

Applicability of CURB-65 score in patients with COVID-19 presenting to King Faisal Specialist Hospital & Research Center: A retrospective study

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Introduction

The SARS-CoV 2 pandemic was a major societal event that acted as a stress test for much of the world's healthcare systems. The pandemic arose in 2019 as a small cluster of index cases presenting with a pneumonia-like illness in Wuhan city, China, originating from the Huannan fish market. Within weeks, the virus spread at an alarming rate both locally and globally, owing to its high transmissibility [1]. On the 23rd of January 2020, the World Health Organization (WHO) issued a formal statement evaluating the evolving outbreak as being of high global risk [2]. Soon after, the outbreak spread rapidly to over 20 countries, prompting the WHO to label the outbreak as a global pandemic on March 11, 2020 [3]. The virus' spread was difficult to contain, and initiated a sprint towards developing appropriate management and diagnostic pathways for infected patients. Nevertheless, many of the world's healthcare systems were overwhelmed by the sheer magnitude of cases, including well-established ones such as China, the United States, and Italy [4]. As of today in 2025, the total infection toll as reported by the WHO sits at 778 million cases worldwide, with at least 7 million deaths [5]. Although the SARS-CoV-2 pandemic has officially passed, it remains to be a pivotal chapter in history from which much can be learned. This will ring particularly true as we examine the evolution of both the clinical and public health response to the pandemic, from initial scramble to a more stable steady-state, with a critical lens on whether the early use of pneumonia severity tools could have mitigated early strain on healthcare infrastructure.

During the early phases of the outbreak, the primary focus of many countries revolved around appropriate detection and containment of the virus. By the time the WHO had released its initial safety report in January 2020, a number of countries had already taken action against minimizing spread including China, Thailand, Japan, South Korea, and the USA. These interventions included screening individuals at risk, contact tracing of flight passengers, and quarantining suspect patients, with some, namely Japan and the USA, having developed their own PCR assay for detection of the virus [2].

The use of pre-validated clinical decision making tools, such as CURB-65 or the PSI was only seriously considered in the later stretches of the pandemic, often producing good sensitivity and specificity. With the benefit of hindsight, it is important to analyze this evidence to guide future preparedness for respiratory illness outbreaks, avoiding early pitfalls which may have strained healthcare systems worldwide.

To the best of our knowledge, we have not found any publications that examined the literature produced during the timeline of the outbreak to evaluate the use of pre-validated clinical decision making tools (CDMs) such as CURB-65 as an early proxy for triage, risk stratification, and prognostication. This study aims to address this gap through a retrospective cohort analysis, integrating these findings in a narrative review to evaluate whether the use of pre-validated clinical decision-making tools would be an appropriate initial approach to guide disposition planning in very early stages of future outbreaks.

Methodology

Study design and participants

This was a single-center, retrospective cohort study, conducted at King Faisal Specialist Hospital and Research Centre, Riyadh (KFSH&RC). The study population included adult patients aged 18 and above who were diagnosed with COVID-19 pneumonia at our center between January 2020 and August 2021. A patient was defined as having COVID-19 pneumonia if: (1) reverse-transcriptase polymerase chain reaction (PCR) results for COVID-19 were positive; and (2) there was evidence of pulmonary infiltrates on chest radiography or chest CT scan. The CURB-65 scoring system was applied retroactively to all study participants in order to calculate sensitivity and specificity of the scoring system at predicting mortality.

Data collection

Retrospectively from patient electronic medical records (EMRs). All data files were stored on a secure platform and only shared with the research team. The following variables were extracted:

- Demographic data: Age, sex, comorbidities
- Clinical data: triage vitals, COVID severity class at triage, Symptoms at presentation (including new-onset confusion), laboratory results (including BUN), imaging findings

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- Outcomes: Patient disposition and hospital course, 30-day mortality

During this time, patients at our center were being triaged into classes based on symptoms and severity of illness:

- Category A: asymptomatic
- Category B: mild symptoms such as fever, mild cough, myalgia, head ache, sore throat, gastrointestinal (GI) symptoms
- Category C: Pneumonia-Sick e.g. shortness of breath, severe head ache, chest pain
- Category D: Severe disease

A 'CURB65 -based predicted disposition' was calculated using the following CURB65 scores:

- Scores 0-1: Outpatient
- Scores 2: Inpatient, admitted to floors
- Scores 3-5: ICU admission

Statistical analysis

Descriptive statistics were used to summarize the baseline characteristics of the cohort. Continuous variables were expressed

Table 1. Baseline characteristics of participants

Variable	N (%)
Gender	
Male	275 (51.8%)
Female	256 (48.2%)
Symptoms	
Fever	344 (64.8%)
Confusion	14 (2.6%)
Dry cough	248 (46.7%)
Headache	82 (15.4%)
Myalgia	105 (19.8%)
Sore throat	75 (14.1%)
Diarrhea	93 (17.5%)
Nasal congestion	34 (6.4%)
Sneezing	9 (1.7%)
Dyspnea	286 (53.9%)
Productive cough	88 (16.6%)
Loss of taste	33 (6.2%)
Loss of smell	20 (3.8%)
No symptoms	26 (4.9%)
Comorbidities	
Smoker	35 (6.6%)
Diabetes	241 (45.4%)
Hypertension	247 (46.5%)
Stroke	24 (4.5%)
Chronic kidney disease	60 (11.3%)
Cardiomyopathy	21 (4.0%)
Previous myocardial infarction	48 (9.0%)
Arrhythmia	37 (7.0%)
Liver disease	25 (4.7%)
COPD	14 (2.6%)
Asthma	50 (9.4%)
Immunocompromised	155 (29.2%)
No comorbidities	77 (14.5%)
COVID severity class on triage	
Class A	31 (5.8%)
Class B	117 (22.0%)
Class C (Moderate)	288 (54.2%)
Class D (Severe)	95 (17.9%)

Table 2. Patient outcomes

Characteristic	N=531 (%)
Hospital course	
Admitted to floor	310 (58.4%)
ICU	216 (40.7%)
Outpatient	5 (0.9%)
Outcome 30 days later/ mortality	
Alive	492 (92.7%)
Dead	39 (7.3%)

Table 3. CURB-65 scores and expected disposition

Characteristic	N=531 (%)
CURB 65 Scores	
0	176 (33.1%)
1	159 (29.9%)
2	103 (19.4%)
3	70 (13.2%)
4	22 (4.1%)
5	1 (0.2%)
CURB 65 predicted disposition	
Outpatient	335 (63.1%)
Admit for inpatient observation	103 (19.4%)
ICU	93 (17.5%)

as mean $\pm$ standard deviation or median (interquartile range), and categorical variables were expressed as frequencies and percentages. Comparisons between 30-day mortality and characteristics were performed using Chi square test for qualitative variables and independent sample t-tests for continuous variables. A contingency table analysis was used to calculate the proportion of agreement between patient hospital course and predicted disposition based on CURB 65 scores. A p-value of <0.05 was considered statistically significant. The analysis was computed using SPSS.

Ethical considerations

This study was conducted in accordance with the Declaration of Helsinki and was approved by the institutional review board (IRB) of KFSH&RC.

Results

Data were collected from 531 patients with a mean age of 57.2 years (SD 15.9). As shown in (Table 1), 275 patients (51.8%) were male. Fever was the most commonly reported symptom (64.8%), followed by dyspnea (53.9%), dry cough (46.7%), and myalgia (19.8%). A small proportion of patients (4.9%) reported no symptoms.

Regarding comorbidities, hypertension (46.5%) and diabetes (45.4%) were the most prevalent. Other notable conditions included chronic kidney disease (11.3%), asthma (9.4%), and previous myocardial infarction (9.0%). A total of 29.2% of patients were immunocompromised, either due to malignancy or immunosuppressive therapy. In contrast, 14.5% of patients reported no comorbidities.

On arrival to the emergency department, patients were triaged into four severity classes according to institutional policy. The majority were categorized as Class C (moderate symptoms, 54.2%), followed by Class B (mild symptoms, 22.0%), Class D (severe symptoms, 17.9%), and Class A (asymptomatic, 5.8%).

Actual disposition vs calculated disposition using CURB 65

The actual disposition of patients showed that 58.4% were admitted to the hospital floor, 40.7% required ICU-level care, and only 0.9% were discharged for outpatient follow-up. Among those admitted to the ICU,

Table 4. Relationship between actual disposition and expected outcomes

Actual disposition				
CURB 65 expected outcomes	Outpatient	Admitted to floor	ICU	Total
Outpatient	4	244	87	335
Inpatient admission	0	46	57	103
ICU	1	20	72	93
Total	5 (0.94%)	310 (58.38%)	216 (40.68%)	531 (100%)

Table 5. Significance of qualitative patient characteristics related to 30-Day mortality outcomes

Characteristic	Outcome 30 days later/ mortality			
	Alive =N (%)	Dead=N (%)	Total=N	p-value
Gender				
Male	249 (90.6%)	26 (9.5%)	275	0.053
Female	243 (94.92%)	13 (5.08%)	256	
COVID Severity Class on Triage				
Class A	28 (90.32%)	3 (9.68%)	31	<0.001
Class B	117 (100%)	0 (0.0%)	117	
Class C (Moderate)	270 (93.75%)	18 (6.25%)	288	
Moderate) D (Severe)	77 (81.05%)	18 (18.95%)	95	
Symptoms Fever				
No	171 (91.44%)	16 (8.56%)	187	0.43
Yes	321 (93.31%)	23 (6.69%)	344	
Confusion				
No	478 (92.46%)	39 (7.54%)	517	0.286
Yes	14 (100%)	0 (0.0%)	14	
Dry cough				
No	258 (91.17%)	25 (8.83%)	283	0.16
Yes	234 (94.35%)	14 (5.65%)	248	
Headache				
No	412 (91.76%)	37 (8.24%)	449	0.064
Yes	80 (97.56%)	2 (2.44%)	82	
Myalgia				
No	389 (91.31%)	37 (8.69%)	426	0.017
Yes	103 (98.10%)	2 (1.9%)	105	
Sore throat				
No	418 (91.67%)	38 (8.33%)	456	0.031
Yes	74 (98.67%)	1 (1.33%)	75	
Diarrhea				
No	403 (92.01%)	35 (7.99%)	438	0.215
Yes	89 (95.70%)	4 (4.30%)	93	
Nasal congestion				
No	460 (92.56%)	37 (7.44%)	497	0.735
Yes	32 (94.12%)	2 (5.88%)	34	
Sneezing				
No	484 (92.72%)	38 (7.28%)	522	0.662
Yes	8 (88.89%)	1 (11.11%)	9	
Dyspnea				
No	225 (91.84%)	20 (8.16%)	245	0.503
Yes	267 (93.36%)	19 (6.64%)	286	
Productive cough				
No	412 (93%)	31 (7%)	443	0.492
Yes	80 (90.91%)	8 (9.09%)	88	
Loss of taste				
No	459 (92.17%)	39 (7.83%)	498	0.095
Yes	33 (100%)	0 (0.0%)	33	
Loss of smell				
No	472 (92.37%)	39 (7.63%)	511	0.199
Yes	20 (100%)	0 (0.0%)	20	
No symptoms				
No	470 (93.07%)	35 (6.93%)	505	0.107
Yes	22 (84.62%)	4 (15.38%)	26	
CURB 65 Code				
Outpatient	331 (67.3%)	4 (10.3%)	335	<0.001
Admitted for Inpatient observation	98 (19.9%)	5 (12.8%)	103	
ICU	63 (12.8%)	30 (76.9%)	93	

Table 6. Significance of quantitative characteristics related to 30-Day mortality outcomes

Outcome 30 days later/ mortality						
Characteristic	Alive	Alive (N=492, Mean (SD))	Dead	Alive (N=39, Mean (SD))	Total Alive (N=531, Mean (SD))	p-value
Age	56.490	(15.667)	66.205	(15.845)	57.203 (15.869)	0.0002
BMI	25.402	(6.984)	29.692	(8.649)	25.718 (7.197)	<0.001
1PaCO2	5.250	(1.501)	5.544	(1.399)	5.275 (1.494)	0.246
2PaO2	6.828	(3.661)	8.226	(3.957)	6.947 (3.704)	0.026
HCO3	25.137	(4.630)	26.189	(5.996)	25.226 (4.762)	0.193
WBC	6.587	(4.763)	8.575	(4.611)	6.733 (4.776)	0.012
Hemoglobin	125.208	(23.588)	111.103	(26.860)	124.172 (24.099)	<0.001
Platelets	225.959	(93.492)	212.833	(138.497)	224.993 (97.396)	0.418
Neutrophils	59.886	(24.068)	71.210	(25.943)	60.698 (24.357)	0.006
Lymphocytes	21.409	(13.987)	12.003	(13.505)	20.740 (14.149)	<0.001
Eosinophils	1.245	(2.090)	0.785	(0.797)	1.212 (2.026)	0.224
Basophils	0.366	(0.931)	0.316	(0.275)	0.363 (0.903)	0.769
PT	15.651	(4.789)	17.441	(3.963)	15.786 (4.752)	0.024
PTT	39.338	(9.682)	46.138	(18.094)	39.851 (10.677)	<0.001
Fibrinogen	7.529	(49.677)	5.744	(5.238)	7.401 (47.885)	0.834
D-Dimer (fixed) 3	1.286	(2.192)	2.638	(3.773)	1.383 (2.361)	<0.001
ESR	40.177	(30.460)	47.731	(38.174)	40.670 (31.021)	0.23
Blood Urea Nitrogen	6.922	(6.295)	16.256	(10.008)	7.609 (7.061)	<0.001
Serum Creatinine	100.199	(113.019)	182.695	(154.585)	106.258 (118.367)	<0.001
Potassium	4.621	(6.844)	6.577	(12.426)	4.765 (7.398)	0.112
Sodium	137.393	(7.990)	139.821	(7.973)	137.571 (8.006)	0.068
HBA1c	15.364	(55.475)	6.475	(1.420)	15.012 (54.383)	0.75
LDH	340.807	(452.746)	491.649	(325.557)	351.969 (446.082)	0.048
ALT	38.484	(41.357)	50.245	(83.106)	39.335 (45.643)	0.126
AST	37.767	(29.394)	78.087	(123.474)	40.685 (44.578)	<0.001
Ferritin	656.671	(868.332)	1,882.370	(2,984.871)	744.391 (1,192.284)	<0.001
Procalcitonin	0.861	(6.985)	4.141	(16.318)	1.106 (8.081)	0.016

the mean length of stay was 7.2 days. The overall 30-day mortality rate for the cohort was 7.3% (Table 2).

CURB-65 scores were calculated for each patient, and predicted dispositions were assigned based on standard scoring guidelines: scores of 0–1 indicated outpatient management, 2 suggested inpatient admission, and scores ≥ 3 warranted ICU-level care. Based on these predictions (Table 3), 63.1% of patients were expected to be managed as outpatients, 19.4% as floor admissions, and 17.5% as ICU-level admissions.

Sensitivity of CURB 65

A cross-tabulation comparing the CURB-65 code–predicted level of care with actual patient disposition is shown in (Tables 4). Overall agreement between the CURB-65 code and observed outcomes was low, with only 22.98% (122/531) of cases showing exact matches. Agreement was highest for ICU-level care, with 72 patients correctly classified as requiring ICU admission.

Given the small number of patients discharged for outpatient care ($n = 5$), a secondary analysis focused on ICU vs. non-ICU admissions. In this binary classification, the CURB-65 code demonstrated a sensitivity of 55.81% (95% CI: 48.84–62.78), specificity of 69.70% (95% CI: 63.25–76.15), positive predictive value of 78.26% (95% CI: 72.47–84.05), and negative predictive value of 44.66% (95% CI: 37.68–51.64). Agreement in this subset improved to 60.51%.

Different variables and 30 day mortality

Significant associations were found between mortality and COVID-19 Severity Class on triage ($p < 0.001$), CURB-65–predicted disposition ($p < 0.001$), and symptoms of myalgias ($p = 0.017$) and sore throat ($p = 0.031$) (Table 5).

Patients who died within 30 days had significantly higher age (66 vs. 56 years, $p = 0.0002$), BMI (29.6 vs. 23.4 kg/m², $p < 0.001$), and PaO₂ (8.22 vs. 6.83 kPa, $p = 0.026$), along with higher WBC count (8.6 vs. 6.6 $\times 10^9$ /L, $p = 0.012$), neutrophil percentage (71.2% vs. 59.8%, $p = 0.006$), PTT (46.1 vs. 39.3 seconds, $p < 0.001$), D-dimer (2.64 vs. 1.29 mg/L, $p < 0.001$), BUN (10.4 vs. 5.9 mmol/L, $p < 0.001$), creatinine (139.7 vs. 89.3 μ mol/L, $p < 0.001$), AST (97.6 vs. 60.1 U/L, $p = 0.001$), ferritin (1291.8 vs. 927.6 μ g/L, $p = 0.033$), and procalcitonin (4.14 vs. 0.86 ng/mL, $p = 0.016$). Hemoglobin and lymphocyte levels were lower among deceased patients (111 vs. 125 g/L, $p < 0.001$; 12% vs. 21.4%, $p < 0.001$, respectively) (Table 6).

Discussion

The evolution of the COVID-19 response

As the initial days of the outbreak unfolded, a far graver problem began to arise which would mark the true hallmark of what most narrators would consider the brunt of the SARS-CoV 2 outbreak. Initial triage tools were developed under pressure to screen and stratify COVID-related admission. At that point in time, data regarding the clinical history and laboratory findings of SARS-CoV 2 was still evolving. Triage typically segregated patients into high risk and low risk patients on the basis of fever exposure history, clinical symptoms of respiratory illness, positive PCR testing, laboratory derangements consistent with viral infections, and positive imaging results [6,7]. These criteria were broad and sufficient for detecting patients at risk of infection, and facilitated isolation measures to help quell spread. However, they lacked the specificity of established pneumonia scoring systems at predicting mortality or severity, which did little to aid downstream decisions regarding resource allocation; namely informing the need for ICU admission. Many centers were not adequately prepared

for the large influx of COVID positive patients that would greet their door, with many hospitals quickly reaching functional capacity [8-10].

As the early days of March 2020 came to an end, the question of “Is this a patient with COVID-19?” quickly evolved into “Does this COVID-19 patient require intensive care?”. A concern magnified by the sheer number of patients requiring respiratory support. Grasselli et al. reported that out of a sample of 1300 patients with confirmed SARS-CoV 2 infection, 99% required respiratory support [9]. ICU admission rates ranged from 5% to 45% [11-14], varying widely between countries, often necessitating pressors and/or advanced respiratory support as a result of hypoxemic respiratory failure [12,15]. The need for efficient triage pathways that guided intensive care resource allocation was superseded by the unique challenge of developing such pathways presented by the urgent nature of a never before seen, rapidly transmissible virus [16].

COVID risk modifiers

Baseline characteristics and comorbidities

Data quickly emerged showing that older patients presented with disproportionately more severe disease as compared to younger patients [17,18], a finding which was found to be among the most predictive of mortality in some studies [18]. This was likely attributed to a more aggressive cytokine response in these populations, concomitant comorbidities, and susceptibility of infection [13,16,17]. A correlation between mortality and age was noted in our sample. Furthermore, comorbidities such as diabetes mellitus, hypertension, and atherosclerotic cardiovascular diseases have been consistently shown to be associated with more severe disease, likely due to increased host susceptibility of infection caused by upregulated ACE II receptors, an important cell surface molecule implicated in the pathogenesis of the disease [16]. Concurrent respiratory disease, specifically COPD, is an important predictor of severity among patients with COVID-19, in light of the physiologic dysregulation triggered by chronic hypoxia among other factors [18]. Obesity is a well-described risk factor which was implicated in more severe disease as well as with mortality [19]. In our sample, higher BMI was associated with increased mortality.

Laboratory derangements

Lymphocytopenia was among the earliest findings captured among patients with COVID-19, and was shown to predict disease severity [16]. SARS-CoV 2 is unique in the sense that it produces a uniquely potent cytokine signal in hosts, contributing to its virulence [16]. The resulting systemic inflammatory response is reflected in some of the laboratory derangements seen in more severe disease. Markers such as CRP, ESR, and D-Dimer. All of these findings were also shown in our sample to be correlated with increased mortality, corroborating the present literature.

CURB 65 and other risk stratification tools during the pandemic

In light of the aforementioned circumstances, a number of authors sought to develop recommendations that informed clinical decision making, the earliest of which (to the best of the authors' knowledge) included the UK NICE NG159 rapid guideline (a), as well as Zhou et al (b), advising the use of the Clinical Frailty Scale (CFS) and SOFA respectively in stratifying patients, both published in March of 2020. The following days and months, namely June 2020 onward, was when we began to see the emergence of more publications evaluating the utility of both pre-validated clinical decision making tools, as well as those developed specifically to predict COVID-19-related mortality.

In our analysis, we retroactively applied the CURB-65 criteria to a sample of 531 patients with confirmed COVID-19 pneumonia, which demonstrated a significant correlation with 30-day mortality but showed only moderate agreement with actual patient disposition. CURB-65 scores correlated significantly with mortality among our sample, which mimics similar studies in the literature. Interestingly, CURB-65 predicted that only 17.5% of patients among our sample would require ICU-level care as opposed to the 40.7% who received ICU-level care when stratified by COVID severity and clinical gestalt. This is underscored by the fact that agreement between actual patient dispositions as per COVID severity class only agreed with the CURB-65 disposition about 60% of the time. When we analyze the subgroup of ICU admitted patients, we begin to see that CURB-65 was more predictive of mortality than clinical gestalt + COVID severity. The authors are cautious about conflating mortality risk with the need for ICU admission, which is a common talking point in triage literature. We do note however that CURB-65 could have been a more useful adjunct to clinical gestalt and typical ICU admission criteria at triaging ICU-level care as compared to the de-novo triage tool used at our center. The primary question the authors would like to pose, as well as the underpinning of our discussion here is: Given that SARS-CoV 2 caused pneumonia, why weren't these pneumonia-specific tools repurposed sooner in the outbreak? In the light of the evolving pandemic, large volumes of research on the topic were published by the day. Triage in such circumstances would be inherently messy as more evidence accumulates elucidating risk factors and laboratory derangements predictive of mortality and increased resource utilization. However, the use of pre-validated clinical decision making tools (CDMs) such as CURB-65 at the onset of the pandemic would have offered a useful foundation to managing resource distribution, as well as guide early research. These tools, although not a “perfect” fit (given that CURB 65 was originally validated for bacterial pneumonia!), may later be augmented and tested with additional modifiers as new evidence emerges regarding risk predictors. In hindsight, it is apparent that even tools created specifically for COVID-19 were poorly calibrated, and were of limited utility as compared to CURB-65 and qSOFA, as illustrated by Gupta et al's analysis of 22 risk prediction models. And although the authors of this analysis continue to the culmination of this philosophy manifested in the 4C score, a modified version of CURB-65 developed and validated by the point of this discussion is not to argue whether CURB-65 would be a perfect tool for triaging ICU-resources in future outbreaks. But rather, to argue for the early use of pre-validated CDMs over clinical gestalt in the face of an unknown illness.

Limitations

Our study comes with a number of limitations we would like to address. Firstly, the design of our study is not sufficiently powered to truly detect AUC performance of CURB-65 in stratifying patients. Our analysis was exploratory to assess whether CURB-65 showed agreement with current practice in our center, as well as whether it correlated with mortality among a unique subset of patients with high disease complexity, including a large proportion of cancer, organ transplant, and immunocompromised patients. As such, greater emphasis should be placed on the narrative review portion of this article.

In addition, it is important to note that CURB-65 was originally validated for bacterial pneumonia. Its mapping onto a disease causing viral pneumonia is only justifiable due to the overlapping clinical presentations of both pathologies. The later developed 4C score represents how more disease-specific criteria improve the performance of the CDM. Finally, the purpose of this article is not to compare CURB 65 to other CDM tools per se, but rather to highlight that, in the early

stages of an outbreak, applying the most specific pre-validated CDM could guide resource allocation, and can then be refined as evidence evolves.

Conclusion

We present a combined retrospective cohort study and narrative review examining how different Clinical Decision Making (CDM) tools were applied during the pandemic to COVID-19 mortality and severity. We note the possible role CURB-65 could have had during the early days of the outbreak in predicting mortality and the need for ICU admission in conjunction with relevant clinical findings. We propose the early deployment of pre-validated CDM tools such as CURB-65 to guide resource allocation in the very early stages of future outbreaks, with subsequent refining as new data emerges. This approach may help improve system preparedness during the early stages of future pandemics.

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