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## Are scoring systems sufficient for predicting mortality due to sepsis in the emergency department?

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### ABSTRACT

**Objectives:** Scoring systems have been used to risk stratify in intensive care units (ICU), but not routinely used in emergency departments. The aim of this study was to determine accuracy for predicting mortality in emergency medicine with Sequential Organ Failure Assessment (SOFA), Mortality in ED Sepsis (MEDS) score and Simplified Acute Physiology Score (SAPSII).

**Methods:** This is a prospective observational study. Patients presenting with evidence of sepsis were all included. SAPSII, MEDS, and SOFA scores were calculated. Analysis compared areas under the receiver operator characteristic (ROC) curves for 28-day mortality.

**Results:** Two hundred patients were included; consisting of 31 (14.3%) septic shock. 138 (69%) severe sepsis and 31 (15.5%) infection without organ dysfunction. 53 (26.5%) patients died within 28 days.

Area under the ROC curve for mortality was 0.76 for MEDS (0.69–0.82), 0.70 for SAPSII (0.62–0.78); and 1.68 for SOFA (0.60–0.76) scores. Pair wise comparison of AUC between MEDS, SAPSII, SOFA and Lactate were not significant.

**Conclusion:** According to our results; SOFA, SAPSII and MEDS were not sufficient to predict mortality. Also this result, MEDS was better than other scoring system.

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### 1. Introduction

Sepsis is a common global health issue due to the increasing elderly population, which results in escalated healthcare costs and mortality.<sup>1</sup> According to the consensus guidelines, septic patients must be characterized by the severity of organ dysfunction and/or septic shock. Early Goal-Directed Therapy is required in the first 6 h; these golden hours often occur in the emergency department (ED).<sup>2</sup> Previous studies found that septic patients were managed in ED for 4.9–6 h, so it is important to understand, recognize, and manage sepsis in the ED.<sup>3,4</sup>

Although septic patients are clinically established by the severity of organ dysfunction and/or septic shock, the admission criteria for inclusion in Intensive Care Unit (ICU) or non-critical hospital beds were not determined. Scoring systems have been

used for critically ill patients in the ICU, but these are difficult to use in emergency medicine due to the abundance of data.

The Mortality in ED Sepsis (MEDS) score was developed for septic patients who were admitted to emergency medicine departments and predicts mortality within 28 days. MEDS was organized according to the recommended PIRO (Predisposition Infection Response Organ Dysfunction) classification approach by 9 characterized risks, according to Predisposition, Infection, Response, or Organ Dysfunction. Predisposition risk includes age over 65, nursing home residency, and rapidly terminal illness. Infection risk includes lower respiratory infection. Response risks are bands >5%, whereas Organ Dysfunction includes tachypnea, hypoxemia, septic shock, platelet counts <150,000, and altered mental status. MEDS contains “Rapidly terminal illness,” which refers to a 50% mortality within 30 days; however, it is difficult to predict mortality with patient’s illness because both sepsis and the other disease(s) can lead to mortality. Therefore, this variable was confusing and was not explained further.<sup>5,6</sup> The Sequential Organ Failure Assessment (SOFA) aims to define organ dysfunction in critically ill patients and describes scores with 6 organ functions; a

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normal score is 1 and scores can change 1–4.<sup>7</sup> The SOFA accounts for organ dysfunction without patient's age, chronic disease status, and vital signs, so the SOFA may not have enough accuracy to predict mortality.<sup>8</sup> Giannazzo et al. found that SOFA correlated with poor prognosis at 24 h after admission but not at 28 days.<sup>9</sup>

The Simplified Acute Physiology Score (SAPSII) is improved according to the SAPS model and includes 17 types of data about major organ systems and physiological data, age, admission type to ICU (scheduled/unscheduled surgery/medical), and chronic disease (metastatic/hematological malignancy). Each criterion is defined by a different point.<sup>10</sup> Previous studies found that SAPSII is better than SAPS for predicting mortality but Acute Physiology and Chronic Health Evaluation (APACHE) scores are better than SAPSII scores. SAPSII is quite comprehensive and useful in the ICU but often requires information that is not readily available to an ED.<sup>11</sup>

High levels of lactate are correlated with shock, low perfusion, and poor prognosis. Previous studies in emergency medicine declared that venous lactate level can predict mortality in 3 days; lactate levels greater than 4 mmol signified high-level critical illness. In an ED, lactate has an important value for the recognition and management of sepsis.<sup>12</sup>

In this study we aimed to compare scoring systems (SOFA, SAPSII, MEDS) for predicting mortality due to sepsis at emergency medicine department. MEDS is an emergency scoring system, so we group MEDS score and add lactate to form a new model for predict mortality.

## 2. Materials and methods

### 2.1. Study setting and population

This was a prospective, observational study at an urban, tertiary care, University Hospital and the study enrollment period was March 1st, 2014 through August 1st, 2014. The hospital's human research ethics committees approved the study.

### 2.2. Definitions<sup>4,5,18</sup>

Adult patients (aged 18 years or more) who had at least two systemic inflammatory response features, heart rate > 90 beats/min, respiratory rate > 20 breaths/min, temperature >38 °C or <36 °C, total white cell count >12 10<sup>9</sup>/ $<4$  10<sup>9</sup>/L, and clinical infection were defined as suffering from sepsis. Infection source was categorized as respiratory tract, urinary tract and respiratory tract, urinary tract, intra-abdominal and soft tissue infections.

We further classified enrolled sepsis patients according to standard consensus definitions. Uncomplicated sepsis was defined as sepsis with no requirement for organ support. Severe sepsis was defined as associated organ dysfunction in the absence of shock. Septic shock was defined as associated hypotension (systolic blood pressure [sBP] < 90 mm Hg despite  $\geq$  1000 mL isotonic crystalloid bolus) and/or hypoperfusion (serum lactate  $\geq$  4 mmol/L).

MEDS score is developed for septic patients at emergency medicine and predicts mortality within 28 days, so we grouped MEDS as original described: group 1; low risk (0–7 point), group 2; moderate risk (8–12 point), group 3; high risk (13–15 point) and group 4; very high risk (>15 point).<sup>5</sup>

### 2.3. Inclusion into the study

Patients who had at least two systemic inflammatory response features and clinical infection were defined as suffering from sepsis and enrolled in the study by emergency physicians not only by researchers, in real time, prospectively, at the ED. According to sepsis' consensus definition, patients were defined as

uncomplicated sepsis, severe sepsis, or septic shock. Patients' demographic information, including history, physical exam, vital sign information, and scoring system variables, was recorded by investigators using a structured data collection instrument in real time at the ED. Blood pressure, heart rate, respiratory rate, oxygen saturation was monitored and blood cell count, liver and renal function tests, electrolytes, coagulation (aPT, PTT), artery or venous blood gases, lactate was performed to all patients when initial diagnosis. First the patients were treated in emergency room and according to patient situation, admitted to ICU or non-critical hospital beds and the remain of the treatment was continued in there (see Fig. 1)

### 2.4. Exclusion of the study

Patients with a non-sepsis diagnosis (e.g., pulmonary embolism, trauma) and those who did not have at least two systemic inflammatory response features or were pregnant were excluded from the study.

### 2.5. Data analysis

The Chi-squared test was used for categorical data and each of the three scoring systems' descriptive values (mean, median). MEDS, SOFA, and SAPSII scores and lactate levels were compared by the method of area under the receiver operator characteristic (ROC) curves (AUC). Pairwise comparison of the groups and comparison of the AUCs were performed. MEDS is grouped as original to compare the groups' mortality ratio and the mortality distributions of the MEDS subgroups were performed using the Chi-squared test. MEDS components and lactate added to logistic regression analysis for compose a new model and compared with mortality. Statistical analyses were performed using Medcalc 13.

## 3. Results

The number of the patients who were admitted to emergency room with two criteria of SIRS were 485 and 182 of them did not want to include to the study. The number of the patients who were excluded from the study were 103. 200 patients were enrolled the study and 55% were male. The mean age was 77 (21–100).

### 3.1. Mortality

Two hundred patients were enrolled and 53 patients (26%) died.

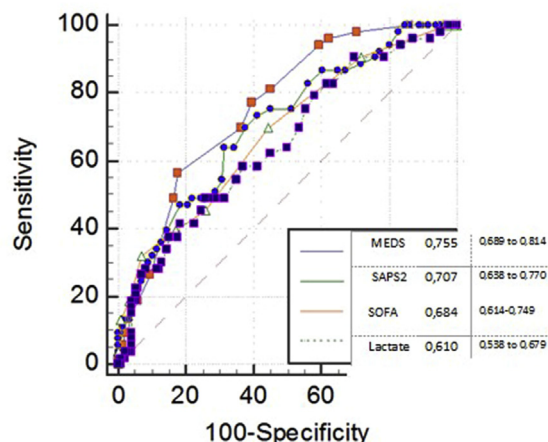


Fig. 1. ROC curves for MEDS, SAPSII, SOFA and Lactate with 28 day mortality.

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