



## Scoring systems in predicting mortality rate of patients applying emergency department

Tahtacı Rezan<sup>1</sup>, Arslan Engin Deniz<sup>2</sup>, Kavalci Cemil<sup>3</sup>

<sup>1</sup>Izmir Katip Çelebi University Atatürk Research and Training Hospital Emergency Department, Izmir, Turkey

<sup>2</sup>Saglik Bilimleri University Diskapi Research and Training Hospital Emergency Department, Ankara, Turkey

<sup>3</sup>Ankara Baskent University Hospital Emergency Department, Ankara, Turkey

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### ABSTRACT

**Objective:** To compare the scoring systems used in intensive care units in terms of predicting the mortality in emergency patients and to determine the most appropriate scoring system for urgent care. **Methods:** This study was carried out by retrospectively reviewing the files of patients admitted to Ankara Numune Training and Research Hospital emergency medicine clinic between October 1, 2010 and October 31, 2010 for non-traumatic reasons and admitted to any service of the hospital. This study calculated automatically with the data obtained from the patients files and records, and Acute Physiology and Chronic Health Evaluation (APACHE II), Simplified Acute Physiology Score (SAPS II), Modified Early Warning Score (MEW) and Sequential Organ Failure Assessment (SOFA) scores via internet. Patient files were reviewed and their outcomes (hospitalization, discharge, referral and mortality) were recorded. The obtained data were entered in SPSS 18 and compared with the scores of APACHE II, SAPS II, MEW and SOFA. **Results:** Based on area under the curve analysis, APACHE II (0.799; 95% CI: 0.746 to 0.845) showed the biggest area under the curve in terms of predicting the patients mortality. However, there was no difference between four scoring system in terms of predicting the mortality. Age ( $P < 0.001$ , odd's ratio 1.055) pulse ( $P < 0.007$ , odd's ratio 1.025) and  $SO_2$  ( $P < 0.003$ , odd's ratio 0.952) variables were found to be independent risk factors for mortality. **Conclusions:** Scores such as APACHE II, SAPS II, and SOFA, can not be used to make an urgent decision on the first encounter with the patient even though they are successful in predicting mortality. In this case, MEW could be recommended as the most useful system. As a result, the use of scoring systems in emergency departments is useful and necessary. But, multi-centered and large patient group studies are needed.

## 1. Introduction

In Turkey the emergency departments give free care, open 7 days and 24 hours and are easy to reach by anybody who thinks

his or her situation should be evaluated by a doctor, even if it is not urgent. This situation causes increase in the number of the patients at emergency departments[1]. This increase causes the

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<sup>✉</sup>First and corresponding author: Tahtacı Rezan, Izmir Katip Çelebi University Atatürk Research and Training Hospital Emergency Department, izmir/TURKEY  
Tel: +905052681673  
E-mail: [rezantahtaci@hotmail.com](mailto:rezantahtaci@hotmail.com)

need of determining priority at the time of applying the emergency departments. For this reason, triage systems have been developed and the patients who apply the emergency department are admitted accordingly to urgency of their situation from the red, yellow and green areas[2-4]. Apart from this, because the intensive care units and the beds in this service are full almost everytime, emergency departments also become the centers where the patients are treated and followed-up[2,5,6]. Therefore, risk identification systems are needed for determining the severity of the disease and mortality early, and also for beginning the treatment and the attempts toward this quickly[1,5-9].

Acute Physiology and Chronic Health Evaluation (APACHE II) score is a simplified modification of the original APACHE which is created by Knaus and his friends at 1985 by reducing the number of physiologic variants from 34 to 12. The aim of the APACHE is to classify the patients according to their clinical severity. The calculations are made by using the worst values of the biochemical analysis which are obtained by the blood samples taken from patients applying to the hospital in the first 24 hours[1,10-12].

Simplified Acute Physiology Score (SAPS II) based on SAPS which was first described at 1984, was developed by using the APACHE II system to examine the effect of 34 parameters to mortality. In 1993 SAPS II was developed. Systolic blood pressure, heart rate, body temperature, urine output, serum urea and creatinine level, blood potassium level, blood bicarbonate level, blood bilirubin level are measured and glaskow coma scale score is added to all of these. In addition to all of these, type of patient's admission to hospital and presence of a chronic disease are graded and the SAPS II score is found[10,12-14].

Modified Early Warning Score (MEW) is a system which can be calculated by the vital signs and enable bedside diagnosis. The MEW is calculated by measuring 5 parameters that can be evaluated at the bedside[2,3,12,15]. It is used to evaluate the critical patient and mortality risk in a crowded emergency. Studies on the cases which are resulted with death and show scores of 5 and above, makes sense[2,3,10,12,15,16].

Sequential Organ Failure Assessment (SOFA) was created in 1994 at the European Society of Critical Care Medicine meeting with the intention of defining one by one and multiple organ failure as a result of the co-operation of emergency medical and intensive care communities[1,9,10,17,18]. After that, SOFA was modified and the QSOFA was developed. But the studies carried out show that SOFA is more effective in terms of determining the organ failure[19-23]. SOFA is an easy-calculated system due to its solely dependency on the vital signs and the data which can be reached in the laboratory. It does not require the definitive diagnosis of the acute disease[1,24,25].

The aim of this study is to search the most appropriate scoring system for determining the mortality among the patients who are hospitalized from emergency department to hospital.

## 2. Materials and methods

This study was carried out by retrospectively reviewing the files of patients admitted to ANH emergency medicine clinic between October 1, 2010 and October 31, 2010 for non-traumatic reasons and admitted to any service of the hospital. This study calculated automatically with the data, obtained from the patients files and records and APACHE II, SAPS II, SOFA and MEW scores on the web-site named Société Française d'Anesthésie et de Réanimation ([www.sfar.org](http://www.sfar.org))[10] via internet. Patients files were reviewed and their outcomes(hospitalization, patients' discharge, referral and mortality) were recorded. The obtained data were entered into SPSS 18 and APACHE II, SAPS II, SOFA, MEW scores were compared with each other in terms of predicting mortality. Receiver Operating Characteristic analyzes were used to determine and compare the performances of the Fisher's exact test, Pearson Chi-square test, Mann Whitney *U* test scoring systems. Sensitivity, selectivity, negative predictive value, positive predictive value, Area Under Curve value were calculated according to these analyzes. Values of *P*, which were less than 0.05, was considered as significant.

## 3. Results

Between October 1, 2010 and October 31, 2010, a total of 12 225 patients applied to the hospital emergency department. A total of 104 patients were hospitalized to intensive care units, 773 patients were hospitalized to emergency department observation unit and 568 patients were hospitalized to various services. Namely the 1 445 patients of 12 225 patients were hospitalized. Among hospitalized patients, patients who applied the hospital due to traumatic reasons were excluded. Other patients' files and laboratory data were analysed from the hospital's data processing system and 269 patients (144 woman, 53.5%; 125 man, 46.5%) whose data were appropriate for the study were included. The mean age was (61.75 ± 18.95) years old. The vital signs and rate of comorbid conditions of the patients were shown in Table 1&2. The rates of hospitalization, discharge, referral and mortality of patients were shown in Table 3. These values were used to calculate the scores and to compare the performance of four scoring systems in terms of predicting the mortality. Based on area under the curve analysis, APACHE II (0.799; 95% CI: 0.746 to 0.845) showed the biggest area under the curve in terms of predicting the patients mortality. However, there was no difference between four scoring system in terms of predicting the mortality [SAPS II (0.793; 95% CI: 0.740 to 0.840), MEW (0.763; 95% CI: 0.707 to 0.812) and SOFA (0.728; 95% CI: 0.671 to 0.780)] (Figure 1).

Logistic regression analysis were performed to examine independent risk factor. Age ( $P < 0.001$ , odd's ratio 1.055) pulse ( $P < 0.007$ , odd's ratio 1.025) and  $SO_2$  ( $P < 0.003$ , odd's ratio 0.952) variables were found to be independent risk factors for mortality.

**Table 1**

Vital signs.

Vital signs	Mean value	Min-max
Age (years)	61.75	18-92
Systolic blood pressure (mmHg)	138.38	50-230
Respiratory rate (/min)	19.62	10-45
Pulse (/min)	90.75	17-200
Temperature ( C)	36.56	34 .0-38.1
Oxygen saturation	90.26	45-100
Glasgow coma score	14.4	3-15
Blood glucose (mg/dL)	146	10-813

**Table 2**

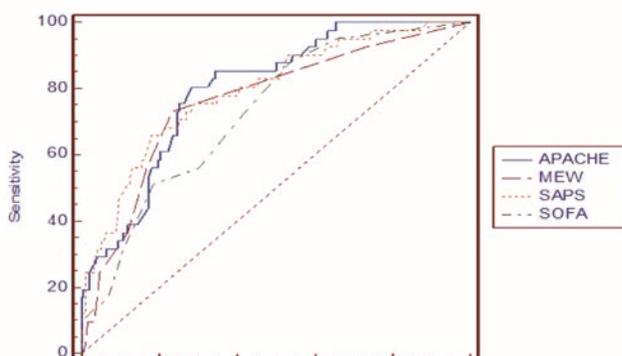
Rate of comorbid conditions [n(%)].

Comorbid conditions	Number of patients
Hypertension	40 (14.87)
Diabetes	37 (13.75)
Renal failure	5 (1.86)
Malignite	24 (8.92)
Central nervous system disease	23 (8.55)
Heart diseases	37 (13.75)
Pneumonopathy	27 (10.04)
Hematologic diseases	1 (0.37)
Other diseases	14 (5.20)

**Table 3**

Rates of hospitalization, discharge, referral and mortality [n(%)].

Status	Number of patients
Patients in intensive care unit	56 (20.82)
Patients in emergency department observation unit	170 (63.19)
Inpatient	129 (47.95)
Referral	13 (4.83)
Discharged	121 (44.98)
Dead	41 (15.24)



**Figure 1.** Area under the curve.

**4. Discussion**

An ideal scoring system should be a guide in the process of deciding urgent intervention on the first encounter with the patient. It should be calculated easily on the bedside and should make predictions about the patient without the need for the laboratory. The scoring systems such as SOFA which requires laboratory and APACHE II, SAPS II which are affected by the last diagnosis as well as the laboratory, are not practical even if they are successful at predicting

the mortality. The studies carried out for developing this scoring systems are made with the intention of developing systems which are more simple and have better quality in the prediction of mortality. Ho and colleagues found the age as an independent risk factor for mortality in univariate analyzes and also revealed that APACHE II, which was calculated by adding age, is superior in the field of organ failure scores[1]. We found that the age is an independent risk factor for mortality in our study. In an another study which was made via MEW scoring system and carried out by Subbe and his colleagues, it is reported that it is not correct to evaluate the O<sub>2</sub> saturation due to its possibility to be affected by inspiratory oxygen concentration[16]. As a result of Jones and his colleagues' study with SOFA, SaO<sub>2</sub> / FiO<sub>2</sub> ratio was proposed instead of PaO<sub>2</sub> / FiO<sub>2</sub> ratio for the patients who are not connected to mechanical ventilation. It was emphasized that oxygen saturation is an important parameter as evaluating the patient's respiration[26]. In our study, oxygen saturation was found as an independent risk factor for the mortality. On the contrary, We found that systolic blood pressure is not an independent risk factor affecting the mortality, parallel to the findings of Kellet and his colleagues[12].

When SAPS II and APACHE II scores are calculated, the presence of comorbid disease is also scored and the result shows the mortality rate[1]. On the other hand, in the studies made by SOFA and MEW scores which are calculated without considering the comorbid medical history have shown that these two scorings correctly predict the mortality and gives correct results on various types of diseases[1-3,7-9,15,24-26]. In our study it has been found out that, the presence of comorbid disease which is used in the calculation of APACHE II and SAPS II, is not associated with mortality. However, at the time of taking a comorbid medical history, it is recorded if the disease existed or not. It may be useful to determine the severity and the grade of the comorbid diseases.

All in all, in our study no significant difference was found between these four scoring system, in terms of predicting the mortality. However, because the scoring systems other than MEW requires laboratory, it is thought that using them in emergency department may be restricted in practise. In practise, MEW scoring system may be improved in terms of ease to implement[27]. The MEW can be strengthened by adding some parameters to the studies performed in multi-centered and large patient groups. In our study, O<sub>2</sub> saturation and age were found as independent factors related to mortality. These two parameters may be useful due to their easily obtainable feature. But more effort is needed to determine the cut-off values.

The most important limitation of this study is its retrospective feature. The number of the patients get involved in the study is limited. There are limitations in obtaining the parameters to calculate the scores. The respiratory rate could only be obtained from patients monitored. Because the blood gas is generally drawn as venous blood gas, the patients whose arterial blood gas do not exist are eliminated. Information about the latest status of the referred patients could not be reached.

## Conflict of interest statement

The authors report no conflict of interest.

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