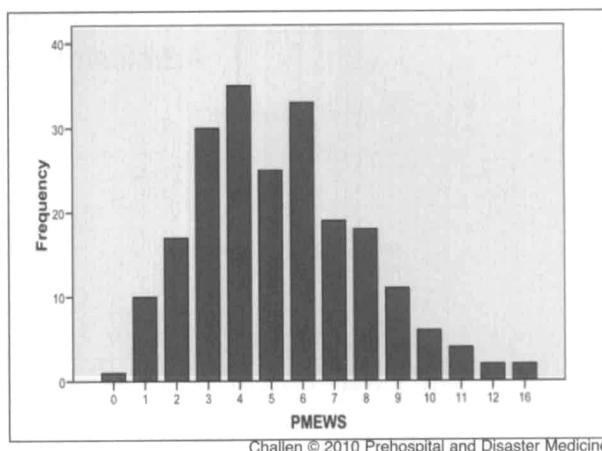


Figure 3—Distribution of calculated PMEWS scores

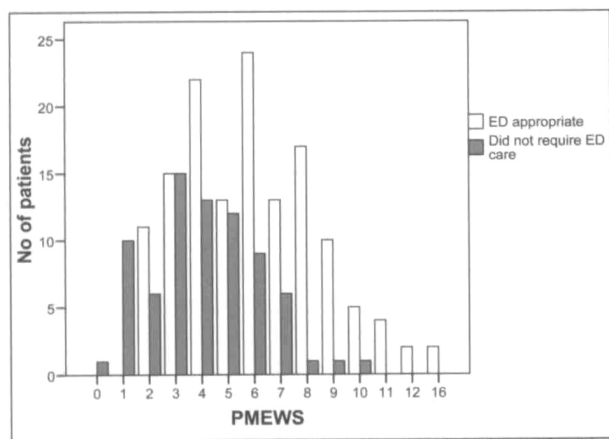


Figure 4—Prehospital PMEWS scores in relation to final disposal

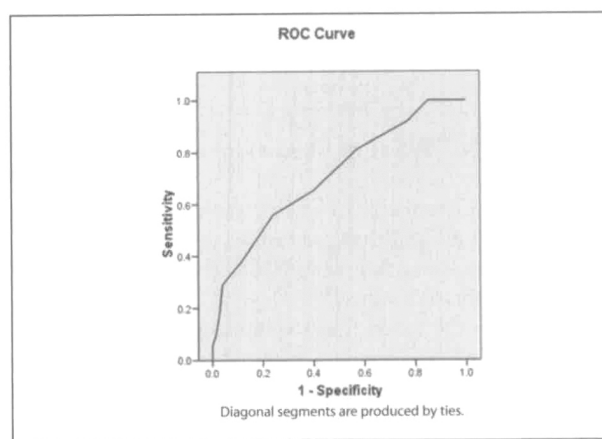


Figure 5—ROC curve for PMEWS as predictor of need for emergency department care

trum of EMS presenting complaints, including chest pain, abdominal pain, and/or trauma. Twenty-seven PRFs (11%) were missing. Of these, five outcomes were missing. For all other patients, enough data were recorded to complete the score.

One hundred thirty-three (61.9%) patients were admitted to the hospital, and one was admitted for psychiatric care. Four patients discharged themselves before an admission decision could be made. The distribution of calculated scores is shown in Figure 3. No patient with a score >2 was admitted. The area under AUROC curve using the score as a discriminator for admission was 0.697 (95% CI = 0.627–0.768).

In terms of appropriateness of attendance, 139 (64.7%) patients were considered to require care in the emergency department. None of these had a score <2. Relative PMEWS scores for patients requiring and not requiring emergency department care are shown in Figure 4. The area under AUROC curve using the score as a discriminator for requiring emergency department care was 0.710 (95% CI = 0.639–0.78; Figure 5). Using PMEWS <2 as a cutoff yielded sensitivity 100%, specificity 15%, positive predictive value 68% and negative predictive value of 100% for requirement for emergency department care. Of the 22 patients where the PRF was missing and outcomes were known, four did not require emergency department care ($\chi^2 = 2.63, p = 0.105$ for difference from the included population).

Discussion
 Implementation of any system including a “refusal” to transport patients who consider themselves to be in need of acute care always will require an effective risk-management strategy and robust decision-support tools. So far, these have been lacking in a pragmatic, useable form. At a preliminary level, it has been demonstrated that a system of physiological scoring could support EMS decision-making in terms of identifying those physiologically stable patients who could be directed safely to alternative sources of unscheduled care. Although there should be a level of over-triage in any system that requires the elimination of under-triage, even using these restrictive criteria, 76 patients could have been diverted to other healthcare providers safely and not transferred to the emergency department.

This study represents a small group of patients with a particular presenting complaint, but it demonstrates the potential of physiological scoring for identification of the low-risk patient. This research opens the door for future study.

Conclusions
 It is feasible that a scoring system can be developed to incorporate physiological and social variables in order to provide support and governance to EMS “alternatives to transport” decision-making.

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Editorial Comments—Physiological Scoring: An Aid to Emergency Medical Services Transport Decisions?

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Widespread emergency department overcrowding has been a simmering crisis for more than 20 years. Changing demographics, urbanization, access issues, and other trends have driven emergency department utilization to the point that policy-makers in Ireland recently termed overcrowding a “national crisis.”

Many studies have pointed to non-urgent or non-emergent patient visits as a major factor contributing to emergency department overcrowding, which, in turn, is blamed for a variety of problems from prolonged pain and suffering for patients, to staff, family, and patient dissatisfaction.

One potential response to excess emergency department utilization is redirection. Patients intending to attend the emergency department are redirected (or *diverted* or *reoriented*) to another avenue for obtaining urgent, unscheduled care. Redirection is felt to be fraught with problems. Many emergency departments have addressed liability and patient acceptance concerns by offering same-site “urgent care”, “fast track”, or similar services, often staffed by physician extenders. Patients are triaged, then sent to urgent care if they meet established criteria. This set-up offers comfort to patients and providers in knowing they are close to the emergency department in the event of under-triage.

Redirection of patients who have not had contact with a formal, hospital-based triage system is less certain. No published studies have demonstrated safe, effective methods to triage emergency medical services (EMS) patients to non-emergency department, unscheduled care sites with “turn down” of transport.

Challen and Walter have put before themselves a daunting task, described in “Physiologic Scoring: An Aid to EMS Transport Decisions?” in this issue of *Prehospital and Disaster Medicine*. By adapting the Pandemic Medical Early Warning Score (PMEWS), a physiologic scoring system that also incorporates patient and social factors with prehospital use, they sought to identify patients who might safely either be transported to a non-emergency department alternative by EMS or redirected there. The PMEWS, as the name implies, has been suggested as a triage tool for resource allocation during pandemic influenza. This represents a novel application of this in two ways: (1) it is the first attempt to utilize the score in the prehospital settings; and (2) it is one of the first used for patients with a medical complaint (dyspnea in this case).

Others have shown that prehospital vital signs are useful for identifying patients who need emergent interventions; most of these studies involve trauma patients. The Cape Triage Score is another proposed tool that prehospital providers could use in the triage of undifferentiated patients, thereby unburdening EMS systems.

Challen and Walter point out that their approach seeks to standardize behaviors already occurring with surreptitious application of patient redirection (outside of protocols) by EMS providers who code such “treat and refer” encounters as patient-initiated refusal of transport.

An interesting methodological twist in this study, arises from the term *treat and refer*, treatments routinely rendered by EMS or primary care providers were not considered indicative of requiring an emergency department visit. Presumably, this could mean that patients experiencing an asthma attack with significant improvement or resolution of symptoms after a single

nebulized bronchodilator, by protocol, would be left at scene or referred, rather than transported to the emergency department. Such protocols would demand low rates of under-triage and would rely on application by well-trained personnel.

The authors used a score that contains both physiologic and patient data that are easily collected, including routine vitals signs already familiar to EMS providers. It also incorporated some of the less tangible items (like social isolation, adomicilia, chronic illness, and functional status) in making disposition decisions; physicians already frequently utilize these data in making these decisions. Thus, there would be little need for extensive training or prolonged assessment at the scene.

This retrospective study shows promising, albeit preliminary, results: 31% of patients transported by EMS were felt on review of emergency department records, not to have had an emergent indication for emergency department use. Clearly, this level of reduction could have a salutary effect on emergency department overcrowding if extended across a large population.

As promising as the results may be, further work is needed before this tool can see widespread implementation. For starters, the tool must be validated prospectively, with close follow up of patients not transported to the emergency department to ensure they were, in fact, appropriately directed to other care sources.

The integration of this tool within a coordinated emergency care system could prove to be more difficult. A single, non-disease-specific, physiological-social score (for more chief complaints, age ranges, etc.) will have wider utility than a collection of specific tools, but is likely to be dif-

ficult to design and implement within an acceptable level of under-triage. Newer technologies, such as point-of-care laboratory testing, might find an application in this scenario in hopes of offering rapid, objective assessments of physiologic status.

Patients have shown acceptance of redirection in some studies, but only if they can be redirected to sources of care that provide the desired services during convenient hours. Paradoxically, patients with insurance have been shown to forego using primary care services in some cases, leading to higher rates of non-emergent emergency department visits. Other socio-economic issues also affect emergency department use and will impact on the effectiveness of systems like the one in the current study.

We also need to await the demonstrated effectiveness of these measures in improving emergency department crowding, length of stay, and other outcomes. Unfortunately, previous studies have not proven the benefits of redirection of patients to non-urgent sources of care. Like so much of medicine, what seems "physiologically plausible" is not always efficacious when applied to a dynamic system.

Studies like the current research by Challen and Walter are necessary, but not sufficient as we attempt to solve the complex issue of emergency department overcrowding. The authors deserve credit for attempting to move the triage desk (as found in most emergency departments) to the scene of first encounter for many patients: the prehospital EMS service. Development of a tool such as the PMEWS to redirect select patients away from crowded emergency departments (and EMS services) offers a potential avenue of mitigating some of the deleterious effects of rising emergency department utilization.