

# A Comprehensive Review of COVID-19 Scoring Systems in India: Implications for Risk Assessment, Triaging, and Clinical Outcome Prediction

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**Abstract—Introduction:** The scoring systems can help classify COVID-19 patients into different groups for optimal resource allocation. While numerous scoring systems have been developed, research on their applicability to the Indian population is relatively limited. This review compares published COVID-19 scoring systems used in India with prominent systems employed globally.

**Discussion:** Key findings of this review analyses include several scoring systems have been developed, including CHASE, OUR-ARDS, and NEWS2. These systems incorporate clinical, laboratory, and radiological factors; they can assist in triaging patients and predicting mortality risk.

**Conclusion:** It's crucial to remember that scoring systems and guidelines are continuously evolving based on new research and clinical findings. Healthcare professionals must stay updated and utilize these tools effectively to prioritize and manage COVID-19 patients based on and each system has its own strengths and limitations.

**Index Terms—**COVID-19, Scoring systems, morbidity, mortality.

## I. INTRODUCTION

SARS-CoV-2, the virus responsible for the COVID-19 pandemic, originated in Wuhan, China<sup>1</sup>, in late 2019 and quickly spread globally. The World Health Organization (WHO) declared COVID-19 a public health emergency of international concern in January 2020 and a pandemic in March 2020<sup>2</sup>.

Most COVID-19 patients experience symptoms like cough, fever, muscle pain, and headache<sup>3</sup>. However, the virus can also lead to severe complications and

death, especially in older adults and individuals with underlying health conditions such as heart disease, diabetes, respiratory problems, or cancer<sup>4</sup>.

To evaluate COVID-19 cases, healthcare professionals assess various parameters, including haematological markers, biochemical indicators, microbiological tests, and radiological scans. Haematological parameters include hemoglobin, total leukocyte count, differential leukocyte count, neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR). Biochemical markers encompass C-reactive protein (CRP), lactate dehydrogenase (LDH), ferritin, D-dimer, procalcitonin, interleukin-6 (IL-6), and the IL-6:IL-10 ratio. The real-time reverse transcriptase-polymerase chain reaction (RT-PCR) is the primary molecular test used to detect SARS-CoV-2 RNA. Chest X-rays and CT scans often reveal abnormalities, even in asymptomatic patients.

Oxygen therapy has been crucial in managing COVID-19 since the pandemic began, and corticosteroids like dexamethasone, monoclonal antibody therapy, and IL-6 receptor blockers have been widely used.

Scoring systems can aid in systematically evaluating patients, facilitating communication among healthcare providers, and guiding treatment decisions. These systems can also help classify patients into different groups for optimal resource allocation. While numerous scoring systems have been developed, research on their applicability to the Indian population is relatively limited. This review compares published COVID-19 scoring systems used in India with prominent systems employed globally.

## II. DISCUSSION

This review examines various scoring systems used to assess disease severity, mortality risk, and complication risk in COVID-19 patients. We have included and analysed key Indian studies (Table 1).

Supriya Sandeepa et al. developed the CHASE score, a clinic-haematological risk assessment tool for COVID-19 patients. This retrospective study involved 451 patients admitted to CDSIMER, Karnataka, from April 2021 to July 2021. The CHASE score incorporates eight parameters (age, gender, symptom duration, comorbidities, SpO<sub>2</sub>, hemoglobin, NLR, PLR), with each parameter assigned a score of 1 or 2. Patients were categorized as low or high risk based on their overall score (8-16). The risk of mortality increased significantly with higher scores, suggesting that a score of  $\geq 11$  could be used as a cutoff to identify high-risk patients. The statistical significance of this finding (p-value = 0.00) supports the validity of the CHASE score. This scoring system can assist clinicians in triaging patients upon admission, determining appropriate care, conducting targeted follow-up investigations, and providing guidance to patient caregivers. Further studies are needed to refine the follow-up protocol and optimize treatment strategies based on the CHASE score<sup>5</sup>.

Vishnu Shankar et al. proposed two separate prognostic scoring systems to predict COVID-19 severity. This retrospective study analysed data from 608 adult COVID-19 patients ( $\geq 18$  years old) admitted to Hindu Mission Hospital, Tamil Nadu, between April 26 and June 25, 2021.

The basic model included nine variables: age group, gender, education level, chronic kidney disease, smoking history, cough, dyspnoea, loss of smell or taste (olfactory-gustatory dysfunction), and gastrointestinal symptoms. These factors were used to develop a nomogram for predicting severity. The advanced model incorporated the same variables as the basic model (excluding olfactory-gustatory dysfunction) along with additional laboratory markers like C-reactive protein, lactate dehydrogenase, ferritin, D-dimer, and a CT severity score.

The basic model had a c-index (discrimination power) of 0.78 (95% CI: 0.74-0.82), while the advanced model achieved a c-index of 0.83 (95% CI: 0.79-0.87). Decision Curve Analysis (DCA) indicated that both

models were beneficial for predicting patient outcomes within a threshold probability range of 10-95%.

A key strength of the basic model is its focus on readily available information, making it ideal for resource-limited settings. The advanced model, while requiring additional resources, provides a more comprehensive assessment for deciding on home isolation or hospitalization. An external validation of these scoring systems using data from larger-scale, longitudinal, and multicentre studies is recommended to ensure their generalizability<sup>2</sup>.

Narendran Gopalan et al. developed the OUR-ARDS score to predict mortality and prioritize treatment in hospitalized COVID-19 patients. This retrospective study analysed data from 746 patients admitted to a tertiary care center in Chengalpattu, Tamil Nadu, between May and November 2020. The OUR-ARDS score was derived from clinical factors, comorbidities, vital signs, and basic lab tests collected as part of routine medical management. The significant predictors of mortality included: SpO<sub>2</sub> <95%, Urea  $\geq 50$  mg/dl, NLR >3, Age  $\geq 50$  years, Heart rate  $\geq 100$  bpm, and Diabetes mellitus. These factors were combined to calculate the OUR-ARDS score. A cutoff score of 25 was identified as a critical predictor of mortality, demonstrating a sensitivity of 90% and a specificity of 64%<sup>6</sup>.

Balchandra Chikhalkar et al. evaluated the National Early Warning Score 2 (NEWS2) as a predictive tool for COVID-19 patient outcomes. This prospective study included 814 confirmed COVID-19 cases over three months. Vital signs were assessed, and NEWS2 scores were calculated upon admission. NEWS2 is based on six physiological parameters: respiratory rate, oxygen saturation, systolic blood pressure, temperature, pulse rate, and level of consciousness (AVPU scale). Patients were categorized into low (0-4), medium (5-6), and high ( $\geq 7$ ) clinical risk categories. The study found that NEWS2 is a valuable tool for early identification of high-risk COVID-19 patients in the emergency department. Its minimal equipment requirements and ease of calculation make it suitable for even remote healthcare settings, facilitating appropriate care placement, such as home quarantine, hospitalization, or intensive care<sup>7</sup>.

Aakashneel Bhattacharya et al. developed a Clinical Symptom-Based Scoring System (CSBSS) for diagnosing COVID-19. A pilot study involving 378

patients with suspected COVID-19 at a tertiary care hospital in New Delhi analysed the association between various clinical symptoms and RT-PCR results to create a scoring formula.

The CSBSS assigns points based on the presence or absence of specific symptoms: fever >100°F (41.7 points), cough (13.5 points), headache (15.8 points), myalgia (10 points), and loss of smell (94.7 points). A total score of >41.7 indicates a positive COVID-19 diagnosis. The adjusted odds ratios for loss of smell, fever >100°F, headache, cough, and myalgia were 5.00, 2.05, 1.31, 1.26, and 1.18, respectively, suggesting their significance in predicting COVID-19. The CSBSS can be used for risk stratification of suspected COVID-19 patients before RT-PCR results are available. However, the study's limitations include its single-center design and potentially non-representative study population. Variations in swab collection techniques among healthcare personnel may have influenced RT-PCR test results<sup>3</sup>.

*Mukul Preetam and Aditya Anurag* developed the MuLBSTA scoring system to predict 14-day mortality risk in Indian COVID-19 patients. This study involved 122 patients treated for SARS-CoV-2 infection at a tertiary hospital in Ranchi, Jharkhand.

MuLBSTA incorporates clinical and laboratory parameters such as multi-lobular infiltration on CT, lymphopenia, bacterial co-infection, smoking,

hypertension, and age. A score of  $\geq 12$  was strongly associated with 14-day mortality risk.

The MuLBSTA scoring system is simple to calculate and can aid primary care physicians in stratifying and referring patients at higher risk of severe complications. However, the study's limitations include its small sample size, single-center design, and retrospective nature, which may introduce potential biases<sup>8</sup>.

*Abijeeth Ashok Salunke et al.* proposed the ABCD scoring system for hospitalized COVID-19 patients. This score incorporates clinical, laboratory, and radiological factors, including age, blood tests (leukopenia, lymphocytopenia, CRP, LDH, D-dimer), chest X-ray, CT scan, comorbidities, and dyspnoea.

The ABCD scoring system uses a letter-based approach (A, B, C, D) to assign a value between 0 and 1. These values correspond to traffic signal colours: green (mild), yellow (moderate), and red (severe). The recommended management for each category includes symptomatic treatment in a ward, active treatment with semi-critical care and oxygen supplementation, or critical care and intensive care, respectively.

The ABCD scoring system is easy to remember and serves as a valuable triage tool for healthcare professionals. However, its validation is currently lacking. If validated, it could facilitate efficient allocation of medical resources<sup>4</sup>.

Table 1:

Sr. No.	Author Name	Title	Name of the Score	Source of Score (Online/ Journal)	Year	Parameters	Salient Features
1	Supriya Sandeepa <sup>5</sup>	Utility of clinico-haematological risk assessment and severity score (chase score) in covid-19 patients	CHASE	Panacea Journal of Medical Sciences	2023	Clinical, Haematological	Age, Sex, Symptom duration, Comorbidity, SpO <sub>2</sub> , Hb, NLR, PLR

2	Vishnu Shankar <sup>2</sup>	Development and validation of prognostic scoring system for COVID-19 severity in South India		Irish Journal of Medical Science	2022	Clinical, Haematological, Biochemical, Radiological	Basic Model - age, sex, education, chronic kidney disease, tobacco, cough, dyspnoea, OGD, gastrointestinal symptoms. Advanced Model - in addition to these variables (except OGD), CRP, LDH, ferritin, D-dimer, CT severity score
3	Narendran Gopalan <sup>6</sup>	Predictors of mortality among hospitalized COVID-19 patients and risk score formulation for prioritizing tertiary care— An experience from South India	OUR-ARDs	PLOS ONE	2022	Clinical, Haematological, Biochemical	SpO <sub>2</sub> , Urea, NLR, Age, Heart Rate, Diabetes Mellitus
4	Balchandra Chikhalkar <sup>7</sup>	Assessment of National Early Warning Score 2 as a Tool to Predict the Outcome of COVID-19 Patients on Admission	NEWS2	Cureus	2022	Clinical	SpO <sub>2</sub> , respiratory rate, pulse rate, systolic blood pressure, level of consciousness, temperature
5	Aakashneel Bhattacharya <sup>3</sup>	Development and Validation of a Clinical Symptom-based Scoring System for Diagnostic Evaluation of COVID-19	CSBSS	Cureus	2021	Clinical	fever, myalgia, headache, cough, anosmia

		Patients Presenting to Outpatient Department in a Pandemic Situation					
6	Mukul Preetam <sup>8</sup>	MuLBSTA score in COVID-19 pneumonia and prediction of 14-day mortality risk: A study in an Indian cohort	MuLBSTA	Journal of Family Medicine and Primary Care	2021	Clinical, Haematological, Microbiological, Radiological	Multi lobular infiltration, lymphopenia, bacterial co-infection, smoking, hypertension, age
7	Abijeeth Ashok Salunke <sup>4</sup>	A proposed ABCD scoring system for better triage of patients with COVID-19: Use of clinical features and radio pathological findings	ABCD	Diabetes and Metabolic Syndrome	2020	Clinical, Haematological, Biochemical, Radiological	Age, Blood tests: leukopenia, lymphocytopenia, CRP, LDH, D-Dimer, Chest radiograph, CT, Comorbidities, Dyspnoea

We analysed prominent scoring systems worldwide and observed that clinical parameters are widely used, including age, sex, dyspnoea, comorbidities, respiratory rate, SpO2, and oxygen supplementation. While blood tests are commonly included in most scoring systems due to their accessibility and cost-effectiveness, the criteria for categorizing patients into mild, moderate, severe, or critical cases vary across countries. Internationally, "pneumonia" is often a key criterion, whereas India uses "breathlessness" and "mental status" for risk stratification.

Overseas scoring systems often provide a comprehensive assessment of patient status,

considering multiple parameters like vital signs, laboratory values, and organ dysfunction. However, some systems, like SOFA and APACHE II,<sup>9</sup> can be complex and resource-intensive, potentially limiting their feasibility in all healthcare settings. There's also a risk of overestimating disease severity and mortality risk, leading to unnecessary interventions and increased costs.

The table below (Table 2) provides a simplified comparison of scoring systems to highlight these differences.

Table 2:

Sr. No	Author Name	Title	Name of the Score	Source of Score (Online/ Journal)	Year	Country	Parameters	Salient features
1	Magdalena Jachymek <sup>10</sup>	The Value of Clinical Frailty Scale (CFS) as a Prognostic Tool in Predicting Mortality in COVID-19— A Retrospective Cohort Study	CFS	International Journal of Environmental Research and Public Health	2022	Poland	Clinical, Haematological, Biochemical	age, gender, BMI, addictions, co-morbidities, medication history, coronavirus-related symptoms, laboratory parameters, respiratory parameters, type of oxygen therapy, COVID 19 specific treatment
2	R Collado – Chagoya <sup>11</sup>	CT findings in survivors and non-survivors of COVID-19 and clinical usefulness of a CT scoring system	CT	Radiologia	2022	Mexico	Clinical, Radiological	age, sex, chest CT findings - typical findings, atypical findings, affection, localization, lung score
3	Jeffrey Petersen <sup>1</sup>	Practical Risk Scoring System for Predicting Severity of COVID-19 Disease	JRSS	Clinical Pathology	2022	USA	Clinical	age, ethnicity, lung disease, cardiovascular disease, smoking, diabetes history with parameters
4	Juan Berenguer <sup>1 2</sup>	Development and validation of a prediction model for 30-day mortality in hospitalised patients with COVID-19: the COVID-19 SEIMC score	COVID-19 SEIMC	Thorax	2021	Spain	Clinical, Haematological, Biochemical	Age, low age-adjusted SpO <sub>2</sub> , NLR, estimated GFR by the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation, dyspnoea, sex

5	Sung- Yeon Cho <sup>13</sup>	Prognosis Score System to Predict Survival for COVID-19 Cases: a Korean Nationwide Cohort Study	COPS	J Med Internet Res	2021	South Korea	Clinical, Haematological	Older age, Dementia, Chronic renal failure, Dyspnoea, Mental disturbance, Absolute lymphocyte count <1000/mm <sup>3</sup>
6	Steve Goodcare <sup>14</sup>	Derivation and validation of a clinical severity score for acutely ill adults with suspected COVID-19: The PRIEST observational cohort study	PRIEST	PLOS ONE	2021	UK	Clinical	NEWS2 score, age, sex, performance status
7	J.L. Pigoga <sup>15</sup>	Derivation of a Contextually Appropriate COVID-19 Mortality Scale for Low-Resource Settings	AFEM-CMS	Annals of Global Health	2021	South Africa	Clinical	age, sex, number of comorbidities, Glasgow Coma Scale, respiratory rate, and systolic blood pressure, SpO <sub>2</sub> / heart rate
8	Jason A. Trubiano <sup>16</sup>	COVID-MATCH65—A prospectively derived clinical decision rule for severe acute respiratory syndrome coronavirus 2	COVID-MATCH65	PLOS ONE	2020	Australia	Clinical	COVID-19 patient exposure/ international travel, Myalgia/malaise, Anosmia or ageusia, Temperature, Coryza/sore throat, Hypoxia–SpO <sub>2</sub> < 97%, 65 years or older

9	Oliver J McElvaney <sup>17</sup>	A linear prognostic score based on the ratio of interleukin-6 to interleukin-10 predicts outcomes in COVID-19	Dublin-Boston	eBioMedicine	2020	Ireland, USA	Haematological	IL-6:IL-10 ratio
10	Dong Ji <sup>18</sup>	Prediction for Progression Risk in Patients With COVID-19 Pneumonia: The CALL Score	CALL	Clinical Infectious Diseases: An Official Publication of the Infectious Diseases Society of America	2020	China	Clinical, Haematological, Biochemical	Comorbidity, Age, Lymphocyte, LDH
11	Stephen R Knight <sup>19</sup>	Risk stratification of patients admitted to hospital with covid-19 using the ISARIC WHO Clinical Characterisation Protocol: development and validation of the 4C Mortality Score	4C Mortality	BMJ	2020	UK	Clinical, Biochemical	age, sex, number of comorbidities, respiratory rate, peripheral oxygen saturation, level of consciousness, urea level, CRP
12	Yufeng Shang <sup>20</sup>	Scoring systems for predicting mortality for severe patients with COVID-19	CSS	eClinicalMedicine	2020	China	Clinical, Haematological, Biochemical	age, coronary heart disease (CHD), lymphocytes %, procalcitonin (PCT), D-dimer
13	Andrea Borghesi <sup>21</sup>	COVID-19 outbreak in Italy: experimental chest X-ray scoring system for quantifying and monitoring disease progression	Brixia	La Radiologia Medica	2020	Italy	Radiological	CXR analysis - interstitial infiltrates, interstitial predominance, alveolar predominance

14	Vincenzo De Sanctis <sup>22</sup>	Proposed Scoring System for Evaluating Clinico-radiological Severity of COVID-19 using Plain Chest X-ray (CXR) changes (CO X-RADS): Preliminary results	CO X-RADS	Acta Bio Medica: Atenei Parmensis	2020	Qatar	Clinical, Radiological	fever, cough, dyspnoea, abdominal and generalized body pains, chest involvement
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### III. CONCLUSION

Various countries have implemented unique scoring systems or guidelines to triage COVID-19 patients during the pandemic. While some systems, such as the WHO and CDC guidelines, are widely used internationally, both Indian and foreign scoring systems have specific advantages and disadvantages. Indian scoring systems offer cultural relevance, cost-effectiveness, and simplicity, but may lack international recognition and validation. Foreign scoring systems provide comprehensive assessments, standardized approaches, and international recognition, but can be complex, resource-intensive, and less adaptable to diverse populations.

The selection of a scoring system should be tailored to the specific needs and characteristics of the local population, healthcare infrastructure, and available resources. This ensures optimal utility and improved patient care outcomes. It's crucial to remember that scoring systems and guidelines are continuously evolving based on new research and clinical findings. Healthcare professionals must stay updated and utilize these tools effectively to prioritize and manage COVID-19 patients.

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