DOI: 10.14744/cm.2022.94103
Comprehensive Medicine 2023;15(1):20-26

RESEARCH ARTICLE

Pandemic Medical Early Warning Score Value to Predict Patient Triage and Mortality During the COVID-19 Pandemic Period

Dilay Satılmış, Egemen Yıldız, Erdem Çevik

Department of Emergency Medicine, University of Health Sciences, Sultan 2. Abdulhamid Han Training and Research Hospital, İstanbul, Türkiye

ABSTRACT

Objective: Pandemics and epidemics have significantly affected public health over the years and have shown us the importance of evaluating the prognosis at the early stage. In the coronavirus disease-19 (COVID-19) pandemic, the necessity of clinical scoring in the triage of patients with similar clinical characteristics in the primary care was highlighted. This study aims to investigate the effectiveness of the Pandemic Medical Early Warning Score (PMEWS), which is a clinical score, in the primary care triage of patients and in distinguishing the risk of 30-day mortality in the COVID-19 pandemic.

Materials and Methods: Data from confirmed COVID-19 patients in the emergency department (ED) were analyzed retrospectively between March 2020, and July 2020. The area under the curve (AUC) was used to evaluate the discriminatory power of the PMEWS in predicting all-cause 30-day mortality.

Results: Four hundred and fifty-eight patients were included in this study. The median age of the patients was 54.5 years (IQR 32.25 years). There was at least one coexisting disease in 227 (49.6%) of the patients, and it was significantly higher in non-survivor patients compared to survivors ($p<0.05$). ROC analysis of the PMEWS showed the optimal cutoffs for the 30-day mortality to be 4 (sensitivity 93.33, specificity 82.62). The AUC of the PMEWS for predicting all-cause 30-day mortality was 0.931.

Conclusion: PMEWS is a non-disease-specific and physiological-social score at times of high ED admissions in a pandemic and can be a potentially useful triage tool for pre-examination patient triage and for estimating mortality during pandemic periods. More detailed studies are needed to determine the effectiveness of scorings in pandemics.

Keywords: Mortality, pandemic management, pandemic medical early warning score, triage

How to cite this article: Satılmış D, Yıldız E, Çevik E. Pandemic Medical Early Warning Score Value to Predict Patient Triage and Mortality During the COVID-19 Pandemic Period. CM 2023;15(1):20-26

INTRODUCTION

Pandemics and epidemics have significantly affected, shaped, and changed public health over the years. The socialization of humans and animals led to the adaptation of zoonotic microbes to humans and the transmission of diseases such as tuberculosis, smallpox, influenza, and pertussis from animals to humans. The similarities of the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) pandemic in 2019 to the SARS-CoV pandemics in 2003, and the Middle East Respiratory Syndrome Coronavirus (CoV) pandemics in 2012 remind us of the importance of analyzing the clinical features of patients and evaluating the prognosis in the early period.[1]

Coronavirus disease-19 (COVID-19), which has infected more than 4.5 million people since March 11, 2020, and was declared a pandemic and public health emergency by the World Health Organization, is a novel beta-coronavirus.[2,3] In the pandemic, there have been differences in the disease changes and prognoses of similar clinical features of patients with the same clinical features all over the world, and this complexity in COVID-19 has highlighted the need for the early analysis of patients according to their clinical features.[4]

Pandemic Medical Early Warning Score (PMEWS) is a purely clinical scoring system that can be applied by health scanners in the primary and secondary care. The purpose of the

Address for Correspondence: Dilay Satılmış, Department of Emergency Medicine, University of Health Sciences, Sultan 2. Abdulhamid Han Training and Research Hospital, İstanbul, Türkiye
E-mail: drdilay09@gmail.com **ORCID ID:** 0000-0003-3765-2208

Received date: 22.09.2022
Revised date: 25.10.2022
Accepted date: 31.10.2022
Online date: 27.01.2023

scoring is to identify patients who need hospitalization and to easily discharge patients who do not indicate hospitalization.[5] Challen et al.[5] found that the PMEWS score, which includes age, social isolation, presence of chronic disease, and activity limitation in addition to the temperature, heart rate, oxygen saturation, respiratory rate, systolic blood pressure, and neurological signs (level of alertness), has an effective performance in determining the triage level according to the appropriate care level of the patients and in the decision of patient admission in hospitals. Unlike other scores, the PMEWS score was designed as an isolated and rapid "snapshot" tool for appropriate triage at the time of physiological dysregulation.

The study not only measured the effectiveness of the PMEWS score in the emergency triage of patients in the COVID-19 pandemic period but also investigated the effectiveness of PMWES in distinguishing the 30-day mortality risk in patients. In addition, in the article, the effectiveness of dynamic changes in laboratory values in predicting 30-day all-cause mortality in COVID-19 patients and their relationship with the PMEWS score were also evaluated.

MATERIALS and METHODS

Study Design and Setting

This is a single-center, retrospective, and observational study. Data were extracted from the medical records of 663 consecutive patients with the pre-diagnosis of COVID-19 who applied to the Emergency Medicine Departments of Sultan 2, Abdulhamid Han Training and Research Hospital between March 01, 2020, and July 01, 2020. Since all hospital data of the patients could be accessed in this period, the records were limited to this time interval. The common characteristics of the patients were that they were admitted to the emergency department (ED) with suspicious clinical findings of COVID-19 and that their laboratory values were checked. A total of 205 patients followed in the ED with imaging or clinical features compatible with COVID-19, but negative for the COVID-19 throat swab test was excluded from the study, and a total of 458 patients with a positive COVID-19 throat swab result, who were diagnosed and treated in the ED, that is, confirmed COVID-19 patients were included in the study. We evaluated records of all 458 patients with a positive COVID-19 throat swab result, who were followed up with a pre-diagnosis of COVID-19 in the ED in terms of their demographic characteristics, ED admission clinics, laboratory parameters, comorbidities, and the effectiveness of the PMEWS in predicting 30-day mortality. The sub-parameters of the PMEWS of the patients (Table 1) with positive COVID-19 throat swab test results requested at the ED admissions were recorded separately, the PMEWS result was calculated, and its effectiveness in predicting the patients' all-cause 30-day mortality was evaluated.

Data Analysis

All statistical analyses were conducted using IBM Statistical Package for the Social Sciences Statistics 25.0 (IBM Corp, Armonk, NY) and MedCalc Statistical Software version 20.1 (MedCalc Software Ltd, Ostend, Belgium) applications for Windows. All continuous data in this study were expressed as a median and interquartile range (IQR) (normality was assessed using the Kolmogorov–Smirnov, and Shapiro-Wilk tests). The Mann–Whitney U-test was used to compare continuous variables between two groups, whereas the Chi-square test was performed to compare categorical variables. The area under the ROC curve (AUROC) was used to evaluate the score's performance, and sensitivity and specificity were

Table 1. PMEWS algorithm

Score	3	2	1	0	1	2	3
Physiological data							
Respiratory rate, cycle/min	≤8			9–18	19–25	26–29	≥30
Oxygen saturation, %	<89	90–93	94–96	>96			
Heart rate, beats/min	≤40	41–50		51–100	101–110	111–129	≥130
SBP, mmHg	≤70	71–90	91–100	>100			
Temperature, °C		≤35.0	35.1–36	36.1–37.9	38–38.9	≥39	
Neurological status				Alert	Confused	Voice	Pain
Patient data (Score 1 for each factor)							
Age >65							
Social isolation or chronic disease or performance status >2 (limited activity or confined to bed/chair)							

PMEWS: Pandemic medical early warning score; SBP: Systolic blood pressure

Table 2. Demographic characteristics, clinical, and radiographic characteristics of the patients

	Total population, n=458		Survivors, n=443		Non-survivors, n=15		p
	n	%	n	%	n	%	
Age, median (IQR), years	54.5 (32.25)		54.0 (32.0)		75.0 (14.0)		**<0.001ǀ**
Sex, no							0.324*
Male	280	61.1	269	60.7	11	73.3	
Female	178	38.9	174	39.3	4	26.7	
Coexisting diseases, no	227	49.6	215	48.5	12	80.0	**0.017***
Hypertension	142	31.0	135	30.5	7	46.7	0.182*
Cerebrovascular disease	12	2.6	11	2.5	1	6.7	0.333*
Coronary artery disease	63	13.8	60	13.5	3	20.0	0.446*
Diabetes mellitus	79	17.2	77	17.4	2	13.3	0.506*
Cancer	28	6.1	22	5.0	6	40.0	**<0.001***
Liver disease	6	1.3	6	1.4	-	-	0.875*
COPD	39	8.5	37	8.4	2	13.3	0.371*
Asthma	31	6.8	31	7.0	-	-	0.613*
Kidney disease	20	4.4	18	4.1	1	6.7	0.135*
Admission measures, median (IQR)							
Temperature, °C	36.9 (1.13)		36.9 (1.1)		37.2 (2.5)		0.392ǀ
Heart rate, beats/min	91 (23.25)		90 (23)		101 (42)		0.107ǀ
Oxygen saturation	97 (3)		97 (3)		94 (16)		**0.034ǀ**
SBP, mmHg	130 (21)		90 (21)		133 (42)		0.828ǀ
DBP, mmHg	79.5 (16.25)		79 (16)		80 (36)		0.879ǀ
Symptoms, No							
Cough	171	37.3	167	37.7	4	26.7	0.385*
Fever	114	24.9	108	24.4	6	40.0	0.220*
Dyspnea	110	24.0	101	22.8	9	60.0	**0.001***
Myalgia/arthralgia	71	15.5	68	15.3	3	20.0	0.714*
Fatigue	49	10.7	47	10.6	2	13.3	0.818*
Anosmia	26	5.7	26	5.9	-	-	
Sore Throat	63	13.8	63	14.2	-	-	
Nausea or Vomiting	32	7.0	32	7.2	-	-	
Diarrhea	32	7.0	32	7.2	-	-	
Syncope	5	1.1	4	0.9	1	6.7	0.154*
Headache	51	11.1	51	11.5	-	-	
Loss of Taste	12	2.6	12	2.7	-	-	
Chest CT or radiography, no							0.668
Normal	208	45.4	202	45.6	6	40.0	
Covid Pneumonia	250	54.6	241	54.4	9	60.0	
PMEWS, median (IQR)	2 (3)		2 (3)		10 (8)		**<0.001ǀ**
ED final status, no							
Discharge from ED	204	44.5	201	45.4	3	20.0	
Hospitalization	220	48.0	210	47.4	10	66.7	0.067*
ICU	34	7.4	32	7.2	2	13.3	0.150*

ǀ: Mann–Whitney U-test was used to compare differences; *: Chi-square test was used for analysis. IQR: Interquartile range; COPD: Chronic obstructive pulmonary disease, SBP: Systolic blood pressure; DBP: Diastolic blood pressure; CT: Computed tomography; PMEWS: Pandemic medical early warning score; ED: Emergency department; ICU: Intensive care unit

Table 3. The main laboratory findings associated with survivor and non-survivor patients

Laboratory findings, median (IQR)	Survivors, n=443	Non-Survivors, n=15	p
WBC, 10^3/mm^3	6.65 (4.02)	9.3 (14.85)	0.06[I]
Lymphocyte count, 10^3/mm^3	1.38 (0.96)	0.81 (0.65)	**0.002**[I]
ALT, U/L	24.5 (20)	33 (33)	0.329[I]
AST, U/L	23 (15)	37 (53)	**0.009**[I]
Lactate dehydrogenase, U/L	400.5 (212)	694 (213)	**<0.001**[I]
CRP, mg/L	15.2 (54.73)	103 (123.7)	**<0.001**[I]
D-dimer, µg/L	368 (776)	2520 (5875)	**<0.001**[I]
Creatinine, mg/dL	1.06 (0.43)	1.38 (0.96)	**<0.001**[I]

[I]: Mann–Whitney U-test was used to compare differences. WBC: White blood count; ALT: Alanine aminotransferase; AST: Aspartate aminotransferase; CRP: C-reactive protein

calculated. Cutoff points were determined using Youden's ROC index. The 95% confidence interval was used to evaluate all analyses, and significance was determined at $p<0.05$ level.

Ethical Consideration

Approval was obtained from the Ethics Committee of the University of Health Sciences Hamidiye Scientific Research Ethics Committee (28499/20–79). It was conducted in compliance with the principles of the Declaration of Helsinki. The hospital ethics committee waived written informed consent because the study was retrospective and evaluated only the clinical data of the patients and did not involve any potential risk. The results of this study are reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations.[6]

RESULTS

The study included 458 patients who were admitted to the ED and diagnosed with COVID-19. The median age of the patients was 54.5 years (IQR 32.25 years). Fifteen patients (3.3%) died in the study population. The median age of the non-survived patients was 75 years (IQR 14 years), which is higher than survivors (IQR 32 years, $p<0.001$). The majority of the patients in the study were men (61.1% n=280), and 11 (73.7%) of the non-survivors were male.

There was at least one coexisting disease in 227 (49.6%) of the patients and it was significantly higher in non-survived patients compared to survivors ($p<0.05$). The most common ones were hypertension (HT) (n=142, 31%), followed by diabetes mellitus (DM) (n=79, 17.2%), coronary artery disease (CAD) (n=63, 13.8%), chronic obstructive pulmonary disease (COPD) (n=39, 8.5%), asthma (n=31, 6.8%), and cancer (n=28, 6.1%). Cancer was more common in non-survived patients than in survivors ($p<0.001$) (Table 2).

The admission oxygen saturation of the survivor and non-survivor patients was 97 (IQR 3) and 94 (IQR 16), respectively ($p<0.05$). There were no statistically significant differences in the other admission measures between patients who survived or died. The main admission symptom was cough (n=171, 37.3%), followed by fever (n=114, 24.9%), dyspnea (n=110, 24%), and myalgia/arthralgia (n=71, 15.5%). A total of 208 patients (45.4%) had a normal chest computed tomography (CT) or radiography. There were no statistically significant differences in having COVID-19 pneumonia on chest CT or radiography between patients who survived or non-survived.

The median PMEWS scores of survived and non-survived patients were 2 (IQR 3) and 10 (IQR 8), respectively ($p<0.001$). Thirty-four (7.4%) patients were admitted to the intensive care unit (ICU) and 220 (48%) were hospitalized (Table 2).

The main laboratory findings are shown in Table 3. The lymphocyte count was statistically significantly lower in non-survivor patients (median 0.81, IQR 0.65) than in survivors (median 1.38, IQR 0.96) ($p<0.01$). Aspartate aminotransferase, lactate dehydrogenase (LDH), C-reactive protein (CRP), and D-dimer values were statistically significantly higher in non-survivor patients than survivors (0.009, <0.001, <0.001, and <0.001, respectively).

Table 4 shows sensitivity and specificity values for various cutoff points for each of the scores. Computation of the Youden index and criterion value of the PMEWS score showed the optimal cutoff for the 30-day mortality to be four. For this cutoff, sensitivity was 93.33 (95% CI 0.681–0.998) and specific-

Table 4. Diagnostic performance of PMEWS according to different cutoff values

PMEWS score	Sensitivity	Specificity
≥0	100	0
>2	100	56
>3	93.3	73.9
>4	**93.3**	**82.7**
>5	66.7	89
>8	66.7	97.3
>9	53.3	98
>10	33.3	98.4
>11	26.7	99.3
>12	26.7	99.6
>13	13.3	99.8
>14	0	100

PMEWS: Pandemic medical early warning score

ity was 82.62 (95% CI 0.788–0.86). In the ROC analysis of the PMEWS score predicting all-cause 30-day mortality, the area under the curve (AUC) was 0.931 (95% CI 0.903–0.952) (Fig. 1).

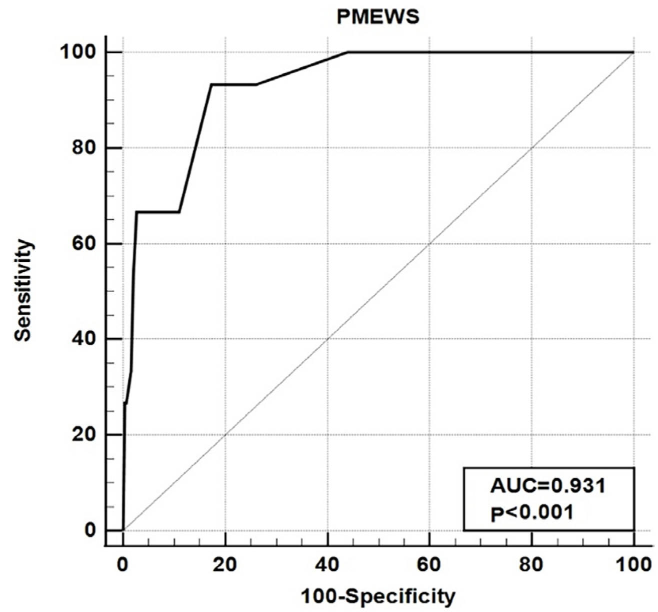

Figure 1. ROC analysis of PMEWS in predicting 30-day mortality

ROC: Receiver operating characteristic; PMEWS: Pandemic Medical Early Warning Score; AUC: Area under curve

DISCUSSION

This retrospective study evaluated the efficacy of PMEWS in predicting effective triage and the prognostic performance of the PMEWS in estimating 30-day mortality in the primary admissions of patients with positive COVID-19 throat swab test results requested during the pandemic period. In this study group, PMEWS had high accuracy (AUC was 0.931, sensitivity 93.33, and specificity 82.62) for the prediction of 30-day mortality. Studies showed the presence of COVID-19 more frequently in male patients than in female patients. The study population in this study consisted of 61.1% male and 38.9% female patients. Although the difference between the two groups was small, the number of male patients was higher. This could be related to sex hormones and x chromosomes, similar to the studies conducted.[7,8] In the study of Zhou et al.,[9] in which 813 patients included 191 COVID-19 positive patients, approximately half of the patients had a comorbid disease, and HT was the most common comorbid disease, followed by DM and CAD, and the mortality rate of patients with comorbid diseases was high (67%). In another study, 46.4% of 138 patients had one or more comorbid diseases. HT (31.2%), DM (10.1%), and CAD (14.5%) were the most common diseases.[10] Similar to other studies, this study showed that 49.6% of COVID-19 positive patients had at least one comorbid disease, and HT (31.1%), DM (17.2%), and CAD (13.8%) were the most common comorbid diseases, and the 30-day mortality rate (80%) of patients with the comorbid disease was significantly higher (P = 0.017).[8,11,12]

In the studies, when the clinical presentation complaints of COVID-19 were evaluated as common, the main clinical symptoms were fever (90% or more), cough (approximately 75%), and dyspnea (up to 50%) and, unlike other pandemics, it showed that in the COVID-19 pandemic, patients were also applying to the ED for non-respiratory reasons.[13] In a study by Talavera et al.,[14] although it is accepted that the symptoms of loss of taste and smell in the COVID-19 pandemic will be effective as a characteristic symptom in early diagnosis and isolation of patients; it has been determined that COVID-19 patients with anosmia have a lower probability of ICU admission and have a better prognosis in terms of mortality and disease severity. Similar to the studies conducted in this study, patients with loss of taste and smell (2.6% and 5.7%, respectively) were evaluated in the ED and their treatment was planned. However, no mortality was detected.[15]

In the study of Shi et al.,[16] based on 11 studies with 2091 cases, which suggested that dyspnea in COVID-19 patients was positively associated with mortality risk, dyspnea was found to be significantly associated with higher mortality in COVID-19 patients. Cough, fever, and dyspnea were the most common causes of admission according to the analysis of the clinical symptoms of the patients similar to the studies, and the mortality rates of the patients who presented with only dyspnea were significantly higher (60.0%) according to the relationship between clinical symptoms and mortality rates (p=0.001).

Zhang et al.,[17] in a systematic review of 28 studies including 4663 patients, showed that the most common laboratory findings in COVID-19 patients were lymphopenia and elevated LDH and CRP. They emphasized that these results require more attention when interpreting laboratory findings in COVID-19 patients and that the management of patients with lymphopenia and increased LDH and CRP are important and that patients should be transferred to the ICU if necessary. Wang et al.[10] evaluated the dynamic change in laboratory findings among 138 surviving and non-surviving COVID-19 patients. The most common laboratory abnormalities observed were significantly decreased lymphocyte levels and significantly elevated CRP, LDH, and D-dimer levels in non-survivors. In the same study, dynamic changes in laboratory parameters in non-survivors were interpreted as SARS-CoV-2 infection may be associated with cellular immunodeficiency, coagulation abnormalities, myocardial injury, hepatic and kidney injury, and the coagulation abnormalities, a cellular immune response may lead to clinical sepsis. In this study, total lymphocyte levels were significantly decreased and CRP, LDH, and D-dimer levels were significantly elevated in non-survivors (p<0.001). This showed us that close follow-up of changes in laboratory parameters in the COVID-19 pandemic, as has been studied in other studies, could be effective in the early evaluation of clinical changes in patients and in estimating the risk of mortality.[8,10,18]

PMEWS was calculated using the algorithm, with scores allocated for varying values of the following indicators: temperature, heart rate, oxygen saturation, respiratory rate, systolic blood pressure, and neurological signs. A score was also given for age ≥65 years, performance status of social isolation, which refers to living alone or not having a social place, chronic disease including respiratory, renal, cardiac, DM or immunosuppression, and limited activity.[5] The PMEWS is a score that increases with the severity of the disease, and studies have shown that it can be used as a clinical triage tool to assist hospital admission decisions in adult patients during a pandemic situation.[19]

In the current data, the optimal cutoff value of PMEWS in predicting disease severity and mortality was four. The AUC outcome of the PMEWS for 30-day mortality was 0.931 (95% CI 0.903–0.952). This rate was given as 0.69 in another study.[19] The predictive performance of the study was found to be higher and more significant compared to other studies in the literature. This difference, from similar triage studies conducted during pandemic periods, may be related to the fact that patients were admitted to the ED for reasons other than respiratory and cardiovascular problems during the COVID-19 pandemic period, and that the scoring results of these patients were normal and their mortality rates were low. In addition, in the literature, there is no adequate comparison and evaluation study for this score in the COVID-19 pandemic. For this reason, this study should be evaluated as a study that can be used in the triage of patients who apply to the ED in different clinics during the pandemic period.

The present study has several limitations. First of all, it is an important limitation that the study is single-centered and retrospective. However, in an ED with a high volume of pandemic patients, all consecutive patients meeting the criteria were included, thereby limiting patient selection bias.

Second, since the study was retrospective, the data were obtained from electronic recording media, and there is a lack of data on laboratory parameters.

Third, patients with negative throat swab tests but with imaging or clinical features consistent with COVID-19 were excluded from the study. Cases with positive throat swab tests were included in the study. This caused a lack of data. COVID-19 patients with negative swab results could not participate in the scoring and were excluded from the evaluation. This is another important limitation of the study.

A shortcoming of the PMEWS is the lack of inclusion of some risk factors for a poor outcome, like obesity. Furthermore, COVID-19 vaccination status is not included in the PMEWS or the study data.

CONCLUSION

In pandemics and epidemics, the increase in hospital admissions of patients with similar clinical characteristics all over the world and the differences in the clinical prognosis of patients has caused emergency physicians to use new clinical tools for safe and high-quality patient triage and care. As in the COVID-19 pandemic, the use of effective scores in patient triage in ED during the pandemic period has also increased its importance. The PMEWS score, a non-disease-specific, physiological-social scoring system at times of high ED admissions in the pandemic, is a potentially useful triage tool for pre-examination patient triage and for estimating 30-day mortality. More studies are needed to determine the effectiveness of such a scoring system in patient triage during the pandemic.

Disclosures

Ethics Committee Approval: The study was approved by the University of Health Sciences Hamidiye Clinical Research Ethics Committee (No: 28499/20–79, Date: 28/07/2020).

Informed Consent: Informed consent is not obtained due to the retrospective nature of this study.

Peer-review: Externally peer reviewed.

Authorship Contributions: Concept: D.S., E.Ç., E.Y.; Design: D.S., E.Y., E.Ç.; Supervision: D.S., E.Ç., E.Y.; Funding: None; Materials: None; Data Collection or Processing: E.Y.; Analysis or Interpretation: D.S., E.Y.; Literature Search: D.S., E.Y.; Writing: D.S.; Critical review: D.S., E.Ç.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study received no financial support.

REFERENCES

1. Samaranayake L, Fakhruddin KS. Pandemics past, present, and future: Their impact on oral health care. J Am Dent Assoc 2021;152:972–80.
2. Zhang G, Zhang J, Wang B, Zhu X, Wang Q, Qiu S. Analysis of clinical characteristics and laboratory findings of 95 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A retrospective analysis. Respir Res 2020;21:74. [CrossRef]
3. Wang Z, Yang B, Li Q, Wen L, Zhang R. Clinical features of 69 cases with coronavirus disease 2019 in Wuhan, China. Clin Infect Dis 2020;71:769–77. [CrossRef]
4. Remuzzi A, Remuzzi G. COVID-19 and Italy: What next? Lancet 2020;395:1225–8. [CrossRef]
5. Challen K, Bright J, Bentley A, Walter D. Physiological-social score (PMEWS) vs. CURB-65 to triage pandemic influenza: A comparative validation study using community-acquired pneumonia as a proxy. BMC Health Serv Res 2007;7:33. [CrossRef]
6. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP; STROBE Initiative. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: Guidelines for reporting observational studies. J Clin Epidemiol 2008;61:344–9.
7. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: A descriptive study. Lancet 2020;395:507–13.
8. Yang X, Yu Y, Xu J, Shu H, Xia J, Liu H, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: A single-centered, retrospective, observational study. Lancet Respir Med 2020;8:475–81. [CrossRef]
9. 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;395:1054–62. Erratum in: Lancet 2020;395:1038. [CrossRef]
10. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA 2020;323:1061–9. [CrossRef]
11. 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;395:497–506. [CrossRef]
12. Genc Yavuz B, Colak S, Guven R, Altundag İ, Seyhan AU, Gunay Inanc R. Clinical features of the 60 years and older patients infected with 2019 novel coronavirus: Can we predict mortality earlier? Gerontology 2021;67:433–40. [CrossRef]
13. Jiang F, Deng L, Zhang L, Cai Y, Cheung CW, Xia Z. Review of the clinical characteristics of coronavirus disease 2019 (COVID-19). J Gen Intern Med 2020;35:1545–9. [CrossRef]
14. Talavera B, García-Azorín D, Martínez-Pías E, Trigo J, Hernández-Pérez I, Valle-Peñacoba G, et al. Anosmia is associated with lower in-hospital mortality in COVID-19. J Neurol Sci 2020;419:117163. [CrossRef]
15. Lee Y, Min P, Lee S, Kim SW. Prevalence and duration of acute loss of smell or taste in COVID-19 patients. J Korean Med Sci 2020;35:e174.
16. Shi L, Wang Y, Wang Y, Duan G, Yang H. Dyspnea rather than fever is a risk factor for predicting mortality in patients with COVID-19. J Infect 2020;81:647–79. [CrossRef]
17. Zhang ZL, Hou YL, Li DT, Li FZ. Laboratory findings of COVID-19: A systematic review and meta-analysis. Scand J Clin Lab Invest 2020;80:441–7. [CrossRef]
18. Milbrandt EB, Reade MC, Lee M, Shook SL, Angus DC, Kong L, et al; GenIMS Investigators. Prevalence and significance of coagulation abnormalities in community-acquired pneumonia. Mol Med 2009;15:438–45.
19. Myles PR, Nguyen-Van-Tam JS, Lim WS, Nicholson KG, Brett SJ, Enstone JE, et al. Comparison of CATs, CURB-65 and PMEWS as triage tools in pandemic influenza admissions to UK hospitals: case control analysis using retrospective data. PLoS One 2012;7:e34428. [CrossRef]