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# Evaluating The CURB-65 Score for Prognostic Assessment in COVID-19 Patients: A Systematic Review

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**Abstract**

**Introduction:** Several instruments and biomarkers have been used to assess the severity and predict outcomes in COVID-19 patients, each with varying sensitivity levels. One such tool is the CURB-65 score—an acronym for Confusion, Urea nitrogen, Respiratory rate, Blood pressure, and age ≥65 years—which has traditionally been used to evaluate the severity of community-acquired pneumonia. Its application in COVID-19 patients aims to identify clinical deterioration and assist in risk stratification. Accurate prognosis is essential to guide clinical management and reduce mortality. However, the utility of the CURB-65 score in predicting outcomes in COVID-19 patients remains a subject of debate. This study aims to evaluate the performance of the CURB-65 score in determining the prognosis of patients with COVID-19.

**Methods:**This systematic review was conducted in accordance with PRISMA guidelines. Relevant studies published between 2020 and 2022 were identified through searches using predefined keywords in PubMed, ScienceDirect, and EBSCO databases. Studies of all designs that assessed the CURB-65 score concerning COVID-19 outcomes were considered for inclusion.

**Results:** Ten studies were included in this review, evaluating the CURB-65 score's effectiveness in predicting various outcomes in COVID-19 patients, including overall mortality, 30-day mortality, adverse outcomes, need for organ support, ICU admission and intervention, critical illness, mechanical ventilation, and 72-hour mortality. Seven out of ten studies demonstrated good prognostic performance of the CURB-65 score, with sensitivity greater than 80% or an Area Under the Curve (AUC) exceeding 0.80 for predicting mortality.

**Conclusion**: The CURB-65 score shows promising utility in predicting mortality among COVID-19 patients and may perform better than several other prognostic tools. Its simplicity and accessibility make it a valuable aid in clinical decision-making, although further validation in different populations may be warranted

**Keywords**: COVID-19 - CURB-65 - mortality - prognosis



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## INTRODUCTION

A variety of instruments and biomarkers have been reported for assessing the severity and prognosis of patients with Coronavirus Disease 2019 (COVID-19), each demonstrating varying degrees of sensitivity.[1] While biomarkers are often recommended for evaluating clinical deterioration and mortality risk, their use can be costly and may not be feasible in all healthcare settings, especially where resources and laboratory standards differ. Therefore, simpler scoring systems based on basic clinical observations and routine tests are needed to bridge this gap. One such tool is the CURB-65 score, which assesses Confusion, Urea nitrogen levels, Respiratory rate, Blood pressure, and age ≥65 years.[2]

Originally developed by the British Thoracic Society in 1987 as the CRB score (Confusion, Respiratory rate, Blood pressure), it was later modified to CURB-65 by adding urea level and age to better stratify pneumonia severity. Establishing an accurate prognosis in COVID-19 patients is essential, as it guides clinical decision-making and helps health policymakers allocate resources and interventions more effectively to reduce mortality.[3]

Several studies have evaluated the performance of CURB-65 in COVID-19 patients, often comparing it with other scoring systems.[4–6] A study by Satici et al. in Istanbul, Turkey, found that the Pneumonia Severity Index (PSI) had better sensitivity than CURB-65 in predicting mortality. Conversely, research by Chen et al. in Wuhan, China, demonstrated that both PSI and CURB-65 were effective in predicting disease severity and mortality in COVID-19 patients.[7]

Further comparison studies, such as one by Anurag et al. in Ranchi, Jharkhand, evaluated CURB-65 and PSI alongside the Severe Community-Acquired Pneumonia (SCAP) score. Their results indicated that all three scores were useful in predicting disease severity and 14-day mortality, with SCAP showing the highest accuracy.[4] However, a contrasting result was reported by Fatih Doganay, who assessed CURB-65, the International Severe Acute Respiratory and Emerging Infection Consortium Clinical Characterisation Consortium (ISARIC-4C) score, and the COVID-GRAM score. In his study, CURB-65 outperformed both ISARIC-4C and COVID-GRAM in predicting in-hospital mortality and ICU admission needs.[8]

Despite these findings, the effectiveness of the CURB-65 score in determining the prognosis of COVID-19 patients remains a subject of debate. Therefore, this systematic review aims to evaluate the performance of the CURB-65 score in predicting outcomes in patients with COVID-19.



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## METHODS

### Design and Search Strategy

This systematic review focuses on evaluating the performance of the CURB-65 score in determining the prognosis of patients with COVID-19. The literature search was conducted using three major databases: PubMed, ScienceDirect, and EBSCO. Keywords used in the search strategy included combinations of terms such as "COVID-19," "SARS-CoV-2," "Pneumonia COVID-19," or "Coronavirus" combined with "Severity," "Prognosis," or "Mortality," and "Confusion, Urea Nitrogen, Respiratory Rate, Blood Pressure, 65 Years of Age and Older" or "CURB-65."

### Inclusion and Exclusion Criteria

Studies included in this review were limited to observational designs that were relevant to the research topic and published between 2020 and 2022. No exclusion criteria were applied in the selection of studies for this review.

### Quality Appraisal

The quality of the included studies was assessed using the National Institutes of Health (NIH) quality assessment tool for observational cohort and cross-sectional studies. The overall process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.

The performance of the CURB-65 score was considered good if at least one of the following conditions was met: it demonstrated better performance compared to other scoring systems in comparative studies, it showed a sensitivity greater than 80%, or it had a statistically significant association ($p < 0.05$) with severity or mortality outcomes in COVID-19 patients.

This research received ethical approval from the Faculty of Medicine, Atma Jaya Catholic University of Indonesia, under approval number 22/11/KEP-FKIKUAJ/2022. The assessment of study quality was conducted independently by three reviewers (GS, YA, and KK), who had previously discussed and agreed upon the rating criteria. In cases of disagreement, a third reviewer (ID) was consulted to compare the ratings, and a final consensus was achieved through discussion among all reviewers.

## RESULTS AND DISCUSSION

### Study Characteristics

A total of 728 articles were initially retrieved from the PubMed, ScienceDirect, and EBSCO databases. After removing 323 duplicates, 405 articles were screened based on the predefined inclusion and exclusion criteria. From this screening process, 10 studies were identified as meeting the eligibility criteria for inclusion in this review.

Among the included studies, seven were retrospective in design, two were prospective, and one study combined both retrospective and prospective approaches. All selected studies were published between 2020 and 2022. Collectively, the ten studies involved approximately 44,923 adult patients. The complete literature selection process is illustrated in Figure 1.

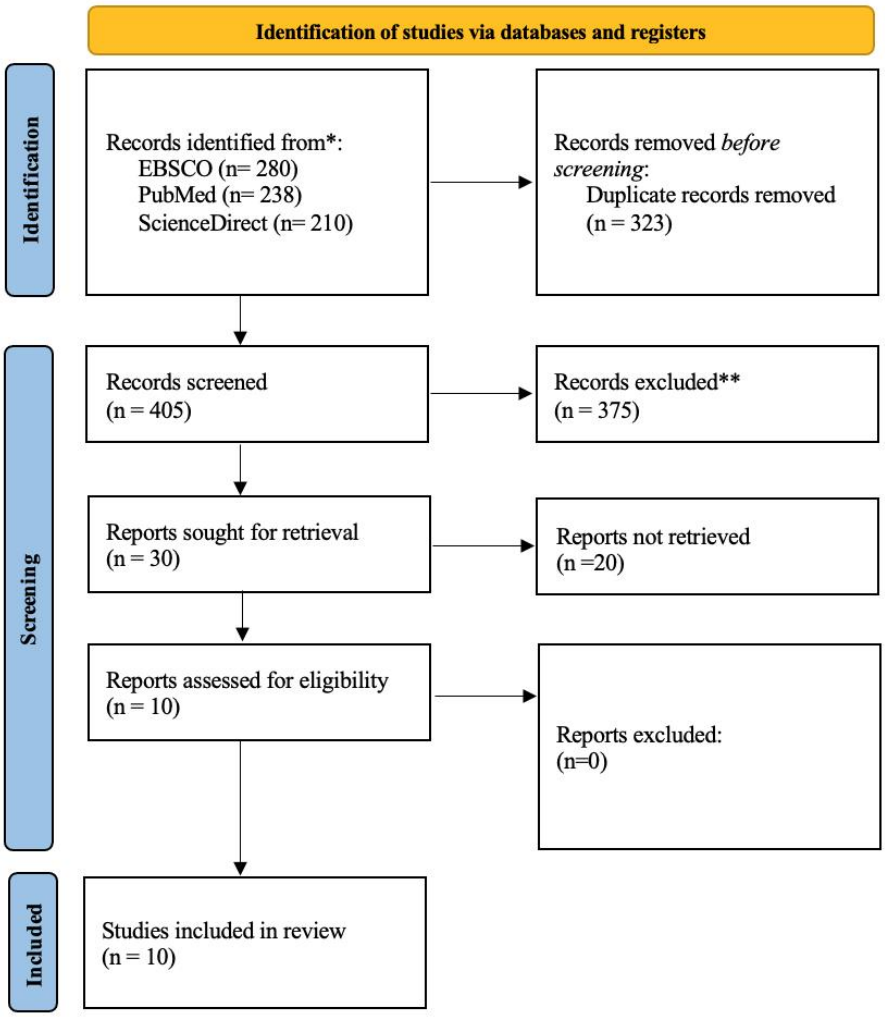


**Figure 1.** Summary of Literature Search

Among the 10 studies evaluating the performance of the CURB-65 score, five focused on predicting overall mortality, while the other five assessed its ability to predict 30-day mortality. Additionally, several studies explored other clinical outcomes, including ICU admission, critical care interventions, prediction of critical illness, the need for mechanical ventilation, 72-hour mortality, adverse outcomes, and the requirement for organ support. To evaluate the predictive performance of CURB-65, eight of the studies reported measures such as sensitivity, specificity, and Area Under the Curve (AUC). One study reported only the AUC, while another presented only sensitivity and specificity data. The detailed results from these 10 studies are summarized in Table 1.

**Mortality**

Among the five studies assessing mortality outcomes, four reported that the CURB-65 score demonstrated good performance, with sensitivity values exceeding 80%.[6,8–10] However, a study by Fan et al. reported a lower sensitivity of 63%, indicating suboptimal predictive capability.[11] In terms of AUC values, Bradley et al. found a result of 0.79, which is considered marginal,[6] while three other studies reported good performance with AUC values above 0.80.[8,10,11]

**30-Day Mortality**

Elmoheen et al. reported one study that assessed 30-day mortality using AUC alone, with a value of 0.78, indicating limited predictive strength.[12] Overall, four studies demonstrated poor performance with AUC values below 0.80,[7,12–14] whereas a study by Armiñanzas et al. reported an AUC of 0.83, indicating good predictive capability.[5] When examined by sensitivity, two studies showed good performance, while the other two showed lower sensitivity, reflecting mixed results [3,12–14].[5,7,13,14]

**Adverse Outcomes and Need for Organ Support**

Thomas et al. found that the CURB-65 score had a sensitivity and specificity of 71% and 69%, respectively, for predicting adverse outcomes. For predicting the need for organ support, the sensitivity and specificity were 52% and 62%, respectively.[9] These results suggest that the CURB-65 score performed poorly in predicting both adverse outcomes and the requirement for organ support, due to sensitivity values falling below the 80% threshold.



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### Critical Care Interventions and Mechanical Ventilation

Elmoheen et al. evaluated CURB-65's ability to predict the need for critical care interventions, reporting an AUC of 0.78, which indicates inadequate performance.[12] Artero et al. assessed the use of CURB-65 in predicting the need for mechanical ventilation, but did not provide a clear definition of this outcome. The AUC value in that study was 0.572, further suggesting weak predictive power.[10]

### Critical Illness

In the study by Armiñanzas et al., critical illness was defined as a combination of ICU admission and 30-day mortality. The CURB-65 score was evaluated using sensitivity (64%), specificity (69%), and AUC (0.727).[5] These values indicate that the score had poor performance in predicting critical illness, as both the sensitivity and AUC fell below accepted thresholds for good prediction.

### ICU Admission

Four studies assessed the CURB-65 score in predicting ICU admission. Two of them used sensitivity, specificity, and AUC as evaluation metrics,[8,14] while the other two reported AUC values only.[10,13] The study by Doğanay et al. showed strong performance, with a sensitivity of 92.94%, specificity of 70.45%, and AUC of 0.898.[8] In contrast, studies by Artero et al. and Bradley et al. reported AUC values of 0.562 and 0.63, respectively, indicating poor performance.[10,13] Similarly, Neto et al.'s study reported low sensitivity (55%) and AUC (0.54), further suggesting that CURB-65 may not reliably predict ICU admission in all settings.[14]

### 72-Hour Mortality

In the study by Bradley et al., the CURB-65 score was evaluated for its ability to predict 72-hour mortality. Two score thresholds were analyzed: <2 and <3. The CURB-65 <2 score demonstrated a sensitivity of 86%, indicating good predictive performance, while the CURB-65 <3 score had a lower sensitivity of 61%.[13] These results suggest that the <2 score threshold is more effective in predicting short-term mortality.



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**Table 1.** CURB-65 Score Performance in Determining Prognosis in COVID-19 Patients

| No | Author | Year | Study design | Subject amount | Hospital Setting | Reference Standard | Performance of CURB-65 |
|---|---|---|---|---|---|---|---|
| 1 | Elmoheen *et al* | 2021 | Retrospective cross-sectional | 1181 | Medical ward | Critical care intervention: invasive or non-invasive mechanical ventilation, extracorporeal membrane oxygenation (ECMO), and/or administration of vasopressor and/or ionotropic drugs, commencing assisted ventilation, insertion of invasive catheters including central line and/or arterial line, and/or renal replacement therapy | 30-day mortality = AUC 0.78<br>Critical care intervention = AUC 0.78 |
| 2 | Armiñanzas *et al*. | 2021 | Retrospective Cohort | 523 | Medical ward | The main outcome measured was a critical illness, which was a combination of ICU admission and 30-day mortality | 30-day mortality:<br>Sensitivity = 86%<br>Specificity = 70%<br>AUC = 0.83<br>Critical illness:<br>Sensitivity = 64%<br>Specificity = 69%<br>AUC = 0.72 |
| 3 | Satici *et al*. | 2020 | Retrospective Cohort | 681 | Medical ward | 30-day mortality: documented death from any cause during hospitalization or within 30 days of admission to the emergency department. | 30-day mortality:<br>Sensitivity = 73%<br>Specificity = 85%<br>AUC = 0.79 |
| 4 | Artero *et al*. | 2021 | Retrospective Cohort | 10.238 | Medical ward | Mortality: death from all causes | Mortality:<br>Sensitivity = 82%<br>Specificity = 71%<br>AUC = 0.82<br>Admission to ICU:<br>AUC = 0.56<br>Use of mechanical ventilation:<br>AUC = 0.57 |
| 5 | Doğanay *et al*. | 2021 | Retrospective study | 481 | Emergency department and medical ward | ICU admission based on *"COVID-19 Diagnosis and Treatment Guide" published by the Ministry of Health* | Mortality:<br>Sensitivity = 85%<br>Specificity = 74%<br>AUC = 0.84<br>Admission to ICU:<br>Sensitivity = 92,94%<br>Specificity = 70,45%<br>AUC = 0.89 |

| No | Author | Year | Study design | Subject amount | Hospital Setting | Reference Standard | Performance of CURB-65 |
|---|---|---|---|---|---|---|---|
| 6 | Bradley, P *et al*. | 2020 | Multicentre prospective | 830 | Medical ward | 30-day mortality: death from all causes within 30 days of hospital admission<br>72-hour mortality: death that occurs within 72 hours (early death) after hospital admission | 30-day mortality:<br>AUC = 0.75<br>CURB-65 <2<br>Sensitivity = 80%<br>Specificity = 61%<br>CURB-65 <3<br>Sensitivity = 47%<br>Specificity = 83%<br>72-hour mortality:<br>AUC = 0.76<br>CURB-65 <2<br>Sensitivity = 86%<br>Specificity = 48%<br>CURB-65 <3<br>Sensitivity = 61%<br>Specificity = 75%<br>Admission to ICU:<br>AUC = 0.63 |
| 7 | Fan *et al*. | 2020 | Retrospective study | 654 | Medical ward | NA | Mortality:<br>Sensitivity = 63%<br>Specificity = 91%<br>AUC = 0.85 |
| 8 | Thomas *et al* | 2021 | Mixed prospective and retrospective cohort | 20891 | Emergency department | Adverse outcome: patients who died or required respiratory, cardiovascular, or renal support | Adverse outcomes:<br>Sensitivity = 71%<br>Specificity = 69%<br>Received organ support:<br>Sensitivity = 52%<br>Specificity = 62%<br>Mortality without organ support:<br>Sensitivity = 86%<br>Specificity = 67% |
| 9 | Bradley, J *et al*. | 2022 | Secondary analysis of two population-based cohort studies | 8081 | Medical ward | NA | Mortality:<br>Sensitivity = 83%<br>Specificity = 61%<br>AUC = 0.79 |
| 10 | Neto *et al*. | 2021 | Retrospective cohort | 1363 | Medical ward | 30-day mortality:<br>Death in hospital over 30 days | 30-day mortality:<br>Sensitivity = 84%<br>Specificity = 53%<br>AUC = 0.74<br>7-day ICU admission:<br>Sensitivity = 55%<br>Specificity = 52%<br>AUC = 0.54 |

## DISCUSSION

COVID-19 is an infectious disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). It was first identified on December 21, 2019, in Wuhan, China, and was officially declared a global pandemic by the World Health Organization (WHO) on March 11, 2020.[15,16] While most individuals infected with SARS-CoV-2 experience mild to moderate symptoms and recover without requiring specialized treatment, certain populations are at higher risk for severe disease and death. This includes the elderly and individuals with pre-existing health conditions such as cardiovascular disease, diabetes, or chronic respiratory illness.[17,18] Given this variability in outcomes, reliable tools and biomarkers are essential to predict disease progression and guide appropriate monitoring and treatment strategies.

One widely used prognostic tool is the CURB-65 score. It is favored for its simplicity, relying on five easily accessible parameters—most of which are derived from basic vital signs. CURB-65 has been validated in multiple populations, is recognized for its strong predictive value in cases of community-acquired pneumonia (CAP), and is easier to apply than many other scoring systems.[19,20] This ease of use has led to its adoption in hospital protocols for managing COVID-19 patients. However, beyond convenience, it is crucial to evaluate the performance of CURB-65 in predicting patient outcomes. A score is considered effective if it achieves an AUC of at least 0.80 or a sensitivity of 80%.

A review of ten studies evaluating CURB-65 in predicting both overall and 30-day mortality found that seven of them concluded the score performed well in this regard.[5,8,13,14] This may be attributed to the strong association between mortality and age in COVID-19 cases, as age is an independent risk factor. Guo et al. found that older age significantly increased the likelihood of death due to age-related impairments in T-cell and B-cell function, inadequate control of viral replication, and a sustained pro-inflammatory response.[10,19] Supporting this, Demir et al. observed that most COVID-19-related deaths occurred in patients aged 70 and older.[21]

In addition to age, mortality has also been linked to elevated blood urea nitrogen (BUN) levels and low blood pressure. Chen et al. reported that non-survivors had BUN levels of ≥7 mmol/L and lower systolic blood pressure,[22] findings echoed by Guo et al.[19] Demir et al. noted that respiratory rates were significantly higher in patients who died compared to survivors.[21] Guo et al. also found that confusion was more common in non-survivors, potentially due to viral neuroinvasion and the presence of


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inflammatory mediators in the central nervous system.[19,23]

Since CURB-65 incorporates all five of these clinical factors—age, BUN, respiratory rate, blood pressure, and confusion—it is unsurprising that it shows strong predictive value for mortality in COVID-19 patients, supported by its AUC >0.80 and sensitivity >80%. Nevertheless, clinicians should also consider other critical markers such as lymphopenia and elevated D-dimer levels, which are known to influence COVID-19 outcomes.[10]

Aside from mortality, several studies evaluated the CURB-65 score's ability to predict other outcomes, including ICU admission, critical care interventions, critical illness, need for mechanical ventilation, adverse events, and requirement for organ support. These indicators are important for determining the severity of a patient's condition. However, only one of the four studies examining ICU admission reported good CURB-65 performance.[8] The remaining studies, which focused on various severity indicators, found the score's predictive performance to be poor, based on both AUC values and sensitivity measures.[5,9,10,12–14]

These findings align with research by Clemente et al., who concluded that CURB-65 is more accurate in predicting mortality than in assessing the appropriate level of care, with AUC values of 0.852 and 0.604, respectively.[24]

In summary, this review concludes that the CURB-65 score is a reliable tool for predicting mortality in COVID-19 patients. However, its effectiveness diminishes when used to predict other clinical outcomes such as ICU admission or the need for advanced interventions.

This study does have limitations. Most of the included studies employed a retrospective design, relying on existing medical records, which may limit the completeness and quality of data. Additionally, the prognostic indicators across the reviewed literature were heterogeneous, suggesting the need for more standardized inclusion criteria in future research.

## CONCLUSION

Based on the current review, the CURB-65 score demonstrates stronger performance in predicting mortality among COVID-19 patients compared to other prognostic indicators such as ICU admission, the need for critical care interventions, prediction of critical illness, use of mechanical ventilation, adverse clinical outcomes, and acceptance of organ support. Its simplicity and reliance on easily measurable clinical parameters make it a practical tool in emergency and inpatient settings. However, its utility appears limited when applied to assess



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the broader spectrum of disease severity or to determine the level of care required.

Given these findings, further research is warranted to better understand the full potential and limitations of the CURB-65 score in the context of COVID-19. It is recommended that future systematic reviews expand the time frame of the literature search to include more recent and diverse studies. Special emphasis should be placed on including prospective research, which allows for more complete and consistent data collection tailored to all five CURB-65 criteria. This would improve the quality of evidence and reduce the risk of bias often associated with retrospective designs. Moreover, by broadening the scope and duration of the review, researchers may be able to identify and validate additional prognostic indicators that are more specific and relevant to COVID-19. These indicators could supplement or enhance the CURB-65 score, leading to the development of more comprehensive and accurate risk stratification tools.

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## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this study.

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