RESEARCH ARTICLE

An easy-to-use prehospital severity scoring tool to triage COVID-19 positive adults in a resource-limited setting

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Abstract

Objective: To develop an easy-to-use severity scoring tool for prehospital triage of patients infected by the coronavirus disease-2019 in resource-limited settings.

Method: The cohort study was conducted at a tertiary care hospital in Karachi, from August to September 2020, and comprised adult patients of either gender who tested positive for coronavirus disease-2019 on real-time polymerase chain reaction. The scoring system and categorisation were based on validated scales for the detection of pneumonia and opinions from pulmonologists. Data was analysed using SPSS 19.

Results: Of the 206 participants, 100(48.5%) were in-patients and 106(51.5%) were out-patients. There were 144(69.9%) males and 62(30.1%) females with an overall mean age of 48.4±16.2 years. After categorisation based on severity, significantly higher number of in-patients were found to be in categories III and IV (p<0.05).

Conclusion: The severity scoring tool could effectively help classify coronavirus disease-2019 patients into mild, moderate and severe cases.

Keywords: Severity scoring tool, COVID-19 management, Pre-hospital triage, Low- and middle-income countries, Resource-limited setting. (JPMA 72: 1959; 2022) **DOI: https://doi.org/10.47391/JPMA.6058**

Submission completion date: 14-02-2022 - **Acceptance date:** 18-05-2023

Introduction

The clinical presentation of coronavirus disease-2019 (COVID-19) can vary on a spectrum of mild self-limiting illness to severe disease. A variety of symptoms have been identified, ranging from fever, cough and fatigue to the less commonly observed gastrointestinal (GI) manifestations, such as vomiting and diarrhoea.[1] In patients with severe COVID-19, pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure can lead to death.[2,3] The major risk factors for severe disease include age ≥50 years, male gender, and underlying comorbidities like hypertension, diabetes, cardiovascular diseases, and malignancy.[4,5]

The latest data from the Ministry of Health in Pakistan confirmed a total of 944,065 cases, of which 39,905 were active and 882,332 had recovered. In Pakistan, the case fatality ratio was 2.3% and the recovery rate was 93.5% till June 7, 2021[6] (Figure 1). Most patients were male (>70%) and the most commonly affected age group was 20-39 years.[7]

The healthcare system in low- and middle-income countries (LMICs) has limited capacity and resources in terms of staffing, testing, triaging and accessibility. Such factors are known to affect clinical outcomes and prognosis. This could be worsened in the face of a pandemic when the isolation facilities and life-saving resources are limited.[8] If the cases continue to rise, there might even be a shortage of current resources in the country. Furthermore, a lack of finances prevents LMICs from acquiring new technologies.[8]

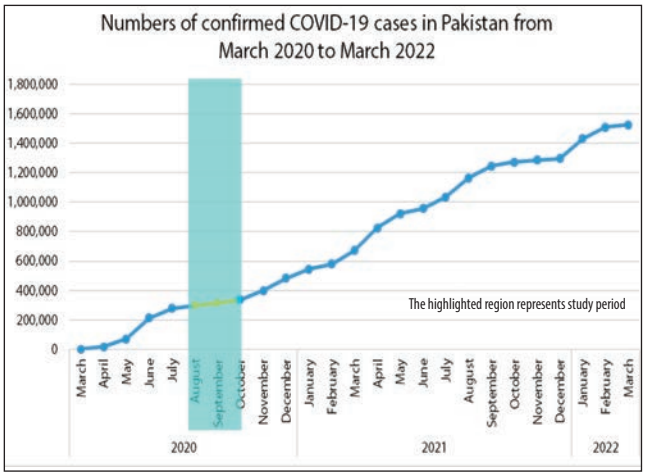

Figure-1: A 2-year course chart of coronavirus disease-2019 (COVID-19) cases in Pakistan.

In May 2020, Wenhua et al. devised a web-based scoring system having 10 variables that predicted if the in-patient might develop a critical illness.[9] An observational cohort study came up with a COVID-19 triage tool based on

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routine observations and clinical assessment of patients presenting to the emergency department (ED) of a hospital in the United Kingdom.[10] However, these did not target pre-hospital triage and community decision-making.

It is thus imperative to develop an easy-to-use, severity tool for the local population that may allow people and physicians to make prompt and well-informed decisions. The current study was planned to develop such a severity scoring tool (SST) that may help first-in line physicians to quickly refer confirmed COVID-19 patients to home or to a hospital, and to classify the urgency of treatment based on a minimal pertinent history and examination findings.

Patients and Methods

The prospective cohort study was conducted from August to September 2020 at the tertiary care Aga Khan University Hospital (AKUH), Karachi, which has 106 beds for COVID-19 isolation.

The sample was raised using non-probability convenience sampling. Those included were adults of either gender who tested positive for COVID-19 on real-time polymerase chain reaction (RT-PCR).

The scoring system and categorisation were arbitrary, and was derived from previously published studies, validated scales for the detection of pneumonia[11,12] and opinions from pulmonologists.

The WHO COVID-19 clinical management guideline describes patient parameters as markers for disease severity categorisation. The clinical parameters deemed easy for the patients to record were fever, dyspnoea, respiratory rate, pulse oximetry at room air, alteration of mental status, heart rate and blood pressure.[13-16] The WHO cut-off for hypoxia in adults was previously a oxygen saturation (SpO_2) ≤94% and it is considered a clinical emergency if the SpO_2 is ≤90%.[17] Hence, it was decided to use SpO_2 ≤94% for a condition that needed immediate medical attention. The cut-off for fever was set at 100.4 °F (38 °C) in accordance with the interim guidance from the Centers for Disease Control and Prevention (CDC) and the Occupational Safety and Health Administration (OSHA).[18-20] Shi et al. confirmed that age ≥50 years and male gender were significantly associated with severe disease. The study also found a significant correlation between disease severity with comorbidities, such as diabetes, hypertension, cardiovascular diseases, and malignancy.[4] Shortness of breath was independently associated with mortality in admitted patients infected with COVID-19.[21,22] The categories for confusion and respiratory rate were used in accordance with the confusion, uraemia, respiratory rate, blood pressure, age ≥65 years (CURB-65) and pneumonia severity index (PSI)/ Pneumonia Patient Outcomes Research Team (PORT) which are used for community-acquired pneumonia triage and mortality prediction. These are well-known validated scores. PSI-PORT has also been effectively used for COVID-19 pneumonia severity scoring and 14-day mortality in patients.[23-26]

Table-1: The Severity scoring tool (SST).

Parameter	Scoring		Reference	Important Notes	Questionnaire
Mean Age (years)	18-49 = 0	≥50 = 1	(4)		1
Gender	Female = 0	Male = 1	(4)		2
Any Co-morbid	No = 0	Yes = 1	(4)		3
Addictions	No = 0	Yes = 1	For nicotine and alcohol use (27–30)	Advise patient to stop smoking	4, 5
Shortness of breath (SOB)	No = 0	Yes = 2	(21,22)		7
SpO_2 (Applicable only if pulse oximeter is available at home)	≥ 95% = 0, ≥ 88% = 0 (for COPD patients)		(17)	≤ 94% (< 88% for COPD patients) = Seek urgent medical consultation (U) ≤ 90% patients should seek emergent medical consultation (E)	8
Confusion	No = 0	Yes = 1	CURB 65 (11) PSI Port (12,23)	Seek urgent medical attention for new onset confusion (U)	9
Respiratory rate (RR)	16-22 = 0	23-29 = 1	CURB 65 (11) PSI Port (12,23)	RR ≥ 30 = Seek emergent medical consultation (E)	10
Temperature	36-38°C = 0	>38°C = 2	(19,20)	< 36 or > 39 = Seek emergent medical consultation (E)	11
Blood Pressure (applicable only if BP apparatus is available)	Any reading >90 systolic and > 60 diastolic = 0		(14)	< 90 systolic, and <60 diastolic = Seek emergent medical consultation (E)	12, 13 and 14
Heart rate (HR)	60-95 = 0		(15,16)	HR < 60 or > 100 = Seek urgent medical consultation (U)	5 – on Day 3, 5 and 7 only
Total score	Max = 10				

SpO_2: Oxygen saturation.

Category	Score range
Category I	0 to 3
Category II	4 to 7
Category III	8 to 10 or Any U
Category IV	Any E

*U: Urgent, defined as a non-life-threatening condition that needs medical attention, E: Emergent, defined as a life-threatening medical condition that requires immediate medical care.

Table-2: Framework for severity scoring.

Category I	Mild (home management and observation)
Category II	Moderate (careful home based/isolation center management)
Category III	Severe (urgent medical care)
Category IV	Critically ill/Life-threatening (emergent medical care)

Once the preliminary scoring tool was formed, 15 forms were filled, and the findings were discussed. The tool was also pre-tested on 5% of the sample size.

Data, such as age, gender, co-morbid status, addictions (smoking and alcohol only),[27-30] shortness of breath, and confusion can be obtained quickly via interview. The remaining parameters, such as SpO_2 (measured by a pulse oximeter), respiratory rate, temperature, blood pressure, and heart rate can be recorded. The scores can then be added, and the patient's triage can be classified into different categories (Tables 1-2).

After approval from the institutional ethics review board, the sample size was determined with 95% confidence interval (CI) and 5% margin of error in line with literature using OpenEpi.[31]

COVID-19-positive out-patient and in-patient lists were retrieved from the AKUH laboratory database. The participants were enrolled within the first 24-48 hours of testing. Informed consent was obtained from all the participants.

Characteristics of out-patients along with vital signs were recorded. Subsequent calls were made every 2 days till the 7th day of testing positive for COVID-19 or the day when the patient got hospitalised. After the first week of enrolment, the patients were then followed on the 14th day. The interviewer made sure that privacy was maintained by conducting the interview alone in an isolated room and a locked door, while the telephone calls were made using hospital landline number, which is a secure line, and it was ensured that the calls were not recorded. The response sheet was uploaded on a password-protected database, and the hardcopy was submitted by the data collector to the principal investigator for safekeeping in a locker.

The medical records for hospitalised patients with COVID-19 disease were reviewed. Patients who had an oxygen requirement of ≥5L/min or those on mechanical ventilation were excluded.

Data was analysed using SPSS 19. An algorithm of symptoms was made based on the symptoms score. The algorithm was reviewed by an expert panel for revision of the scoring system. Normality was assessed using the Kolmogorov-Smirnov test. Continuous variables with normal and non-normal distributions were reported as mean±standard deviation (SD) and median with interquartile range (IQR), respectively. Frequencies and percentages of demographic as well as clinical factors were assessed and stratified by COVID-19 positive out-patient and in-patient status. Continuous variables with normal distribution were analysed using an independent sample t-test, while those with skewed distribution were analysed using the Mann-Whitney U test. Odds ratios (ORs) and their 95% CIs were estimated using logistic regression, with respect to COVID-19 severity and out-patient and in-patient status. Two-sided $p<0.05$ values were considered significant.

Results

Of the 388 patients assessed, 206(53%) were enrolled (Figure 2). There were 100(48.5%) in-patients and 106(51.5%) out-patients. Of the total, 144(69.9%) were males and 62(30.1%) were females. The overall mean age was 48.4±16.2 years. Age and co-morbidities were significantly different between in-patients and out-patients ($p<0.05$). Clinical characteristics were also significantly different except diastolic blood pressure (Table 3).

After categorisation based on severity, significantly higher number of in-patients were found to be in categories III and IV ($p<0.05$) (Table 4).

Out-patients were more likely to be in categories I (the

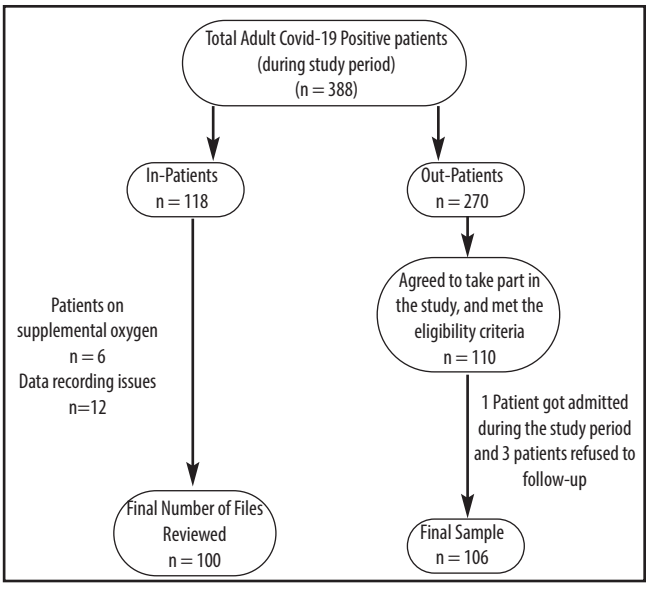

Figure-2: Flowchart of subject enrolment.

Table-3: Patient characteristics (n=206).

	Total; n (%)	In-patient; (n=100)	Out-Patient; (n=106)	*p*-value
Mean Age (years)	48.4±16.2	56.7±13.9	40.6±14.3	**<0.001**
Median (IQR)	49 (37-60)	55.5 (46-67.7)	39 (28-52)	
Age (years)				**<0.001**
<50	109 (52.9)	33 (33)	76 (71.7)	
≥50	97 (47.1)	67 (67)	30 (28.3)	
Gender				0.56
Female	62 (30.1)	32 (32)	30 (28.3)	
Male	144 (69.9)	68 (68)	76 (71.7)	
Any co-morbidities				**<0.001**
Yes	102 (49.5)	67 (67)	35 (33)	
No	104 (50.5)	33 (33)	71 (67)	
Addiction				0.99
Yes	28 (13.6)	14 (14)	14 (13.2)	
No	178 (86.4)	86 (86)	92 (86.8)	
Oxygen saturation (%)	88.8±15.4	83.3±18.1	96.2±4.0	**<0.001**
Median (IQR)	95 (88-98)	90 (80-96)	97 (95-99)	
Respiratory rate (breaths/min)	28.7±8.5	29.2±8.4	19.6±3.2	**0.007**
Median (IQR)	28 (20.5-35)	28 (22-36)	19 (16.7-23.2)	
Heart rate (beats/min)	90.5±18.9	95.0±20.3	83.2±13.6	**<0.001**
Median (IQR)	89 (80-103)	93 (82.5-110)	84 (74-92)	
Temperature (°F)	100.0±1.8	101.0±1.7	99.0±1.3	**<0.001**
Systolic BP (mmHg)	129.5±16.5	131.9±17.2	123.3±12.8	**0.006**
Diastolic BP (mmHg)	78.8±10.4	10.9±1.0	9.1±1.4	0.55
Shortness of breath				**<0.001**
Yes	58 (28.2)	44 (44)	14 (13.2)	
No	148 (71.8)	56 (56)	92 (86.8)	
New onset confusion				**<0.001**
Yes	37 (18)	32 (32)	5 (4.7)	
No	169 (82)	68 (68)	101 (95.3)	

Bold P values are statistically significant; IQR: Interquartile range; BP: Blood pressure.

Table-4: Easy-to-use Severity scoring tool (SST).

Categories	Total; n (%)	In-patient; n=100	Out-Patient; n=106	Odd Ratio (95% CI)	*p*-value
Category I	89 (43.2)	9 (9.0)	80 (75.5)	1.0	**<0.001**
Category II	18 (8.7)	6 (6.0)	12 (11.3)	4.4 (1.3-14.7)	**0.01**
Category III	15 (7.3)	9 (9.0)	6 (5.7)	13.3 (3.6-46.2)	**<0.001**
Category IV	84 (40.8)	76 (76.0)	8 (7.5)	84.4 (31-230.1)	**<0.001**

Bold P values are statistically significant: CI: Confidence interval.

reference category) and II (OR: 4.44, 95% CI: 1.34-14.72, $p<0.01$) than in-patients. Out-patients were more likely to be in categories III (OR: 13.3, 95% CI: 3.6-46.2, $p<0.001$) and IV (OR: 84.4, 95% CI: 31-230.1, $p<0.001$).

Discussion

The SST categorizes COVID-19 patients into 4 categories of increasing severity. According to the scale, patients in categories I and II can be managed at home in isolation, and those in categories III and IV are advised to acquire urgent and emergency medical care, respectively. The scale correctly identified 85.9% of the patients requiring urgent or emergency hospital admissions based on their personal and clinical characteristics. Some patients in categories III and IV were managed at home, and the reason for this could be a shortage of available beds at a nearby hospital or isolation centre. Category I was chosen to be the reference category. OR values also suggested that these patients were more likely to be hospitalised compared to patients in category I. However, as seen in the study 14% of patients in the first two categories were admitted to the hospital, the reason for this can be that their laboratory testing revealed a bad prognosis while their clinical picture did not seem so. Furthermore, 86% of the out-patients were also correctly identified by the scale. The proportion of out-patients reduced with increasing severity.

The patient characteristics in the study were congruent with literature which enlisted age ≥50, male gender, and underlying comorbidities[4,5] as risk factors for severe illness. Therefore, each of these characteristics was given a score.

The current study did not reveal that current or past addictions were associated with hospital admissions. However, large-scale meta-analyses highlighted a strong association between smoking and alcohol consumption with poor prognosis.[27,28,30] As alcohol consumption is prohibited by Pakistani laws and substance use is considered a taboo, it was suspected that due to the cultural norms, most participants did not reveal a history of addictions. However, with literature backing up poor prognosis, the experts decided to give it a score.

Confusion, which is a part of pneumonia severity index tools,[28,32] showed a significant association with hospital admission of patients. This is probably because only severe diseases or sequelae manifest with an altered mental state. The mean admitting respiratory rate of patients was 29.2 breaths/min. Hence, following PSI-PORT and CURB-65, a respiratory rate of ≥30 should be evaluated as an emergency (category IV).[11,12] With expert opinion, the respiratory rate 23-29 breaths/min was given a score of 1.

A significant difference in oxygen saturation was seen between in-patients and out-patients. The availability of a pulse oximeter was a limitation as almost half of the interviewed patients did not have access to a pulse oximeter, and those who had it often did not measure their oxygen saturation levels.

Tachycardia can be seen in severe disease.[33] The current study showed a significant difference in heart rate between

in-patients and out-patients. Hence, for a heart rate ≥95 beats/min, a score was awarded in the SST. This study highlighted that the mean temperature in admitted patients was 101°F. Even though fever might not be associated with a bad prognosis[34] and most out-patient participants were asymptomatic, it is an indicator of symptomatic disease and thus was included in the scoring tool. None of the patients had their blood pressure readings in the hypotensive range; clinically defined as a systolic blood pressure ≤90mmHg (or a drop of >40mmHg from baseline).[14] Hypotension is a finding of critical disease[33] and the experts advised seeking emergency medical attention for it. Most out-patients did not perform pulse oximetry and to record heart rate, respiratory rate, and blood pressure. This could be due to a lack of knowledge and resources.

The current study has limitations, and biggest of them was recall bias. Most out-patients did not record their symptoms and recalled them when interviewed. Also, many patients only recorded their temperature when they felt 'feverish'. Most patients were not aware of the importance of recording vitals.

The use of more pre-hospital triages is recommended to reduce the burden on hospitals in LMICs. In places with a lack of basic healthcare and necessities, people can be educated to conduct pre-hospital triage. More such studies are recommended, particularly in LMICs, to gather more data and improve early decision-making practices. Finally, the development of mobile health (m-Health) applications is also recommended for use at home which may help improve pre-hospital healthcare.

Conclusion

The SST could effectively help classify COVID-19 patients into mild, moderate and severe cases, which may help physicians in LMICs practise effective pre-hospital triage and management of such patients.

Disclaimer: None.

Conflict of Interest: None.

Source of Funding: None.

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