ORIGINAL ARTICLE

ARE SCORING SYSTEMS SUPERIOR TO EACH OTHER IN CLINICAL FOLLOW-UP PLANNING AND MORTALITY ASSESSMENT OF COVID-19 PATIENTS?

Covid-19 Hastalarının Klinik Takip ve Mortalite Değerlendirmesinde Puanlama Sistemleri Birbirinden Üstün Mü?

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ABSTRACT

Objective: In COVID-19 patients,different scoring systems are used to predict the course of disease severity. Aim of the current study is to investigate the superiority of scoring systems over each other in assessment of mortality in Covid-19 patients.

Material and Methods: Study was in retrospective, observational, single-center design.Population of study patients who applied to emergency department between 01.04.2021 and 01.09.2021 with various symptoms and complaints with one or more COVID-19 symptoms.

Results: A total of 1279 full data of 1404 Covid-19 patients between 01/04- 01/09 2021 were reached and 129 patients were excluded because of lack of data.119 patients died within 28 days of admission to the emergency department.28-day mortality rate was 9.3%.Patients with mortal course, diseases including hypertension and diabetes risk factors were found to be higher than those who survived.It was seen that especially age, systolic and diastolic blood pressure from vital signs, diabetes and hypertension from comorbid diseases, Chronic Obstructive Pulmoner Disease, Chronic kidney failure, and Coronary Artery Disease affect the mortality of Covid-19 patients. It was also found that cerebrovascular disease did not affect survival.

Conclusion: Although their superiority over each other is still matter of debate in studies conducted on scoring systems, the calculation of MEWS, NEWS, 4C Mortality Score and qSOFA during hospital admission can predict critical clinical outcomes in COVID-19 patients, according to the results found in the present study. We think qSOFA, NEWS, and 4C Mortality Scores were superior to MEWS.

Keywords: *Covid-19; News; Qsofa; Mews; 4c Mortalite Score; Score System*

ÖZET

Amaç: COVİD-19 hastalarında hastalık şiddetinin seyrini tahmin etmek için farklı skorlama sistemleri kullanılıyor.Bu çalışmanın amacı Covid-19 hastalarında mortalitenin değerlendirilmesinde skorlama sistemlerinin birbirine üstünlüğünü araştırmaktır.

Gereç ve Yöntemler: Çalışma retrospektif, gözlemsel ve tek merkezlidir.Bu çalışmanın evrenini 01.04.2021 ile 01.09.2021 tarihleri arasında acil servise başvuran Covid-19 hastaları dahil edilmiştir.

Bulgular: 01 Nisan - 01 Eylül 2021 tarihleri arasında 1404 Covid-19 hastasının toplam 1279 tam verisine ulaşıldı ve 129 hasta veri eksikliği nedeniyle çalışma dışı bırakıldı. Acil servise başvurduktan sonraki 28 gün içinde toplam 119 hasta öldü. Tüm çalışma boyunca 28 günlük ölüm oranı %9,3 idi. Özellikle ölümlü seyreden hastalarda hipertansiyon ve diyabet risk faktörlerini içeren hastalıkların hayatta kalanlara göre daha yüksek olduğu belirlendi. Hastaların özellikleri, vital bulguları, laboratuvar bulguları ve komorbiditeleri değerlendirildiğinde özellikle yaş, vital bulgulardan sistolik ve diyastolik kan basıncı, yandaş hastalıklardan diyabet ve hipertansiyon, Kronik obstrüktif akciğer hastalığı,, Kronik böbrek yetmezliği ve Koroner arter hastalığı'nın etkilendiği görüldü. Kovid-19 hastalarının ölüm oranı. Ayrıca serebrovasküler hastalığın sağkalımı etkilemediği de tespit edildi.

Sonuç: Skorlama sistemleri üzerinde yapılan çalışmalarda birbirlerine üstünlükleri halen tartışılsa da, sonuçlara göre MEWS, NEWS, 4C Mortalite Skoru ve qSOFA'nın hastaneye başvuru sırasında hesaplanması, COVID-19 hastalarındaki kritik klinik sonuçları öngörebilmektedir. Bu durum mevcut çalışmamızda bulunmuştur. Burada değerlendirilen tüm skorlamalar mortaliteyi öngörmede faydalı olsa da qSOFA, NEWS ve 4C Mortalite Skorlarının MEWS'e üstün olduğunu düşünüyoruz. Özellikle hastaneye ilk başvurudan kritik döneme kadar olan sürede erken müdahaleler COVID-19'da klinik sonuçları iyileştirebilmektedir.

Anahtar Kelimeler: *Covid 19; News; Qsofa; Mews; 4c Mortalite Skoru; Skorlama Sistemleri*

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Geliş tarihi/Received: 30.09.2024
Kabul tarihi/Accepted: 06.02.2025
DOI: 10.16919/bozoktip.1558016

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Bozok Med J 2025;15(1):23-30

INTRODUCTION

Covid 19 SARS-CoV-2 pneumonia, which emerged as a severe acute respiratory disease, was declared a pandemic in 2020 (1). The requirements for critical care and mortality rates varied between countries throughout the pandemic (2).

Although the mortality of COVID-19 infection is high and the age group is the priority, the vital signs of adults in all age groups may deteriorate very quickly and their clinical manifestations may worsen (3-5). Various risk factors such as age, smoking history, critical diseases, diabetes history, high hypersensitive troponin I levels, leukocytosis, neutrophilia, Mean Platelet Volume (MPV), platelet, and D-dimer levels were defined until our present day to predict the course of these patients in the early period of hospital admission (6-10).

Differentiating between a mild disease that does not require hospitalization, a serious disease that requires hospitalization, and a critical disease according to the facilities of hospitals such as critical care units and mechanical ventilators required more studies in the COVID-19 pandemic (11). However, initiating intensive medical treatments at an early stage requires a new urgency for the effectiveness of scoring systems to prevent the dysfunction of other affected organ systems other than the respiratory system (12, 13).

Among these, the Quick Sequential Organ Failure Assessment (qSOFA) System was developed from the Sofa Score as a bedside clinical scoring system to classify patients according to the severity of sepsis clinically. If the qSOFA score is 2 or higher, this may predict a poor prognosis (14). In a study that was conducted on sepsis in 2016, it was reported that a qSOFA score of ≥ 2 points was beneficial in predicting mortality (13). The National Early Warning Score (NEWS), which is another scoring system aimed at the early detection of clinical deterioration, is a physiology-based evaluation that includes vital signs quickly and is used to determine the risk of worsening in patients hospitalized in intensive care units for their follow-up or referral from the very beginning (15). The Modified Early Warning Score (MEWS), on the other hand, can usually be obtained within minutes after the patient is admitted, provides a rapid evaluation result for clinicians, and ensures timely treatment of high-risk patients (16). The 4C Mortality Score includes the parameters that reflect the demographic characteristics, comorbidities, physiology, and inflammation at hospital admission (17).

In COVID-19 patients, different scoring scores are used to predict the course of disease severity. Although the effectiveness of the different scores planned in the present study in predicting mortality was demonstrated in different studies, their comparisons were not evaluated sufficiently so far. The purpose of the present study was to investigate the superiority of scoring systems over each other in mortality evaluation in SARS-Cov2(Covid-19) patients.

MATERIAL AND METHOD

The study was planned in a retrospective, observational, and single-center design. The population of this study consisted of real-time patients who applied to the emergency department between 01.04.2021 and 01.09.2021 with various symptoms and complaints with one or more COVID-19 symptoms such as fever, cough, sputum, shortness of breath, loss of taste or smell, and sore throat. It consists of Covid-19 patients over the age of 18 whose diagnosis was confirmed by the Reverse Transcription Polymerase Chain Reaction (RT-PCR) Test. The criteria for not being included in the study were being younger than 18 years old and having missing data.

The source of the data was the computer-based system of the hospital. It included information on the Glasgow Coma Scale scores (GCS) and vital parameters of patients, as well as patient identification information used to identify each patient in the computer-based system for the patients included in the study. Vital parameters in the form were blood pressure (systolic and diastolic), pulse pressure, body temperature, respiratory rate, and oxygen saturation, as well as patients' demographics, clinical characteristics, comorbidities, laboratory findings, and 30-day mortality rates. As comorbidities, Chronic Obstructive Pulmonary Disease (COPD), Diabetes Mellitus (DM), hypertension, coronary artery disease (CAD), congestive heart failure, active malignancy, chronic kidney disease, and immunosuppressive diseases were recorded. The patients' age, gender, chronic disease history, clinical outcome, and survival were recorded, and among

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blood parameters, the serum biochemistry values from nasal and pharyngeal swabs were determined with the Roche Cobas c501 Device, and SARS-CoV-2 detection kit (Coyote Bioscience Co., Ltd) and were tested with RT-PCR. All data were recorded retrospectively from patient files and the hospital information system.

Scores to be evaluated in the study were as follows. The qSOFA Sore consists of 3 parameters; Glasgow Coma Scale score (GCS<15), systolic hypotension (≤100 mm Hg), tachypnea (≥22/min) as a scoring scale with a total score between 0-3 points (13).

The MEWS scoring system consists of systolic blood pressure (mmHg), pulse (beats per minute), respiratory rate (breaths per minute), the temperature in °C/(°F), and AVPU (Alert, Voice, Pain, Unresponsive) parameters. Parameters have different scores, and a score of ≥5 is considered to be statistically associated with an increased probability of mortality or admission to the intensive care unit. Also, a higher level of care was recommended for the patient for any physiological parameter with a score of +3 (18).

NEWS consists of Respiratory Rate (breaths per minute), Oxygen saturation (%), Any Additional Oxygen demand, Temperature in °C/(°F), systolic blood pressure, pulse (beats per minute), and AVPU parameters (19).

The 4C Mortality Score includes 8 variables consisting of age, gender, number of comorbidities, respiratory rate (breath/min), peripheral oxygen saturation in room air, Glasgow coma scale, BUN(Blood Urea Nitrogen) or creatine, and CRP (C-reactive Protein)(17).

All statistical analyzes were made by using the SPSS 20.0 program for Windows (SPSS Inc., Chicago, IL, USA). The Kolmogorov Smirnov Test and skewness-kurtosis values were used to evaluate the normal distribution of all variables. Also, the normal distribution of the data was evaluated with the histogram, which is one of the graphical methods. Descriptive statistics were used in the demographic analysis of the patients. The Chi-Square and Fisher's Exact Tests were also used to compare the ratios of categorical variables. Quantitative variables in study data were expressed as mean ± standard deviation and minimum-maximum values. The Kruskal-Wallis H Test and the Mann-Whitney U Test were used in the statistical evaluations made according to the categorical (nominal or ordinal) and numerically independent groups of the statistically nonparametric variables.

Univariate analyzes were made by using the Chi-Square, Fisher's Exact, Student's t, and Mann-Whitney U to identify the variables that were associated with 28-day mortality status (NEWS, MEWS, qSOFA, 4C Mortality). Receiver Operating Characteristic (ROC) curves were used to evaluate the accuracy of the scores in the study to predict mortality, and results were reported as Area Under the Curve (AUC) values. The Youden's Index was used to determine the optimal cutoff value of the scores with the highest sensitivity and specificity. Statistical significance was defined at $p < 0.05$.

The ethics committee approval of this study was obtained from the Local Ethics Committee with the approval number 07-2021/03. The data collection was performed retrospectively by the researchers by scanning the automation system data. All researchers adhered to the principles of the Declaration of Helsinki throughout the study period.

RESULTS

A total of 1279 full data of 1404 Covid-19 patients between 01 April - 01 September 2021 were reached and 129 patients were excluded because of lack of data. In the study, the data of 1279 hospitalized patients with confirmed COVID-19 were analyzed (Table 1). Among the 1279 patients who were included in the study, 641 (50.1%) were male and the mean age of the patients was 61.6±17. A total of 119 patients died within 28 days of admission to the emergency department. The 28-day mortality rate was 9.3% for the entire study. The demographic characteristics of SARS-Cov2 patients, clinical results in the first 24 hours, comorbidities, and vital parameters at presentation are given in Table 1. Especially in patients with a mortal course, diseases including hypertension and diabetes risk factors were found to be higher than those who survived. When the characteristics, vital signs, laboratory findings, and comorbidities of the patients were evaluated, it was seen that especially age, systolic and diastolic blood pressure from vital signs, diabetes and hypertension from comorbid diseases, COPD, Chronic kidney failure, and CAD affect the mortality of Covid-19 patients. It was also found that cerebrovascular disease did not affect survival (Table I).

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When the scores that were evaluated in the study with mortality and spearman correlation were evaluated, the MEWS score showed a weak positive correlation, and the qSOFA, NEWS, and C-Mortality scores showed a moderate and positive correlation (Table II).

The mortality evaluations of the Covid 19 patients, who were the subject of the present study, are summarized in Table 3, including MEWS, NEWS, 4C Mortality, and qSOFA scores. In this context, when the scores between the survivors and the deceased were evaluated, statistically significant differences were detected between the groups in MEWS, NEWS, 4C Mortality, and qSOFA scores (<0.05).

ROC analysis for qSOFA, MEWS and NEWS,4C Mortality score The laboratory parameters of the COVID-19 patient groups are shown in Table IV (Figure 1).

DISCUSSION

According to the results and evaluations of the present study, when the effects of vital signs and comorbidities on the mortality of Covid-19 patients were evaluated regarding the mortality of Covid-19 patients, it was found that age and systolic and diastolic blood pressure scores were especially effective among vital signs and characteristic findings, and especially diabetes, hypertension and CAD were effective among comorbidities. In the present study, the purpose was to compare the superiority of these

Table 1. Clinical baseline characteristics of COVID-19 patients

Characteristics	Survivors (Mean±SD)	Mortality(Mean±SD)	P value
Age	60.3±17.5(22-82)	75.1±12.8(23-94)	<0.05
Gender			0.531
Male n(%)	575(%90.3)	62(%9.7)	
Female n(%)	580(%91.1)	57(%8.9)	
Vital Signs			
GCS	14.8±0.2	12.9±2.1	<0.05
Systolic Blood Pressure (mmHg)	126.3±22	116±29	<0.05
Diastolic Blood Pressure(mmHg)	76.2±13.1	67.3±17.3	<0.05
Pulse (rate/minutes)	98±18.2	102.8±22.8	<0.05
Temperature (°C)	37.3±3.5	36.7±0.5	<0.05
SPO2 (%)	90.8±6.8	81.3±10	<0.05
Number of days of hospitalization	9.3±8.1	15±11.1	<0.05
Mechanical ventilator support-n(%)	47(%34.6)	89(%65.4)	<0.05
NIMV(noninvaziv mechanical Ventilation) support n(%)	162(%94.7)	9(%5.3)	<0.05
Presence in comorbidity	1.3±1.3	2.2±1.3	<0.05
Hypertension	454(%39.9)	69(%58.5)	<0.05
Diabetes	320(%28.1)	39(%33.1)	<0.05
CODP	81(%7.1)	18(%15.3)	<0.05
CAD	110(%13.6)	16(%18)	0.26
Cerebrovascular disease	35(%4.3)	5(%12.5)	0.58
Chronic kidney disease	146(%12.8)	35(%19.3)	<0.05
Laboratory Findings			
Urea (mg/dl)	38.2±25.2	81.9±61.3	<0.05
Creatine (mg/dl)	20±38.6	18.5±44.2	<0.05
Albumin (g/dl)	33.2±4.6	29.4±4.7	<0.05
C-reactive protein (0-6 mg/L)	127±26.4	157±27.2	<0.05

Note* sign and P < .05 was considered statistically significant. CODP: Chronic obstructive pulmonary disease CAD: Coronary Artery Dısease,GCS:Glascow Coma Score

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Table 2. Evaluation of the correlation of scoring systems with survival

Score	Correlation coefficient (rs)	P value
QSofa score	0.435	<0.05
MEUS score	0.219	<0.05
NEWS score	0.341	<0.05
4C Mortality score	0.456	<0.05

As statistical analysis, Spearman rank correlation method was used. * p≤0.05 was considered significant. qSofa Score: quick sequential organ failure assessment Mews Score: Modified Early Warning Score News Score: National Early Warning Score

Table 3. Evaluation of mortality in Covid 19 patients according to scoring systems.

Characteristics	Survivors (Mean±SD)	Mortality(Mean±SD)	P value
qSOFA	0.3±0.6	1.7±0.8	<0.05*
Meus	2.4±1.3	3.7±1.7	<0.05*
News	6.2±2.8	10.4±3.7	<0.05*
4C-Mortality	8.3±4.1	15.2±3.4	<0.05*

As statistical analysis, Mann-Whitney U test was used. * p≤0.05 was considered significant. qSofa Score: quick sequential organ failure assessment Mews Score: Modified Early Warning Score News Score: National Early Warning Score

Table 4. ROC analysis results of scoring systems

Score	Cut-off value	AUC	p value	95% CI (lower bound- upper bound)	Sensitivity %	Specificity %
qSofa	2.5	0.878	0.000	0.841-0.915	21	98
MEUS	6.5	0.721	0.000	0.667-0.775	37	93
NEWS	4.5	0.836	0.007	0.792-0.881	34.6	98.2
4C Mortality	14.5	0.895	0.000	0.863-0.927	64	98.2

* p≤0.05 was considered significant. qSofa Score: quick sequential organ failure assessment Mews Score: Modified Early Warning Score News Score: National Early Warning Score

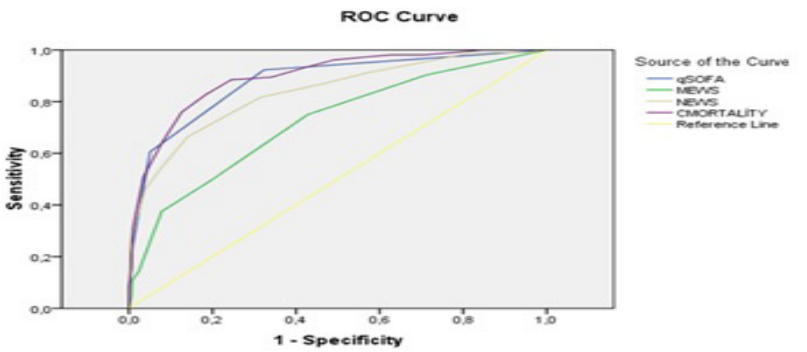

Figure 1. Roc analysis of scoring systems in predicting mortality in Covid 19 patients

scores to each other in the evaluation of mortality by including many scoring systems especially used in hospitals. It is obvious that MEWS, NEWS, 4C Mortality, and qSOFA scores, which were the subjects of our study, give significant results, but it was found that qSOFA Score and 4C Mortality Score were more significant in mortality evaluation than others.

The qSOFA Score evaluated in the present study was 24% in patients with sepsis and in patients with a qSOFA Score ≥ 2 in the mortality evaluation, the mortality rate was reported as 3% in patients with a qSOFA Score ≤1 (20). It was emphasized that the qSOFA Score predicted mortality in a large meta-analysis study conducted on pneumonia (21). Unlike in our study,

although Finkelsztein et al. reported that the qSOFA mortality value was 2 in their sepsis study, it was found that the cut-off value was 2.5, especially in determining mortality in COVID-19 patients. In a study presented by Ferreira et al. in 2020, it was reported that the qSOFA Score does not play a good role in determining the prognosis of Covid-19 patients, while in the present study, it was shown that it can be decisive(20) .We think that the reason why the opposite results were found in this study was because of the number of patients. Although factors such as age, gender, and respiratory support were similar in our study, the numerical values of the patients differed. In a study that was conducted in 2017 to predict qSOFA and SIRS criteria for in-hospital mortality , the specificity values of qSOFA scoring were similar to the present study and support our study (22).

Mellhammar et al. reported in their study that the News score was superior to the qSOFA score (23). NEWS, MEWS, and qSOFA, which were the three scores as the subject of the present study, have the advantage of being evaluated quickly at the bedside, not requiring laboratory tests, and being effective in prognostic evaluation. Calculating the News Score is not time-consuming because it is obtained from routinely measured vital signs by clinicians (24-25). In the present study, although the NEWS Score had a lower AUC (0.836, 95% Cl 0. 0.792-0.881) compared to the ROC Analysis in predicting mortality, its specificity was higher than the qSOFA score. It was concluded that the reason for this was that the NEWS Score had more parameters than the qSOFA Score, and for this reason, its specificity was higher. We think that the NEWS Score is valuable in predicting mortality in SARS-CoV2 disease.

The threshold value for estimating in-hospital mortality seems to have been changed in studies conducted on the efficacy evaluation of MEWS (26-28). In previous studies conducted with non-traumatic patients in the emergency department, the cut-off value was found to vary between 2 and 5 to predict mortality. In another study conducted on intensive care patients, it was emphasized that a MEWS score above 6 could predict mortality (29,30). Based on these studies, it is suggested that the performance and effective threshold of MEWS may differ in certain patient groups. Although the cut-off value, specificity, and sensitivity of the mortality estimation presented by Wang et al. in SARS-CoV2 disease differed from our study, the cut-off values were found to be 7 in another study and showed similarities with our study (31-32). It was observed that the MEWS Score was low in predicting mortality in the ROC analysis and correlation analysis compared to the other three scoring systems. We think that the wide variability of the cut-off value of the MEWS score may cause contradictions in terms of standardization in predicting mortality.

However, aside from the 4C Mortality Score out of the 4 scores evaluated here, the other scores were not time-consuming, so they are easy to use in places where multiple patients are evaluated, such as a pandemic. In this context, it is important for rapid intervention that the results of qSOFA, NEWS, and 4C mortality scores are more significant in the present study. In a previous study, it was emphasized that the NEWS Score is better at predicting mortality than the 4C Mortality Score, which is one of the scores developed specifically for Covid-19 (12). Unlike this study, in our study, although the specificities were similar according to the 4C Score in evaluating mortality, its low sensitivity suggested that it was less effective in predicting mortality. The fact that laboratory values were also included in the components of the 4C Mortality Score can also be considered a disadvantage of the score in terms of prolonged hospitalization times. Although the AUC areas of the qSOFA and the 4C Mortality Score seem to be very close to each other, we concluded that the 4c Mortality Score is more effective in the evaluation of mortality because of their different specificities and sensitivities. We also think that the planning of the follow-up of patients in critical care units, especially during the first admission, in emergencies where the triage system is used, will be advantageous when compared to the 4C Mortality Score because the qSOFA and NEWS Score are not time-consuming and are decisive from the first entry to the emergency services. We believe that the 4C Mortality Score will also be useful in predicting the clinics where the patients will be followed up in hospitalization procedures after the transition of the triage areas is completed.

CONCLUSION

Although their superiority over each other is still a matter of debate in studies conducted on scoring systems, the calculation of MEWS, NEWS, 4C Mortality Score, and qSOFA during hospital admission can predict critical clinical outcomes in COVID-19 patients, according to the results found in the present study. Although all the scorings evaluated here were useful in predicting mortality, we think that qSOFA, NEWS, and 4C Mortality Scores were superior to MEWS. Especially, from the first admission to the hospital to the critical period, early interventions can improve clinical outcomes in COVID-19.

Acknowledgment

The authors declare that there is no conflict of interest between the authors.

REFERENCES

1. Wang, C. C., Wu, C. K., Tsai, M. L., Lee, C. M., Huang, W. C., Chou, H. H et al. 2019 focused update of the guidelines of the Taiwan society of cardiology for the diagnosis and treatment of heart failure. Acta Cardiologica Sinica,2019; 35(3): 244.

2. Reese, H., Iuliano, A. D., Patel, N. N., Garg, S., Kim, L., Silk, B. J, et al.Estimated incidence of coronavirus disease 2019 (COVID-19) illness and hospitalization—United States, February–September 2020. Clin Infect Dis. 2021 Jun 15;72(12):e1010-7.

3. Wu, Z., & McGoogan, J. M. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020 Apr 7;323(13):1239-42.

4. Verity, R., Okell, L. C., Dorigatti, I., Winskill, P., Whittaker, C., Imai, N, et al. Estimates of the severity of coronavirus disease 2019: a model-based analysis. Lancet Infect Dis. 2020 Jun;20(6):669-77.

5. Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., et al.Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020 Feb 15;395(10223):497-506.

6. Zhou, F., Yu, T., Du, R., Fan, G., Liu, Y., Liu, Z., et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. Lancet. 2020 Mar 28;395(10229):1054-62.

7. Hu, L., Chen, S., Fu, Y., Gao, Z., Long, H., Ren, H. W., et al. Risk factors associated with clinical outcomes in 323 coronavirus disease 2019 (COVID-19) hospitalized patients in Wuhan, China. Clin Infect Dis. 2020 Nov 19;71(16):2089-98.

8. Lighter J., Phillips M., Hochman S., Sterling S., Johnson, D., Francois, F. et al.Obesity in patients younger than 60 years is a risk factor for Covid-19 hospital admission. Clin Infect Dis. 2020 Jul 28;71(15):896-7.

9. Zhang, J. J., Lee, K. S., Ang, L. W., Leo, Y. S., Young, B. E. Risk factors for severe disease and efficacy of treatment in patients infected with COVID-19: a systematic review, meta-analysis, and meta-regression analysis. Clin Infect Dis. 2020 Nov 19;71(16):2199-206.

10. Atik, D., Burak Kaya, H. Evaluation of the relationship of MPV, RDW and PVI parameters with disease severity in COVID-19 patients. Acta Clinica Croatica, 2021;60(1.):103-13.

11. Colombo, C. J., Colombo, R. E., Maves, R. C., Branche, A. R., Cohen, S. H., Elie, M. C., et al. Performance analysis of the national early warning score and modified early warning score in the adaptive COVID-19 treatment trial cohort. Crit Care Explor. 2021 Jul 13;3(7):e0474.

12. Heldt, S., Neuböck, M., Kainzbauer, N., Shao, G., Tschoellitsch, T., Duenser, M., et al. qSOFA score poorly predicts critical progression in COVID-19 patients. Wien Med Wochenschr. 2022 Jun;172(9-10):211-9.

13. Kluge, S., Janssens, U., Welte, T., Weber-Carstens, S., Schälte, G., Spinner, C. D., et al. S2k-Leitlinie–Empfehlungen zur stationären Therapie von Patienten mit COVID-19. Pneumologie. 2021 Feb;75(2):88-112.

14. Singer, M., Deutschman, C. S., Seymour, C. W., Shankar-Hari, M., Annane, D., Bauer, M., et al.The third international consensus definitions for sepsis and septic shock (Sepsis3). JAMA. 2016 Feb 23;315(8):801-10.

15. Covino, M., Sandroni, C., Santoro, M., Sabia, L., Simeoni, B., Bocci et al. Predicting intensive care unit admission and death for COVID-19 patients in the emergency department using early warning scores. . Resuscitation. 2020 Nov;156:84-91.

16. Churpek, M. M., Carey, K. A., Merced, N. D., Prister, J., Brofman, J., Edelson, D. P. Validation of early warning scores at two long-term acute care hospitals. Crit Care Med. 2019 Dec;47(12):e962-5.

17. Knight, S. R., Ho, A., Pius, R., Buchan, I., Carson, G., Drake, T. M., et al. Risk stratification of patients admitted to hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: development and validation of the 4C Mortality Score. BMJ. 2020 Nov 13;371:m4334.

18. Mitsunaga, T., Hasegawa, I., Uzura, M., Okuno, K., Otani, K., Ohtaki, Y., et al. Comparison of the National Early Warning Score (NEWS) and the Modified Early Warning Score (MEWS) for predicting admission and in-hospital mortality in elderly patients in the pre-hospital setting and in the emergency department. PeerJ. 2019 May 16;7:e6947.

19. Pimentel, M. A., Redfern, O. C., Gerry, S., Collins, G. S., Malycha,

J., Prytherch, D., et al. A comparison of the ability of the National Early Warning Score and the National Early Warning Score 2 to identify patients at risk of in-hospital mortality: A multi-centre database study. Resuscitation,2019; 134:147-56.

20. Ferreira, M., Blin, T., Collercandy, N., Szychowiak, P., Dequin, P. F., Jouan, Y., et al. Critically ill SARS-CoV-2-infected patients are not stratified as sepsis by the qSOFA. Ann Intensive Care, 2020 Apr 19;10(1): 43.

21. Jiang, J., Yang, J., Jin, Y., Cao, J., Lu, Y. Role of qSOFA in predicting mortality of pneumonia: a systematic review and meta-analysis. Medicine (Baltimore). 2018 Oct;97(40):e12634.

22. Finkelsztein, E. J., Jones, D. S., Ma, K. C., Pabón, M. A., Delgado, T., Nakahira, K., et al . Comparison of qSOFA and SIRS for predicting adverse outcomes of patients with suspicion of sepsis outside the intensive care unit. Crit Care. 2017 Mar 26;21(1):73.

23. Mellhammar, L., Linder, A., Tverring, J., Christensson, B., Boyd, J. H., Sendi, P., et al. NEWS2 is superior to qSOFA in detecting sepsis with organ dysfunction in the emergency department. J Clin Med. 2019 Jul 29;8(8):1128.

24. Tagliabue, F., Schena, D., Galassi, L., Magni, M., Guerrazzi, G., Acerbis, A., et al. Modified national early warning score as early predictor of outcome in COVID-19 pandemic. SN Compr Clin Med. 2021;3(9):1863-9.

25. Bilben, B., Grandal, L., Søvik, S. National Early Warning Score (NEWS) as an emergency department predictor of disease severity and 90-day survival in the acutely dyspneic patient–a prospective observational study.Scand J Trauma Resusc Emerg Med. 2016 Jun 2;24:80.

26. Dundar, Z. D., Ergin, M., Karamercan, M. A., Ayranci, K., Colak, T., Tuncar, A., et al. Modified Early Warning Score and VitalPac Early Warning Score in geriatric patients admitted to emergency department. Eur J Emerg Med. 2016 Dec;23(6):406-12.

27. Bulut, M., Cebicci, H., Sigirli, D., Sak, A., Durmus, O., Top, A. A., et al. The comparison of modified early warning score with rapid emergency medicine score: a prospective multicentre observational cohort study on medical and surgical patients presenting to emergency department. Emerg Med J. 2014 Jun;31(6):476-81.

28. Churpek, M. M., Snyder, A., Han, X., Sokol, S., Pettit, N., Howell, M. D., et al. Quick sepsis-related organ failure assessment, systemic inflammatory response syndrome, and early warning scores for detecting clinical deterioration in infected patients outside the intensive care unit. Am J Respir Crit Care Med. 2017 Apr 1;195(7):906-11.

29. Bhatnagar M, Sirohi N, Dubey AB Prediction of hospital outcome in emergency medical admissions using modified early warning score (MEWS): Indian experience. J Family Med Prim Care. 2021 Jan;10(1):192-8.

30. Reini, K., Fredrikson, M., & Oscarsson, A. The prognostic value of the Modified Early Warning Score in critically ill patients: a prospective, observational study. Eur J Anaesthesiol. 2012 Mar;29(3):152-7.

31. Wang, L., Lv, Q., Zhang, X., Jiang, B., Liu, E., Xiao, C., et al. The utility of MEWS for predicting the mortality in the elderly adults with COVID-19: a retrospective cohort study with comparison to other predictive clinical scores. PeerJ. 2020 Sep 28;8:e10018

32. Aygun H, Eraybar S. The role of emergency department triage early warning score (TREWS) and modified early warning score (MEWS) to predict in-hospital mortality in COVID-19 patients. Ir J Med Sci. 2022 Jun;191(3):997-1003.