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COMMUNICATION EFFORT SCORE (CES) IN PATIENTS HOSPITALIZED IN INTERNAL MEDICINE WARD

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ABSTRACT — Aims: There are more than thirty prognostic scoring systems defined in the literature for emergency patients up to now. The purpose of this study is to develop communication effort score (CES) to be used in internal medicine ward by considering it from a different angle, and also to examine the relation of this index with prognosis.
Methods: The study had a prospective-observational study design, and was conducted on patients followed-up in the ward due to acute diseases. The patients were graded under 4 categories according to communication effort within the first 8 hours after referring to emergency department, between exhibiting active communication effort and being closed to communication.The prognostic performance of CES was tested comparatively with other scoring systems by using AUROC analysis.
Results: Data were collected on 308 consecutive acute medical admissions, 55.2% of whom were men, with the mean age of 65.4 ± 15.6 years The mortality rate of the patients in hospital was 2% in CES-1, 4.8% in CES-2, 27.2% in CES-3; and 51.6% in CES-4.The CES model showed a good discrimination power for in-hospital mortality as 0.813 AUC(95% CI, 0.77–0.85). These results were better than the prognostic scoring systems (RAPS, MEWS, REMS, WPS, GAP, and NEWS) and the other specific and general descriptive scoring systems (ECOG, GCS, qSOFA, CCL). The sensitivity and specificity of CES for the optimal cut-off point (2.5) in predicting in-hospital mortality were 0.957 and 0.632, respectively.
Conclusions: The present study showed that CES, which is a new definitive score, is a strong predictor of both in-hospital mortality and short-term mortality.

KEYWORDS — Communication Effort Score, CES, acute medical admission, internal medicine ward, early warning scoring systems, prognosis.

HIGHLIGHTS

— The CES model showed a good discrimination in in-hospital mortality (AUROC:0.813).
— The CES model also showed good discrimination in 1-month mortality (AUROC:0.827).
— The optimal cut-off level was 2.5 with 95% sens, 63% spec for in-hospital mortality.
— CES is a strong predictor of in-hospital and 1-month mortality (HR:3.2 and 3.4 respec).

INTRODUCTION

Several scoring systems have been developed — either disease-specific or general-varying according to the place used and the purpose of use for first evaluation of patients, to identify the seriousness of their diseases, and to determine the risk of mortality and morbidity. For example, specific scoring systems such as the New York Heart Association (NYHA-1974) system used for functional classification of patients admitted with heart failure [1], Killip (1967) heart failure classification used for patients admitted with acute coronary syndrome [2], Eastern Cooperative Oncology Group (ECOG-1960) [3] performance score used for cancer patients, Child-Pugh Score [4] used in patients with cirrhosis, CURB-65 (2003) Score [5] used for patients with pneumonia, quick Sepsis-related Organ Failure Assessment (qSOFA-2016) [6]used in patients with sepsis, and general scoring systems such as Charlson Comorbidity Index (CCI-1987) [7], which shows the chronic disease burden.

Scoring systems that evaluate the seriousness of the disease in detail including clinical and laboratory parameters are used in guiding the treatment in Intensive Care Units (ICUs), while scoring systems that are simpler and faster are preferred in emergency services. The Glasgow Coma Scale (GCS-1961) [8], which is widely used in evaluating conscious and coma in emergency services, and several other prognostic scoring systems were developed, such as Rapid Acute Physiology Score (RAPS-1987[9]), used in critical patient identification, Modified Early Warning Scores (MEWS-2001) [10], Rapid Emergency Medicine Score (REMS-2004) [11], Goodacre score (2006 [12]), Worthing Physiological Scoring System (WPS-2007) [13], Groarke (2008) [14], VitalPac Early Warning Score (ViEWS-2010) [15], National Early Warning Score (NEWS-2012) [16], and Glasgow Coma Scale-Age-Systolic Blood Pressure (GAP-2011) [17], which is used in trauma patients. In this respect, according to a compilation that included 48 studies that received high references, 28 different early warning scoring systems regarding patients admitted to emergency services were developed [18]. In another study, that number is reported as 34 [19]. Although there are many scoring systems used in specific disease groups or featured clinics, there is no scoring system used in general identification or performance evaluation of patients in internal medicine wards.

With this study, the purpose was to develop a scoring system from a different perspective, based solely on observation and communication, reflecting the performance status of patients followed-up with acute internal diseases in wards, to examine the relation of this scoring system with mortality, and to compare it with various scoring systems defined in the literature so far.

METHODS

Study design

The study was a prospective and observational study conducted on patients who were hospitalized due to acute internal diseases in the internal medicine ward of Dr. Lutfi Kırdar Kartal Training and Research Hospital in Istanbul between May 2019 — November 2019. The study was in line with the Helsinki Declaration, and was conducted after the necessary ethical board permission was obtained.

Patient population

Patients who were over the age of 18 admitted to the Emergency Service due to acute internal diseases (acute kidney damage, acute GIS bleeding, acute pancreatitis, acute liver damage, and electrolyte disorder) and referred to the internal medicine ward were included in the study consecutively. Patients who required acute surgical intervention, who were evaluated with acute or subacute traumas, whose first intervention was carried out in another healthcare center, or who were admitted to ICU, were not included in the study.

Communication Effort Score (CES)

All patients admitted to the Emergency Service, and who were then admitted to the internal medicine service with acute internal diseases were evaluated by the internal medicine specialist in the visits within the first 8 hours. The attitudes of the patients during the visits, and their efforts to communicate were carefully evaluated by the entire team, grouped in 4 stages, and were then recorded in the Case Report Forms. These four groups were as follows;

1. Agile (alert) physical communication effort
2. Slow physical communication effort
3. Verbal communication effort
4. No communication effort

To define these groups in more detail:

1. Patients who were very open to communication, who participated actively in physical terms straightened up dynamically in their beds, or waited upright in bed during visits.
2. Patients who were open to communication, physically participated in a resigned way, followed the instructions exhaustedly, tried to straighten up slowly during the visits, or waited in a position sitting with a 45-degree angle.
3. Patients who could only communicate verbally, who could not participate physically, who could follow the instructions only with help, who did not try to straighten up physically during the visits, and who waited in a semi-lying position.
4. Patients who did not have any communication efforts, who shut themselves out physically and psychologically, did not follow instructions, did not straighten up during visits, and those who did not change the full-lying position.

Clinical follow-up

The demographic data, comorbidities, hospitalization indications, clinical findings (anamnesis, arterial blood pressure, heart peak beat, respiratory count per minute, O2 saturation, body temperature, and consciousness status) were recorded in the Case Report Forms specific to the study and to the database.

The hospital admission dates, hospital stay times, release from the ward dates, discharge status (as are, with cure, refusal of treatment, transfer to ICU, and exitus), and the dates of transfer to ICU of all the patients were recorded in the same way. The hospital stay (ward ± ICU) times as of the date of admission to the Emergency Service were recorded, and the 30, 90 and 180-day follow-ups were performed. The in-hospital mortality status of the patients was checked from the hospital data systems; and the 30-day, 90-day and 180-day mortality status was checked from the national death notification system. The findings were recorded in the Case Report Forms.

Statistical Analyses

The data were analyzed by using IBM Statistical Package for Social Sciences (SPSS version 22 for Windows), and were considered significant at $\alpha<0.05$. After confirming the approximate normality of the data by using skewness and kurtosis, descriptive statistics for clinical parameters and all scoring systems were presented by arithmetic mean (standard deviation; SD) or median [min-max], or percentages (% and number). For testing hypothesis about difference of means between the 2 groups, continuous variables were compared using either the t-test (normal distribution) or the Mann-Whitney test (non-normal distribution). To test the hypothesis about the difference in frequency, the Chi-Square test was used.

The prognostic performance of the new scoring system (CES) was tested comparatively with others

(RAPS, MEWS, REMS, WPS, GAP, NEWS, ECOG, GCS, qSOFA and CCI). Discrimination power (i.e., the ability to distinguish between survivors and non-survivors) was assessed using the Receiver Operator Characteristic (ROC) Curves and the Area under ROC curves (AUROC).GCS and GAP were defined as 1-GCS and 1-GAP in order to compare AUROCs, because the high scores of them show poor prognosis, unlike others. A value of 0.5 indicated no discrimination, 0.7–0.8 indicated reasonable discrimination, exceeding 0.8 indicated excellent discrimination, and 1 indicated perfect discrimination. In addition, the sensitivity and specificity of CES were calculated based on the optimal cutting value. Univariate cox-regression analyses were carried out to assess the association for in-hospital, and 1-month mortality in all scoring systems. The Hazard Ratio (HR) with 95% confidence interval (CI) was calculated in the regression models.

RESULTS

Data were collected from 308 consecutive emergency medical admissions. A total of 170 (55.2%) were male, and the mean age was 65.4+15.6 years [min–max: 18–94]. A total of 68.2% of the patients were discharged with recovery, 5.5%in their current conditions, 5.8%by rejecting the treatment upon their will, 3.9% died, 16.9% were transferred to ICU; and 98.1% of those who were transferred to ICU died in hospital. In this respect, the in-hospital mortality rate was determined to be 20.5% (63/308).

The hospital stay duration of the survivors was 7 days [1–47], and that of those who died was 13 days [2–58]. A total of 31.7% of in-hospital deaths (20/63) occurred in 1 week, 52.3% (33/63) in 2 weeks, 87.3% (55/63) in 1month. The comparative analysis of clinical findings and various scoring systems according to the in-hospital mortality status of the patients is summarized in Table 1.

Communication Effort Score (CES)

The patients were classified according to communication efforts during the first examination in the hospital admission. A total of 15.9% of all patients were categorized as CES-1 (n:49), 34.1% as CES-2 (n:105), 29.9% as CES-3 (n:92), and 20.1% as CES-4 (n:62). According to CES scores of the patients, hospital stay times and in-hospital mortality rates are presented in Table 2.

According to the communication effort scores, the in-hospital, 1-month, 3-month and 6-month mortality rates of the patients are presented in Fig 1. As seen, the in-hospital mortality rates were 2% in patients with CES-1; 4.8% in patients with CES-2; 27.2% in patients with CES-3; and 51.6% in patients with CES-4; and it was determined that the 1-3-6-month mortality rates had a similarly increasing trend.

Comparison of CES with other scoring systems

As seen in Table 3, the scores that predicted in-hospital mortality showed a discrimination power between 0.568 and 0.813, and the discrimination power of the same scores were determined between 0.570 and 0.827 for 1-month mortality.

The CES Model showed good discrimination with 0.813 AUC (95% CI, 0.77–0.85) for in-hospital mortality, and 0.827 AUC (95% CI, 0.79–0.86) for 1-month mortality. In this respect, the in-hospital mortality and 1-month mortality power of CES were significantly better than the prognostic scoring systems (RAPS, MEWS, REMS, WPS, GAP, and NEWS), and other specific and general descriptive scoring systems (ECOG, GCS, qSOFA, and CCI) (Fig. 2).

The cut-off point that gave the maximum combined sensitivity and specificity for CES was 2.5. The sensitivity and specificity of CES for this cut-off point was 0.957 and 0.632, respectively.

Univariate Cox Regression Analysis was made to compare the power of all scoring systems in predicting the in-hospital mortality and 1-month mortality. It was determined that all scoring systems predicted in-hospital mortality and 1-month mortality, and CES, the new score, had the highest predictive power (for in-hospital mortality: HR:3.26, 95% CI:2.45–4.24; for 1-month mortality: HR:3.46 95% CI:2.77–4.31) (Table 4).

DISCUSSION

The present study of ours showed that CES, which is a new descriptive scoring system, is a strong predictor of both in-hospital mortality and 1-month short-term mortality. This scoring system, which is scored between active communication and being closed to communication, is important for high-score patients to show the requirement of being monitored more closely. In addition, it was found that the rate of in-hospital mortality of patients with CES 1 was 2%, and those with CES 4 was increased to 51.6%.

ECOG, which shows the performance status in cancer patients, evaluates the physical activity and bed-dependency status of patients only, and is similar to ours because it does not depend on any clinical or laboratory values [3]. It has been demonstrated with this study that CES is a scoring system that can be used as a prognosis indicator, even in internal medicine ward, where not only cancer patients but also all chronic diseases are included, and after our recent scor-

Table 1. *Analysis of scoring systems according to their prognosis in our patient population*

	survivors (n: 245)			non-survivors (n: 63)			p sig
	Mean	SD	Min-Max	Mean	SD	Min-Max	
Age, years	63,9	(16,3)	[18-94]	71,5	(10,6)	[40-91]	<0,001
LHS, days	9,48	(9,3)	[1-47]	16,65	(12,6)	[2-58]	<0,001
Clinical findings							
HR, bpm	88,1	(16,7)	[48-140]	94,7	(19,1)	[58-150]	<0,001
RR, c/min	15,0	(3,9)	[8-35]	19,2	(6,3)	[10-34]	<0,001
SBP, mm Hg	119,3	(24,4)	[50-200]	114,0	(28,5)	[60-220]	0,065
MAP, mm Hg	87,6	(15,6)	[37-140]	83,6	(17,4)	[40-140]	0,016
BT, °C	36,8	(,6)	[35,6-39,5]	36,7	(,7)	[34,8-39]	0,396
SaO_2, %	95,1	(3,3)	[80-100]	94,0	(3,4)	[83-99]	0,015
Scoring systems							
CES	2,32	(,9)	[1-4]	3,43	(,7)	[1-4]	<0,001
RAPS	0,88	(1,3)	[0-5]	1,27	(1,7)	[0-6]	0,013
MeWS	1,11	(1,4)	[0-7]	2,31	(2,2)	[0-10]	<0,001
REMS	4,95	(2,8)	[0-12]	6,26	(2,3)	[1-14]	<0,001
WPS	1,22	(1,7)	[0-8]	3,02	(2,6)	[0-11]	<0,001
GAP	20,79	(2,1)	[10-24]	19,75	(1,7)	[14-24]	<0,001
NEWS	2,52	(2,1)	[0-12]	5,02	(3,5)	[0-17]	<0,001
qSOFA	0,42	(,6)	[0-3]	0,95	(,8)	[0-3]	<0,001
CCI	4,41	(2,7)	[0-11]	5,98	(2,9)	[0-14]	<0,001
GKS	14,82	(,9)	[6-15]	14,61	(,9)	[10-15]	0,023
ECOG	1,68	(1,3)	[0-4]	3,17	(1,1)	[0-4]	<0,001

__LHS:__ Length of hospital stay, HR: Heart rate,RR: Respiratory rate, SBP: Systolic blood pressure, MAP: Mean arterial pressure, BT: Body temperature, SaO_2: Oxygen saturation, CES: Communication effort score, ECOG: Eastern Cooperative Oncology Group performance score, GCS: Glasgow Coma Scale, RAPS: Rapid Acute Physiology Score, MEWS: Modified Early Warning Scores, REMS: Rapid Emergency Medicine Score, WPS: Worthing Physiological Scoring System, GAP: Glasgow Coma Scale-Age-Systolic Blood Pressure, NEWS: National Early Warning Score, CCI: Charlson Co-morbidity Index, qSOFA: quick Sepsis-related Organ Failure Assessment

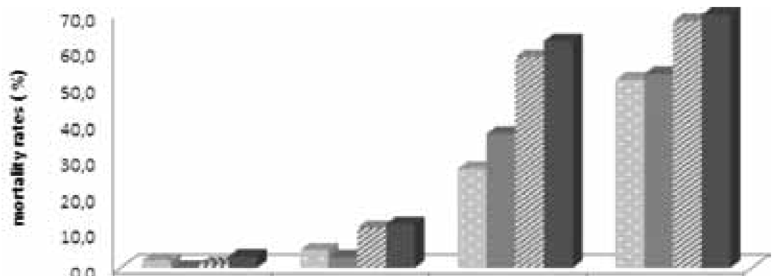
Table 2. *Length of hospital stay and in-hospital mortality rates according to communication effort scores*

		survivors					non-survivors				
score on admission	no of patients	number of patients (%)		length of hospital stay mean(sd) [min-max]			number of patients (%)		length of hospital stay mean(sd) [min-max]		
CES 1	49	48	(98,0%)	3,4	(2,1)	[1-9]	1	(2,0%)	58,0	(.)	[58]
CES 2	105	100	(95,2%)	11,1	(9,8)	[1-47]	5	(4,8%)	33,8	(16,0)	[12-58]
CES 3	92	67	(72,8%)	11,2	(10,5)	[1-44]	25	(27,2%)	16,6	(10,5)	[3-37]
CES 4	62	30	(48,4%)	10,1	(8,2)	[2-35]	32	(51,6%)	13,6	(10,6)	[2-37]

ing system, it is the strongest predictor [for in-hospital and 1-month mortality: HR:2.3(1.78–2.95) and 2.34 (1.97–2.77)] and again, it has the best discrimination power after CES for mortality (AUROC 0.780 and 0.810,respectively).

Similarly, GCS, which is widely used in the evaluation of consciousness and coma, is a scoring system that evaluates both verbal, motor, eye and clinical response, and is similar to ours in that it is independent from the laboratory[8]. Although it meets the needs in emergency services and Intensive Care Units, it does not seem to be appropriate to use in identifying patients who are generally conscious in the internal medicine ward. In fact, the low short-term mortality prediction in our study population supports this situation.

CCI, which shows the burden of chronic disease in 17 areas, from myocardial infarction to meta-



	CES 1	CES 2	CES 3	CES 4
in-hospital	2,0	4,8	27,2	51,6
1-month	0,0	2,9	36,8	53,2
3-month	1,0	11,0	57,8	67,7
6-month	3,1	12,0	62,2	69,4

Fig. 1. *Mortality rates according to communication effort score*

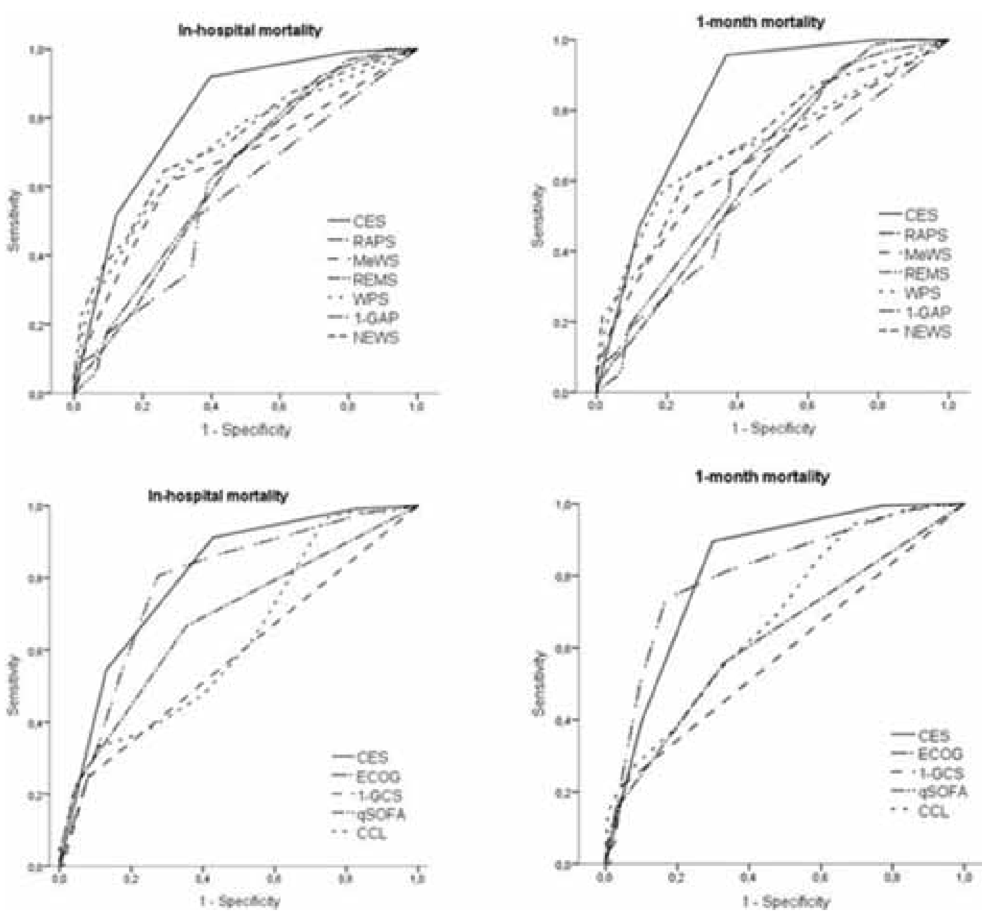


Fig. 2. *Receiver operating curves for predicting hospital admission according to the new scoring system (CES) and RAPS, MEWS, REMS, WPS, GAP, NEWS and ECOG, GCS, qSOFA, CCI*

static tumors, also has a usage in patients in internal medicine wards dealing with comorbidities[7]. It was demonstrated with this study that this index, which is originally used in 10-year mortality prediction, has the strength of predictive power in in-hospital mortality and short-term mortality albeit this power is weak.

The qSOFA, which is defined in adult patients suspected of infection in out-of-hospital, Emergency Service or general hospital conditions, is used to identify the sepsis-related prognosis[6]. This score, which is created based on simple clinical indicators like blood pressure and respiratory count, and mental state, was proven with our study that it can be used as a short-term mortality indicator in patients in the general internal medicine ward, except for sepsis. It was shown that the in-hospital and 1-month mortality predic-

Table 3. *Discriminatory power for predicting in-hospital mortality and 1-month mortality for all scores*

	In-hospital mortality		1-month mortality	
	AUROC (95% CI)	p sig.	AUROC (95% CI)	p sig.
CES	0,813 (0,77-0,85)	<0,001	0,827 (0,79-0,86)	<0,001
RAPS	0,568 (0,51-0,62)	0,020	0,570 (0,51-0,62)	0,012
MeWS	0,667 (0,61-0,72)	<0,001	0,658 (0,60-0,71)	<0,001
REMS	0,632 (0,58-0,68)	<0,001	0,631 (0,58-0,68)	<0,001
WPS	0,715 (0,66-0,77)	<0,001	0,703 (0,65-0,76)	<0,001
1-GAP	0,641 (0,59-0,69)	<0,001	0,649 (0,60-0,70)	<0,001
NEWS	0,730 (0,68-0,78)	<0,001	0,715 (0,67-0,76)	<0,001
ECOG	0,780 (0,73-0,83)	<0,001	0,810 (0,77-0,85)	<0,001
1-GCS	0,583 (0,52-0,65)	0,007	0,584 (0,53-0,63)	0,001
qSOFA	0,682 (0,62-0,74)	<0,001	0,631 (0,58-0,68)	<0,001
CCI	0,630 (0,57-0,69)	<0,001	0,687 (0,64-0,73)	<0,001

GCS and GAP were defined as 1-GCS and 1-GAP in order to compare AUROCs, because the high scores of them show poor prognosis, unlike others

Table 4. *Univariate cox regression analysis for predicting in-hospital mortality and 1-month mortality*

	In-hospital mortality		1-month mortality	
	Sig.	HR (95% CI)	Sig.	HR (95% CI)
CES	<0,001	3,26(2,45-4,24)	<0,001	3,46(2,77-4,31)
RAPS	0,038	1,22(1,01-1,47)	0,041	1,19(1,01-1,40)
MeWS	<0,001	1,33(1,18-1,49)	0,002	1,45(1,31-1,62)
REMS	<0,001	1,21(1,08-1,35)	0,006	1,24(1,04-1,36)
WPS	<0,001	1,48(1,34-1,63)	<0,001	1,50(1,36-1,65)
GAP	<0,001	0,78(0,70-0,87)	<0,001	0,76(0,69-0,85)
NEWS	<0,001	1,41(1,30-1,54)	<0,001	1,38(1,27-1,49)
ECOG	<0,001	2,30(1,78-2,95)	<0,001	2,34(1,97-2,77)
GCS	0,012	0,81(0,62-1,06)	0,004	0,72(0,58-0,90)
qSOFA	<0,001	1,95(1,58-2,36)	<0,001	2,15(1,74-2,54)
CCI	<0,001	1,23(1,11-1,37)	0,003	1,14(1,04-1,24)

CES: *Communication effort score, ECOG: Eastern Cooperative Oncology Group performance score, GCS: Glasgow Coma Scale, RAPS: Rapid Acute Physiology Score, MEWS: Modified Early Warning Scores, REMS: Rapid Emergency Medicine Score, WPS: Worthing Physiological Scoring System, GAP: Glasgow Coma Scale-Age-Systolic Blood Pressure, NEWS: National Early Warning Score, CCI: Charlson Co-morbidity Index, qSOFA: quick Sepsis-related Organ Failure Assessment*

tion scores are quite good when compared with other scoring systems [HR and 95%CI: 1.95(1.58–2.36) and 2.15 (1.74–2.54), respectively].

In this study, 6 of the early warning systems, which were also valuable as prognosis indicators in the emergency services, were applied to our patient population. In general, these systems are scored through clinical parameters like respiratory count, heart rate, blood pressure, conscious status, fever, and SaO_2. It was shown with regression analyses that WPS was a stronger predictor in both in-hospital mortality and 1-month mortality in patients in the internal medicine ward (HR:1.48, 95% CI:1.34–1.63). It was also determined that NEWS ranked the first with the highest number of discriminatory power among these, and WPS ranked the second (AUROC 0.730 and 0.715, respectively). Although a recent study conducted by Wei et al. has shown that REMS is stronger in predicting hospital stay time and in-hospital mortality compared to RAPS and NEWS[20], another study conducted on a fairly high patient population showed that NEWS is superior in distinguishing patients with cardiac arrest, unexpected ICU admission, or mortality risk[19].In another study comparing six scoring systems, it was reported that WPS had a good discriminatory power in identifying patients in terms of 24-hour and overall hospital mortality. The results of these two studies conducted on similar patient population of a similar nature support the result of the present study of ours [21].

The one-way scoring design of the WPS, just like GAP, is important in terms of ease of use. The other four scoring systems are more difficult to use, because they gradually make a bilateral scoring for both low and high values. When the other small differences among them were evaluated, the age factor was added to REMS and GAP; the body temperature was added to WPS and MEWS; O_2 saturation was added to WPS, REMS and NEWS; REMS and RAPS were based on average blood pressure, while others took only SKB as the basis; and REMS, RAPS and GAP used GCS in the evaluation of consciousness, and others used AVPU. Another point not be overlooked is that increasing scores in GCS and GAP show a clinical wellbeing, while in other scoring systems, including ECOG, CCI and qSOFA, increasing scores show deterioration.

The present study of ours naturally had limits. Firstly, only the acute medical patients with comorbidities were included in the study. For this reason, the results of it cannot be generalized for surgical or trauma patients or patients with ICU requirements. However, many statistically significant findings were found in the present study, which require further and wider investigation of patients hospitalized in internal medicine wards. We care about our study in terms of being a reference for future studies.

As a result, as the evidence accumulates, the beneficial clinical outcomes of scoring systems become clear. It is envisaged by us that CES, as one of these systems, can be used as an early prognostic indicator for patients who are at risk of worsening at the time of admission to hospital. For this reason, CES can help both at the level of nursing care, in terms of the frequency of the physician visits, and with the decisions to be taken in patient management from the initial application to the resuscitation.

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Conflict of Interest

The authors state that they have no conflict of interest.

Data Availability

The dataset used to support the findings of this study are available from the corresponding author upon request.

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Author Contributions

Idea/concept:Y.Ö.; design:Y.Ö.; control/supervision:YÖ.; data collection: Y.Ö, N.L.; analysis:Y.Ö.; interpretation:Y.Ö.; literature review : Y.Ö.; writing the article:Y.Ö.; critical review:Y.Ö.

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