Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Effectiveness of the rapid emergency medicine score and the rapid acute physiology score in prognosticating mortality in patients presenting to the emergency department with COVID-19 symptoms

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ABSTRACT

Objective: We investigated the effectiveness of the Rapid Emergency Medicine Score and the Rapid Acute Physiology Score in identifying critical patients among those presenting to the emergency department with COVID-19 symptoms.

Material and methods: This prospective, observational, cohort study included patients with COVID-19 symptoms presenting to the emergency department over a two-month period. Demographics, clinical characteristics, and the data of all-cause mortality within 30 days after admission were noted, and the Rapid Emergency Medicine Score and the Rapid Acute Physiology Score were calculated by the researchers. The receiver operating characteristic curve analysis was performed to determine the discriminative ability of the scores.

Results: A total of 555 patients with a mean of age of 49.4 ± 16.8 years were included in the study. The rate of 30-day mortality was 3.9% for the whole study cohort, 7.2% for the patients with a positive rt-PCR test result for SARS-CoV-2, and 1.2% for those with a negative rt-PCR test result for SARS-CoV-2. In the group of patients with COVID-19 symptoms, according to the best Youden's index, the cut-off value for the Rapid Emergency Medicine Score was determined as 3.5 (sensitivity: 81.82%, specificity: 73.08%), and the area under curve (AUC) value was 0.840 (95% confidence interval 0.768–0.913). In the same group, according to the best Youden's index, the cut-off value for the Rapid Acute Physiology Score was 2.5 (sensitivity: 90.9%, specificity: 97.38%), and the AUC value was 0.519 (95% confidence interval 0.393–0.646).

Conclusion: REMS is able to predict patients with COVID-19-like symptoms without positive rt-PCR for SARS-CoV-2 that are at a high-risk of 30-day mortality. Prospective multicenter cohort studies are needed to provide best scoring system for triage in pandemic clinics.

1. Introduction

Providing appropriate and timely medical support is associated with reduced mortality and morbidity in patients with trauma and sepsis [1]. On the other hand, the overcrowding of the emergency department (ED) prevents healthcare workers from allocating the necessary time to patients [2]. Many scoring systems; e.g., the Emergency Department Sepsis Score, the Modified Early Warning Score (MEWS), the Rapid Emergency Medicine Score (REMS), and the Rapid Acute Physiology Score (RAPS) have been developed to prioritize patients who need emergency medical support in emergency services [2,3]. Contrary to scores used in intensive care units, such as APACHE II, laboratory parameters are not included in the scoring system used in triage in ED to achieve prompt decisions [4]. Pulse rate, mean arterial pressure respiratory rate, and Glasgow Come Scale are using to calculate RAPS [2]. Age and peripheral oxygen saturation are being used to calculate REMS in addition to these parameters [2].

Since SARS-CoV-2 infection was first described, more than 66 million people have been infected and more than 1.5 million people have died worldwide. The rapid spread of the disease around the world has increased the burden on health systems. Governments have had to take measures to prevent health systems from collapsing [5]. EDs have been redesigned as the main gate for patients with COVID-19 symptoms [6]. The increasing number of patients with COVID-19 symptoms presenting to ED makes it necessary to quickly evaluate these patients and identify those requiring urgent medical support. Thus, we speculated that the REMS and RAPS triage scores could be used in ED to prioritize critically ill patients with COVID-19 symptoms.

This study intended to investigate the effectiveness of two scoring systems, namely REMS and RAPS, in prognosticating mortality in patients presenting to ED with COVID-19 symptoms.

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2. Materials and methods

2.1. Study design

This study was designed as a prospective, observational, cohort study and included patients presenting to ED with COVID-19 symptoms over a two-month period. The ED where the study was conducted receives approximately 438,000 emergency visits annually.

2.2. Study population

The population of this study consisted of patients presenting to our ED with COVID-19 symptoms between April 24, 2020 and June 24, 2020. During the pandemic process, a new triage desk was established outside the ED, where patients with COVID-19-related complaints are first evaluated by the emergency nurse. Our study population comprised all patients who has COVID-19 symptoms were evaluated by the second emergency nurse at the pandemic triage desk.

We included all patients with COVID-19 symptoms, not just patients confirmed with reverse transcription polymerase chain reaction (rt-PCR). Because not only confirmed COVID-19 patients apply to emergency pandemic clinics, but also suspected COVID-19 patients. Patients with one or more symptoms of COVID-19 as fever, cough, sputum, shortness of breath, loss of taste or smell, sore throat, or a history of contact with a confirmed case were included in the study. Other inclusion criterion was being over 18 years old. The patients who had missing data or refused to have a PCR test were excluded. The information regarding the patient selection is summarized in Fig. 1.

In our study, we sought an answer to the clinical question of which is the ideal scoring system that can be used in pandemic clinics. Therefore, patients with a positive rt-PCR test for SARS-CoV-2 and those with a negative rt-PCR test for SARS-CoV-2 subgroups of the study population were created.

Nasal and pharyngeal swabs were tested by RT-PCR with the SARS-CoV-2 detection kit (Coyote Bioscience Co., Ltd) that the turn-around time was 1–4 days due to crowdedness. To diagnose COVID 19, ORF1ab and N gene of SARS-CoV-2 were targeted and Biorad CFX 96 platform were used. Twenty-nine and above Ct values were considered positive. Tests that were positive for both ORFlab and N genes were reported as positive.

2.3. Data collection

Data were collected using two sources: the pandemic triage form and the computer-based system of the hospital. The pandemic triage form was completed for each patient suspected to have COVID-19. It contains information on patient ID to define each patient in the computer-based system, COVID-19 symptoms, other nonspecific symptoms (nausea-vomiting, diarrhea, headache, weakness, muscle-joint pain), Glasgow Coma Scale score, and vital parameters. Vital parameters noted on the form are blood pressure (systolic and diastolic), pulse pressure, body temperature, respiratory rate, and oxygen saturation. The data on demographics, clinical characteristics, comorbidities, laboratory findings,

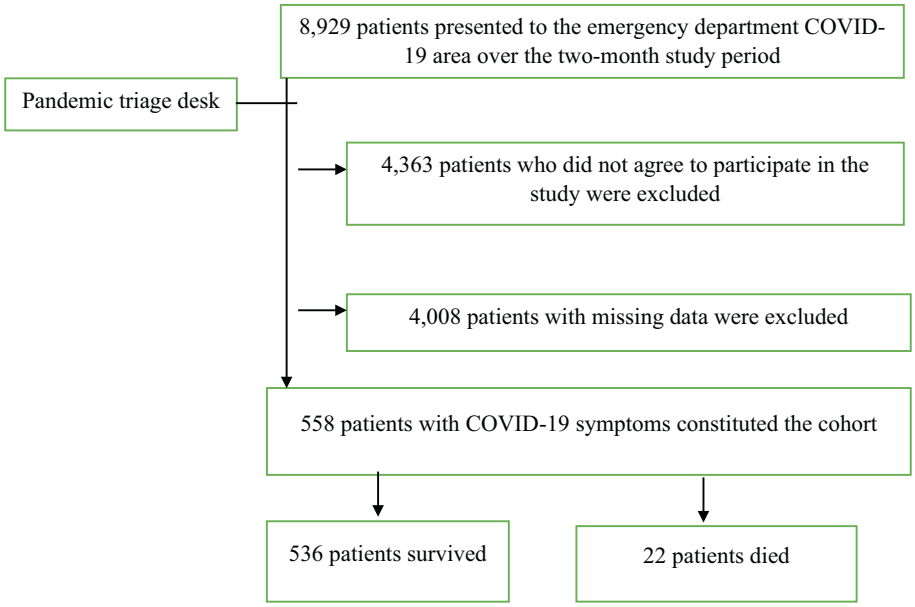

Fig. 1. Flow chart of the study.

Table 1
Parameters of Rapid Emergency Medicine Score and the Rapid Acute Physiology Score.

	0	+1	+2	+3	+4	+5	+6
Age (years)	<45		45–54	55–64		65–74	>74
Peripheral oxygen saturation (%)	>89	86–89		75–85	<75		
Pulse rate (/minute)	70–109		55–69 or 110–139	40–54 or 140–179	≤39 or > 179		
Mean arterial pressure (mmHg)	70–109		55–69 or 110–139	110–159	≤49 or > 159		
Respiratory rate (/minute)	12–24	10–11 or 25–34	6–9	35–49	≤5 or > 49		
Glasgow coma scale	14–15	11–13	8–10	5–7	3–4		

clinical outcome for the first 24 h, necessity of mechanical ventilation, and 30-day mortality were extracted from the computer-based system. Comorbidities were recorded as chronic obstructive pulmonary diseases, diabetes mellitus, hypertension, coronary artery disease, congestive heart failure, active malignancy, chronic kidney disease, and immunosuppression. Laboratory findings examined included white blood cell count, platelet count, neutrophil count, lymphocyte count, C-reactive protein, albumin, and results of rt-PCR test for SARS-CoV-2. REMS, RAPS, mean arterial pressure, C-reactive protein-to-albumin ratio, platelet-to-lymphocyte ratio, and neutrophil-to-lymphocyte ratio were calculated. Parameters used in the calculation of REMS and RAPS are listed in Table 1. Pulse rate, mean arterial pressure, respiratory rate, and Glasgow coma scale used in calculation of RAPS age, peripheral oxygen saturation, pulse rate, mean arterial pressure, respiratory rate, and Glasgow coma scale used in calculation of REMS. Final diagnoses of the patients with a negative rt-PCR result were recorded. Data were collected and analyzed by five independent researchers who have 5–10 years of experience in emergency medicine. Each case was analyzed by one of five independent researchers who were not blinded to the purpose of the study. Information on mortality was collected by checking the computer-based system or calling patients or their relatives if necessary. All the patients discharged from the hospital were contacted and follow up was totally completed.

Table 2
Baseline characteristics of the enrolled patients and comparison of the patient characteristics between the survivor and non-survivor groups.

Variables	Total $n = 558$	Survivor $n = 536$ (96%)	Non-survivor $n = 22$ (3.9%)	LR +	LR -	p values*
Age, years	48 (19–96)	47 (19–96)	75 (46–93)			**<0.001**
Gender						0.224
Male	310 (55.6%)	295 (55%)	15 (68.2%)			
Female	248 (44.4%)	241 (45%)	7 (31.8%)			
Clinical outcome for the first 24 h						
Discharge	254 (45.5%)	254 (47.4%)	0			
Hospitalization	295 (52.9%)	282 (52.6%)	13 (59.1%)			
Intensive care unit admission	9 (1.6%)	0	9 (40.9%)			
Positive rt-PCR test result for SARS-CoV-2						**<0.001**
yes	249 (44.6%)	231 (43.1%)	18 (81.8%)			
no	309 (55.4%)	305 (56.9%)	4 (18.2%)			
Comorbidities						
Chronic obstructive pulmonary disease	27 (4.8%)	26 (4.9%)	1 (4.5%)	0.9	1	0.948
Hypertension	109 (19.5%)	103 (19.2%)	6 (27.3%)	1.4	0.9	0.407
Diabetes mellitus	81 (14.5%)	75 (14%)	6 (27.3%)	2	0.8	0.113
Coronary artery disease	24 (4.3%)	21 (3.9%)	3 (13.6%)	0.6	1.1	0.063
Congestive heart failure	10 (1.8%)	7 (1.3%)	3 (13.6%)	**10.5**	0.9	0.005
Chronic kidney disease	7 (1.3%)	5 (0.9%)	2 (9.1%)	**10.1**	0.9	0.028
Active malignancy	6 (1.1%)	3 (0.6%)	3 (13.6%)	**22.7**	0.9	**0.001**
Immunodeficiency	1 (0.2%)	0	1 (4.5%)	1		0.039
Frequency of symptoms						
Fever	193 (34.6%)	184 (34.3%)	9 (40.9%)	1.2	0.9	0.525
Cough	351 (62.9%)	341 (63.6%)	10 (45.5%)	0.7	1.5	0.084
Sputum	22 (3.9%)	21 (3.9%)	1 (4.5%)	1.2	1	0.594
Shortness of breath	202 (36.2%)	195 (36.4%)	7 (31.8%)	0.9	1.1	0.663
Weakness	106 (19%)	103 (19.2%)	3 (13.6%)	0.7	1.1	0.781
Muscle-joint pain	93 (16.7%)	93 (17.4%)	0	0.01	1.2	0.035
Loss of taste or smell	23 (4.1%)	23 (4.3%)	0	0.01	1	0.321
Headache	35 (6.3%)	34 (6.3%)	1 (4.5%)	0.7	1	0.733
Sore throat	63 (11.3%)	62 (11.6%)	1 (4.5%)	0.4	1.1	0.495
Nausea-vomiting	36 (6.5%)	34 (6.3%)	2 (9.1%)	1.4	1	0.646
Diarrhea	36 (6.5%)	34 (6.3%)	2 (9.1%)	1.4	1	0.646
Vital parameters, median (IQR)						
Systolic blood pressure (mmHg)	*120 (66–200)*	120 (66–200)	120,5 (80–177)			0.455
Diastolic blood pressure (mmHg)	*75 (45–118)*	75 (50–118)	71 (45–89)			0.159
Pulse rate (/min*)*	*80 (64–130)*	80 (64–130)	98,5 (72–123)			**0.001**
Body temperature (◦C)	*36.5 (35.4–36.7)*	36.5 (35.4–36.7)	36.7 (35.9–39)			0.281
Respiratory rate (/min)	*20 (12–38)*	20 (12−30)	20 (14–38)			0.511
Oxygen saturation (%)	*97 (70–100)*	97 (84–100)	93,5 (70–99)			**<0.001**
Mean arterial pressure (mmHg)	*90 (52–136)*	90 (52–136)	90,3 (57–107)			0.937
Glasgow Coma Scale score, median (IQR)	*15 (7–15)*	15 (14–15)	15 (7–15)			**<0.001**
Mechanical ventilation requirement	11 (2%)	0	11 (50%)			**<0.001**
Scoring system, median (IQR)						
Rapid Emergency Medicine Score (REMS)	2 (0−12)	2 (0–11)	6 (2–12)			**<0.001**
Rapid Acute Physiology Score (RAPS)	0 (0–6)	0 (0–6)	0 (0–5)			0.676
Blood test parameters, median (IQR)						
White blood cell count (/μL)	*6.9(0.04–27.7)*	6.9 (0.04–21.5)	7.1 (0.2–27.7)			0.757
Neutrophil count (/μL)	*4.2 (0.03–21.2)*	4.2 (0.03–18.9)	6.6 (0.03–21.2)			**0.001**
Lymphocyte count (/μL)	*1.7 (0.01–10.6)*	1.7 (0.01–8.7)	0.9 (0.01–10.6)			**<0.001**
Platelet count (10^3/μL)	*230 (22–487)*	230 (22–487)	193 (83–399)			0.020
C-reactive protein, mg/L	*0.4 (0.1–24.6)*	0.4(0.1–24.3)	9.7 (0.2–24.6)			**<0.001**
Albumin (g/dL)	*4.01(2.6–5.02)*	4.3 (2.6–5.02)	3.5 (2.6–4.5)			**<0.001**
Neutrophil-to-lymphocyte ratio	*2.3 (0.01–11.8)*	2.2 (0.01–11.8)	7.6 (0.03–8.4)			**<0.001**
Platelet-to-lymphocyte ratio	*128 (14.6–252)*	126.9 (14.6–252)	172 (37.5–194)			0.002
C-reactive protein-to-albumin ratio	0.1 (0.02–8.45)	0.09 (0.02–7.39)	2.66 (0.05–8.45)			**<0.001**

* The Bonferroni-corrected *p*-value is 0.0012. LR: Likelihood ratio.

2.4. Statistical analysis

All statistical analyses were performed using SPSS version 22.0 for Windows (SPSS Inc., Chicago, IL, USA). The normality analysis of continuous data was undertaken using the Kolmogorov-Smirnov test. Categorical data were presented as n (%) and compared using the chi-squared test. Quantitative variables were presented as median and interquartile range (IQR, 25th–75th percentile), then compared using the Mann-Whitney test or Student's *t*-test according to the normality of distribution for the two groups. The Bonferroni correction was used a method to counteract the problem of multiple comparisons. The univariate analyses to identify variables (RAPS and REMS) associated with 30-day mortality status were performed using the chi-square, Fisher's exact, Student's t and Mann-Whitney *U* tests, where appropriate. In the multivariate analysis, the effective factors identified with the univariate analyses were further examined with the logistic regression analysis to determine the independent predictors of mortality. The Hosmer-Lemeshow goodness-of-fit statistics were used to assess the model fit. Receiver operating characteristic (ROC) curves were used to assess the accuracy of RAPS and REMS to predict mortality, and the results were reported as the area under the curve (AUC) values. Youden's index was used to determine the optimal cut-off value for scores with highest sensitivity, and specificity. Likelihood ratios were calculated using sensitivity and specificity values in the evaluation of relationship between 30-day mortality and scoring systems. Statistical significance was defined at $p < 0.05$.

2.5. Ethics

The ethical committee approval of this study was obtained from the local ethics committee with the approval number B.10.1.TKH.4.34.H.GP.0.01/127. Data collection was performed prospectively by emergency nurses. Before including the study, informed consent forms were signed by patients or their relatives. All researchers adhered to the principles of the Declaration of Helsinki throughout the study period.

3. Results

Of the 558 patients included in the study, 310 (55.6%) were male. The mean of age of the 558 patients was 49.4 ± 16.8 years. A total of 22 patients died within 30 days of ED presentation. The rate of 30-day mortality was 3.9% for the whole study cohort, 7.2% for the patients with a positive rt-PCR test result for SARS-CoV-2, and 1.2% for those with a negative rt-PCR result for SARS-CoV-2. The demographic characteristics, clinical outcomes for the first 24 h, comorbid diseases, symptoms, vital parameters at presentation, initial laboratory findings, REMS, RAPS, and mortality data are shown in Table 2. Of the 309 patients with negative rt-PCR test for SARS-CoV-2, 215 (65.6%) patients were diagnosed with other upper respiratory tract infections, 12 (3.8%) patients with decompensated heart failure, 49 (15.8%) patients with bacterial pneumonia, 8 (2.5%) patients with urinary system infection, and 27 (8.7%) patients with acute gastroenteritis.

3.1. Outcomes

The comparisons of the demographics, clinical characteristics and laboratory findings of the non-survivor and survivor groups are shown in Table 2. Significant differences were observed between the non-survivor and survivor groups in three parameters used to calculate REMS and RAPS: age [47 (19–96) versus 75 (46–93) years, $p < 0.001$], pulse rate [80 (64–130) versus 98.5 (72–123) per minute, $p = 0.001$], and oxygen saturation [97 (84–100) versus 93.5 (70–99)%, $p < 0.001$]. Subgroup analyses performed with patients with a positive rt-PCR test for SARS-CoV-2 yielded similar results. A statistically significant difference was observed between the survivor and non-survivor groups in terms of REMS [2 (0—11) versus 6 (2–12), $p < 0.001$], but not with in relation to RAPS [0 (0–6) versus 0 (0–5), $p = 0.676$].

The analysis of the ROC curve was performed to determine the discriminative ability of the two scoring systems in 30-day mortality. In the group of patients with COVID-19 symptoms, according to the best Youden's index, the cut-off value for REMS was 3.5 (sensitivity: 81.82%, specificity: 73.08%), and the AUC value was 0.840 (95% confidence interval 0.768–0.913). In the same group, according to the best Youden's index, the cut-off value for RAPS was 2.5 (sensitivity: 9.09%, specificity: 97.38%), and the AUC value was 0.519 (95% confidence interval 0.393–0.646) (Table 3, Fig. 2). Table 3 and Fig. 3 present the cut-off values of REMS and RAPS and their sensitivity, specificity, AUC, and 95% confidence interval values for the subgroups. Likelihood ratios for both scoring systems were not considered as clinically useful in the assessment of 30-day mortality as the values were between 0.2 and 5 in the all patients and with positive rt-PCR patients. However, in the patient group without rt-PCR positivity, LR (+) value of REMS was 7.7 and prognostically useful (Table 3).

The multivariate logistic regression analysis was performed to identify the independent predictors of mortality, and age and oxygen saturation were determined to be independent predictors with the p values of <0.001 and 0.001, respectively (Table 4).

4. Discussion

In this study, we compared two emergency scoring systems and found REMS to be the useful tool in predicting 30-day mortality in only in the group without rt-PCR positivity. However, both scoring systems were not useful in predicting 30-day mortality in rt-PCR positive and general patient population. On the other hand, the subgroup

Table 3
Accuracy of the Rapid Emergency Medicine Score and the Rapid Acute Physiology Score in predicting 30-day all-cause mortality.

Scores	AUC	95% CI	p	Cut-off value	Sensitivity	Specificity	LR +	LR -
RAPS	0.519	0.393–0.646	0.701	>2	9.09%	97.38%	3.5	0.93
REMS	0.841	0.808–0.870	<0.001	>3	81.82%	73.08%	3.03	0.25
Subgroup analysis								
Patients with positive rt-PCR for SARS-CoV-2 ($n = 249$)								
RAPS	0.523	0.459–0.587	0.687	>2	11.11	96.97	3.7	0.92
REMS	0.826	0.773–0.871	<0.001	>3	83.33	72.29	3	0.23
Patients without positive rt-PCR for SARS-CoV-2 ($n = 309$)								
RAPS	0.508	0.451–0.565	0.949	>1	25.0	80.92	1.31	0.93
REMS	0.873	0.830–0.908	<0.001	>5	75.0	90.46	7.7	0.28

AUC: area under the curve; LR: Likelihood ratio; REMS: Rapid Emergency Medicine Score; RAPS: Rapid Acute Physiology Score; rt-PCR; reverse transcription polymerase chain reaction; CI: confidence interval.

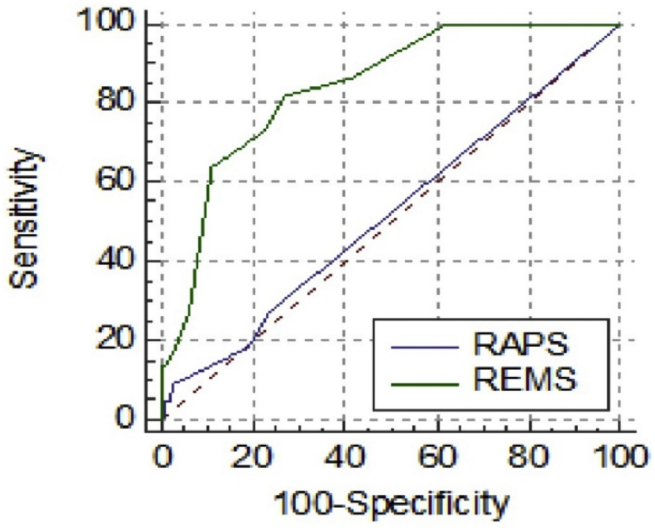

Fig. 2. Receiver operating characteristic curves for the Rapid Emergency Medicine Score (REMS) and the Rapid Acute Physiology Score (RAPS) for the prediction of 30-day mortality in all patients presenting with COVID-19 symptoms.

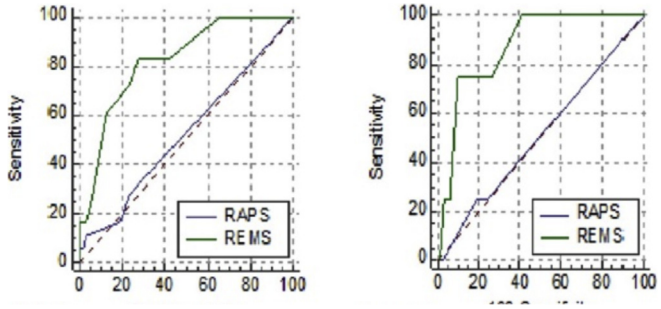

Fig. 3. Receiver operating characteristic curves for the Rapid Emergency Medicine Score (REMS) and the Rapid Acute Physiology Score (RAPS) for the prediction of 30-day mortality in patients with a positive rt-PCR test for SARS-CoV-2 (a) and those with a negative rt-PCR test for SARS-CoV-2 (b).

analysis showed that REMS could predict 30-day mortality in patients without a positive rt-PCR test for SARS-CoV-2. To the best of our knowledge, this is the first study to evaluate all patients presenting to the emergency pandemic clinics with COVID-19- like symptoms using scoring systems.

In our analysis, first, nonparametric comparison tests were used to determine the relationship between scoring systems and mortality. While REMS was significantly higher in the patients with mortality, no significant relationship was found between RAPS and mortality. A further analysis was performed based on the ROC curve to determine the two scoring systems' ability to distinguish whether a patient survived or died. AUC values less than 0.5 were evaluated as indistinguishable from random, while those close to 1 were considered close to the perfect model [7,8]. It has been reported that the AUC value should be greater than 0.8 for a model to predict mortality well [7,8]. In the discriminatory power analysis, we determined the AUC value of RAPS as 0.519, which was considered to be unacceptable. However, the AUC value of REMS in predicting 30-day mortality was 0.840, which indicated the predictive ability of this score for mortality. Thus, our prospective, comparative study, was demonstrated that only REMS was a predictor of 30-day mortality in patients with COVID-19 symptoms and confirmed COVID-19 according to ROC analysis. On the other hand, LRs supply the clearest data on the way in which scoring system can be used reliably [9,10]. Ratios >5 or < 0.2 provide of strongest evidence [9,10]. In the patient group without rt-PCR positivity, LR (+) value of REMS was in this range and clinically useful.

The logistic regression analysis performed to determine the independent predictors of mortality revealed REMS as a predictor of mortality; however, RAPS was not found to be a predictive parameter. A possible explanation for this result is that among the parameters used in the calculation of scores, only age and oxygen saturation are correlated with mortality, as shown by the multivariate logistic regression analysis. Age and oxygen saturation is the only difference between RAPS and REMS.

REMS, first described by Olsson et al. from Sweden, is a new prognostic tool for in-hospital mortality in non-surgical ED patients [11,12]. In a cohort study, the authors showed that oxygen saturation and age were the strongest prognostic parameters and added these parameters to RAPS and validated REMS as a new scoring system [11]. Subsequently, many researchers investigated this new scoring system and compared it with different scoring systems in different patient groups. In a 2019 study of 39,977 patients, REMS was shown to be a more powerful predictor of in-hospital mortality compared to RAPS and MEWS [13]. In the mentioned study, the negative predictive value and cut-off value of REMS were found to be 0.88 and 8, respectively and they did not present LRs of REMS [13].

In the current literature, scoring systems in COVID-19 patients were first evaluated in two studies by Hu et al. [14,15]. In a retrospective study of 105 patients, they demonstrated that AUC for in-hospital mortality predictability and cut-off values were 0.841, and 6, respectively for REMS [14]. The authors suggested that REMS could be used by ED workers to prognosticate in-hospital mortality in critically ill COVID-19 patients. In a second study by Hu et al. evaluating 319 patients with COVID-19, five early warning system scoring system were determined to predict hospital discharge [15]. After Hu et al., researchers investigated different emergency alert scores or sepsis scores in confirmed COVID-19 patients in emergency department and intensive care unit [15-17]. The study indicated that REMS and NEWS scores could predict in-hospital mortality and seven-day hospitalization in

Table 4
Univariate and multivariate logistic regression analyses of the parameters used in the calculation of RAPS and REMS.

	Univariate Analysis		Multivariate Analysis	
	OR (95% CI)	p	OR (95%CI)	p
Age, years			1.09 (1.04–1.13)	**<0.001**
Age, ≥50 vs. <50	27.51 (3.67–206.06)	**0.001**		
Pulse rate (/min)		**0.001**	1.02 (0.98–1.07)	0.170
Mean arterial pressure (mmHg)		0.937	0.97 (0.92–1.02)	0.279
Respiratory rate (/min)		0.511	0.91 (0.78–1.05)	0.219
Glasgow Coma Scale score		**<0.001**	0.53 (0.20–1.38)	0.198
Oxygen saturation (%)		**<0.001**	0.746(0.63–0.88)	**0.001**

OR: Odds Ratio; Cl: confidence interval.

the intensive care unit in patients with confirmed COVID-19 [16]. In contrast, we included all patients with COVID-19-like symptoms patients in our study and evaluated REMS and RAPS prospectively.

5. Limitations

The data were collected from a teaching hospital declared as a pandemic hospital during the pandemic period. Despite the high number of patients presenting to the clinic and the patients being informed about the study by the researchers, only a small number of volunteers participated in the study over a two-month period, limited our cohort. Firstly, misinformation about COVID-19 spreading especially on social media negatively affects the patients' willingness to participate in studies on COVID-19 [18,19]. Secondly, low health literacy is mainly a problem in patients who admitted our department [20]. Thirdly, due to the intensity of the emergency room and pandemic conditions, there was not enough time to persuade all patients to participate in the study. Data belong to each patient were analyzed by a single researcher and there was no patient evaluated by more than one researcher. Therefore, interobserver agreement was not evaluated. On the other hand, although our study was designed prospectively, there were patients with missing mortality information and incomplete forms due to the intensity of ED, which was another reason for the limited sample size. In order to increase the generalizability of the results, they should be confirmed by multi-center studies conducted with large patient groups.

In conclusion, the use of scoring systems consisting of easily measurable parameters in ED allows for critical patients to be identified early and access early medical support. REMS is able to predict patients with COVID-19-like symptoms without positive rt-PCR for SARS-CoV-2 that are at a high-risk of 30-day mortality. Prospective multicenter cohort studies are needed to provide best scoring system for triage in pandemic clinics.

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Declaration of Competing Interest

We declare no conflict of interest.

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