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Comparison of CURB-65, BAP65, and DECAF scores for risk stratification in acute exacerbation of COPD

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Key words: AECOPD, DECAF score, CURB-65s core, BAP-65 score, mortality.

Abstract

According to the WHO, Chronic obstructive pulmonary disease is the fourth leading cause of death worldwide. Acute exacerbations of COPD (AECOPD) are critical events that affect quality of life, increase hospital admissions, and mortality rates. DECAF, BAP-65, and CURB-65 scores are commonly used for risk stratification. However, limited comparative data exist regarding their prognostic performance in Indian populations presenting to the emergency departments. The primary outcome of the study is to compare the DECAF, BAP-65, and CURB-65 scoring systems for predicting in-hospital mortality. The secondary outcome is to assess the need for mechanical ventilation. This prospective, cross-sectional, observational study was conducted at a tertiary care teaching hospital.

Adult patients who presented to the Emergency Department (ED) with Acute Exacerbations of COPD were enrolled from April 2023 to December 2025. Demographic details, DECAF, BAP-65, and CURB-65 scores were recorded after initial assessment. ROC and Area Under Curve analysis were done to assess the prognostic performance of the individual score. Of the total 100 participants, 59% were females. The areas under the curve for DECAF, CURB-65, and BAP-65 are 0.806, 0.707, and 0.673, respectively. A DECAF score of more than 04 was associated with the need for mechanical ventilation. The DECAF score was found to be a better risk stratification tool to predict mortality (score >4) and need for mechanical ventilation (score >3) in acute exacerbations of chronic obstructive pulmonary disease.

Introduction

Globally, chronic obstructive pulmonary disease accounts for 5% of overall deaths, with nearly 90% of deaths in low- and middle-income countries. There are two types: emphysema and chronic bronchitis. It is a common lung disease that usually manifests as breathing difficulties associated with a chronic cough. The most common etiology is Tobacco smoking, accounting for 70% in developed countries and 30-40% in developing countries.¹ Household air pollution, Biomass exposure, and inhalation of dust are other risk factors contributing to the occurrence of disease in low- and middle-income countries.

Studies have shown that 30% to 50% of people may experience at least one exacerbation per year. Mortality after exacerbation ranges from 3.6% to 31% (between 90 days and 2 years), and patients admitted to Intensive Care Units (ICUs) is as high as 29%.²

Early identification of high-risk patients is crucial for appropriate triage, allocation of healthcare resources, timely escalation of care, and informed clinical decision-making. Accurate risk stratification may help predict important clinical outcomes, such as in-hospital mortality, need for ICU admission, mechanical ventilation, length of hospital stay, and readmission rates.³⁻⁵

Several prognostic scoring systems have been developed to assess disease severity and predict outcomes in patients admitted with AECOPD. Among these, the CURB-65 score, originally designed

for community-acquired pneumonia, incorporates confusion, blood urea level, respiratory rate, blood pressure, and age. Despite not being specifically developed for COPD, it has been widely used in clinical practice because of its simplicity and ease of application.⁵

The BAP-65 score was specifically developed for patients with acute exacerbations of COPD and includes blood urea nitrogen, altered mental status, pulse rate, and age. This scoring system has demonstrated utility in predicting in-hospital mortality and the need for mechanical ventilation. However, its predictive performance varies across different patient populations.⁶

The DECAF score, comprising Dyspnea, Eosinopenia, Consolidation, Acidemia, and Atrial Fibrillation, was specifically designed and validated for hospitalized patients with AECOPD. Previous studies have suggested that DECAF provides superior discrimination for in-hospital mortality compared with several other prognostic tools. Furthermore, it incorporates COPD-specific clinical and laboratory parameters that reflect the underlying severity of the exacerbation.^{7,8}

Although these scoring systems are commonly used, there remains uncertainty regarding their comparative effectiveness in predicting adverse clinical outcomes among patients hospitalized with AECOPD, particularly in different healthcare settings and populations. Direct comparisons of CURB-65, BAP-65, and DECAF scores may provide valuable evidence regarding their relative prognostic accuracy and clinical utility.

Therefore, in the present study, we aimed to compare the DECAF65, CURB 65, and BAP 65 scores to predict in-hospital mortality and need for mechanical ventilation in patients presenting with acute exacerbation of Chronic obstructive pulmonary disease. The findings of this study may help clinicians identify the most appropriate prognostic tool for routine use in emergency departments and inpatient settings, thereby improving patient management and resource allocation

Materials and Methods

This single-center, prospective, observational study was conducted in the Department of Emergency Medicine, Rajrajeswari Medical College and Hospital, Bangalore, from April 2024 to December 2025. Participants were recruited using convenience sampling by the study investigator. All eligible patients presenting during periods when the investigator was available were approached for enrollment. Patients who declined consent or did not meet eligibility criteria were excluded from the study.

Sample size was calculated based on expected prevalence of COPD of 7% from a previous study⁹ ($P = 0.07$), a margin of error of 5% (d), a 95% confidence interval, and a standard deviation of 1.96 (z). The formula applied was $N = Z^2 [p(1-p)] \div d^2$. The study included 100 participants.

A diagnosis of COPD was established based on prior spirometry confirmation of persistent airflow limitation according to GOLD criteria (post-bronchodilator FEV_1/FVC ratio <0.70).¹⁰ For patients without available spirometry records at presentation, a documented physician diagnosis of COPD with compatible clinical history, symptoms, and ongoing COPD treatment was accepted.

Patients of chronic obstructive pulmonary disease aged more than 30 years with an acute onset of dyspnea and/or cough with expectoration within 14 days of symptom onset were included. Acute myocardial infarction (positive troponin-I), Chronic Kidney Disease (CKD) with serum creatinine >1.5 mg/dL, diagnosed with malignancy, hemodynamically unstable, and a recent trauma history were excluded.

Upon arrival, the patient's medical history and clinical examination findings will be noted. Vital signs will be recorded before commencing treatment. An Arterial Blood Gas (ABG) analysis will be conducted within five minutes of the provisional diagnosis. Furthermore, an Electrocardiogram (ECG), chest X-ray, and any additional required investigations will be performed following resuscitation, with all findings systematically recorded in the designated data form.

The DECAF, BAP-65, and CURB-65 scores were calculated from clinical findings, laboratory, and radiological parameters obtained during the initial assessment in the Emergency Department. Patients were then admitted to the ward or ICU, depending on clinical condition, after initial treatment. They were followed up during the hospital stay for the requirement for mechanical ventilatory support.

The DECAF score is a specific prognostic tool for COPD, which consists of five variables: Dyspnea severity, Eosinopenia, Consolidation, Acidemia, and Atrial Fibrillation. The total score ranges from 0 to 6, and higher scores indicate a greater risk of mortality.

The BAP-65 score includes four variables: Blood Urea Nitrogen, Altered Mental Status, Pulse, and Age ≥ 65 years. Total score ranges from 0 to 4, and increasing scores are associated with a higher risk of adverse outcomes, such as mortality and the need for mechanical ventilation.

CURB-65 was originally used for community-acquired pneumonia and has also been evaluated for its role in patients with AECOPD. The score includes Confusion, Blood Urea Nitrogen, Respiratory Rate,

Blood Pressure, and Age. Scores range from 0 to 5, with high scores suggesting greater disease severity and mortality risk. The individual scoring system and score comparisons are provided in Appendix 1 (supplementary file).

Statistical analysis was performed using SPSS version 26.0 (Statistical Package for the Social Sciences). Categorical variables were expressed as frequencies and percentages. Continuous variables such as age and clinical scores (DECAF, CURB-65, BAP-65) were summarized using mean and Standard Deviation (SD). A Receiver Operating Characteristic (ROC) curve analysis was used to assess the accuracy and Area Under the Curve (AUC) to compare the diagnostic ability of the scores. A p -value < 0.05 was considered statistically significant. Ethical approval was obtained from the Institute Ethics Committee, reference no. RRMCH-IEC/32/2024, dated 11/03/2024. Informed and written Consent was obtained from study participants.

Results

Of the total 100 participants, females accounted for 59% and male 41%. More than half of the population was aged 41 to 80 years. Notably, 7% had mortality, and 93% were discharged from the hospital. Mortality was highest in the age group 61 to 80 years. Results showed no marked sex-based difference in discharge or death outcomes (Table 1).

Patients with comorbidities demonstrated a higher mortality rate (10.0%) compared to those without comorbidities (2.5%). However, this difference was not statistically significant on Fisher's exact test ($p = 0.238$).

Among patients admitted to the ICU, 75 (91.5%) were discharged, and 7 (8.5%) died. In contrast, all the patients admitted to the ward (100%) were discharged, with no deaths. Fisher's exact test demonstrated no statistically significant association between admission location and in-hospital mortality ($p = 0.345$; Table 2).

The ROC curve analysis demonstrated that the AUCs were 0.806 for the DECAF score, 0.707 for the CURB-65 score, and 0.673 for the BAP score. DECAF score with a cutoff of ≤ 4 (Sensitivity 89.25%, Specificity 57.14%), CURB 65 with a cutoff of ≤ 2 (sensitivity 61.29% and specificity 71.43%), and BAP 65 with a cutoff of ≤ 2 (sensitivity 66.67%, while specificity 57.14%) appear to be the most appropriate thresholds for predicting in-hospital mortality (Figure 1, 2 and 3). Pairwise comparison of

the ROC curves of all three scores using DeLong's test showed no statistically significant differences between the AUCs of the three scoring systems.

Patients with DECAF scores ≥ 4 were significantly more likely to require ventilatory support compared to those with lower scores ($\chi^2 = 52.69$, $p < 0.001$; Table 3).

Discussion

We found that among the three scoring systems evaluated, the DECAF score showed the strongest association and highest discriminatory ability for predicting in-hospital mortality and the need for mechanical ventilation. The performance of CURB-65 and BAP-65 demonstrated that they are alternative, reliable tools for risk prognostication.

In the present study, females accounted for 59%, and more than half of the participants were aged between 41 and 80 years. The overall in-hospital mortality rate was 7%, which is similar to mortality rates reported in previous studies for evaluating hospitalized patients with AECOPD.²⁰ Mortality was higher in the age group of 61–80 years, highlighting the relation of advancing age to adverse outcomes. Increasing age is a well-established predictor of mortality in COPD due to declining physiological reserve, greater disease severity, and a higher burden of comorbid illnesses.^{11,12}

We observed that although patients with comorbidities experienced a higher mortality rate than those without comorbidities (10.0% vs. 2.5%), the association was not statistically significant. This finding may be attributable to the small sample size and low number of deaths, limiting the statistical power to detect significant differences. Nevertheless, the observed trend is consistent with previous studies demonstrating that cardiovascular disease, diabetes mellitus, renal dysfunction, and other chronic conditions contribute to worse outcomes in patients with AECOPD.^{13,14}

The primary objective of our study was to compare the predictive accuracy of DECAF, CURB-65, and BAP-65 scores for in-hospital mortality. ROC analysis showed that the DECAF score had the high discriminatory ability, with an AUC of 0.806, followed by CURB-65 (AUC 0.707) and BAP-65 (AUC 0.673). An AUC value greater than 0.80 indicates good predictive performance, suggesting that DECAF is a reliable tool for mortality prediction. These findings are consistent with the studies by Meena et al and Rakshana et al on the DECAF score, which demonstrated superior prognostic accuracy compared to other commonly used risk assessment tools.^{7,15}

The better performance of the DECAF score may be explained by the inclusion of variables closely associated with COPD-specific disease severity, such as dyspnea, eosinopenia, consolidation, acidemia, and atrial fibrillation. However, CURB-65 was originally developed for community-acquired pneumonia and does not incorporate COPD-specific clinical parameters. Likewise, BAP-65 depends primarily on age, mental status, pulse rate, and blood urea nitrogen, which fails to fully capture the complexity of acute COPD exacerbations.^{16,17}

The DECAF score ≥ 4 was the optimal cut-off value, which demonstrated high sensitivity (89.25%) with moderate specificity (57.14%) for predicting in-hospital mortality. This finding of high sensitivity makes DECAF particularly useful as a screening tool to identify high-risk patients early in the emergency department. CURB-65 and BAP-65 reported lower sensitivities and specificities, suggesting a reduced ability to identify patients who subsequently experience adverse outcomes.^{7,15}

Despite the better predictive accuracy of DECAF, pairwise comparison of ROC curves using DeLong's test revealed no statistically significant differences among the AUCs of the three scoring systems. This finding may be related to the small sample size and the exclusion of chronic kidney disease, trauma, and hemodynamically unstable patients, which reduces the ability to detect significant differences between predictive models. Larger multicenter studies may provide greater statistical power to confirm whether the observed differences represent true superiority of one scoring system over another.

The secondary objective of this study was to investigate the performance of different scores in predicting the need for ventilatory support. In our study, patients with DECAF scores ≥ 4 were likely to require ventilatory support, suggesting the score's utility not only in mortality prediction but also in identifying patients who need respiratory support. This finding affirms the use of DECAF as a practical bedside tool to guide decisions on monitoring, escalation of care, and early ICU referral.^{18,19}

Our study has several limitations. First, small sample size and single-centric study. Second, we excluded hemodynamically unstable patients. Third, all the scores were calculated by the study investigator, who also initially treated the acute exacerbation in the emergency department. Fourth, a spirometry test was not performed in the emergency department for the diagnosis of COPD. Lastly, serial reassessment of scores after admission was not performed.

Conclusions

The DECAF was found to be a better risk-stratification tool than other scores in acute exacerbations of chronic obstructive pulmonary disease. A score of ≥ 4 was significantly associated with in-hospital mortality and need for mechanical ventilatory support.

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Table 1. Association of age with in-hospital mortality.

Age group (years)	Death, n (%)	Discharge, n (%)	Total, n (%)	p-value
21–40	0 (0.0)	13 (100.0)	13 (13.0)	0.509
41–60	2 (5.9)	32 (94.1)	34 (34.0)	
61–80	4 (11.8)	30 (88.2)	34 (34.0)	
>80	1 (5.3)	18 (94.7)	19 (19.0)	

Table 2. Association of Admission Location (Ward/ICU) with in-hospital mortality.

Admission location	Discharge, n (%)	Death, n (%)	p-value
ICU	75 (91.5)	7 (8.5)	0.345
Ward	18 (100.0)	0 (0.0)	

Table 3. Scoring system and need for mechanical ventilation.

Score	Chi-square	p-value	Significance
DECAF ≥ 4	52.69	<0.001	Highly significant
CURB-65 ≥ 2	9.15	0.002	Significant
BAP-65 ≥ 3	10.95	0.0009	Significant

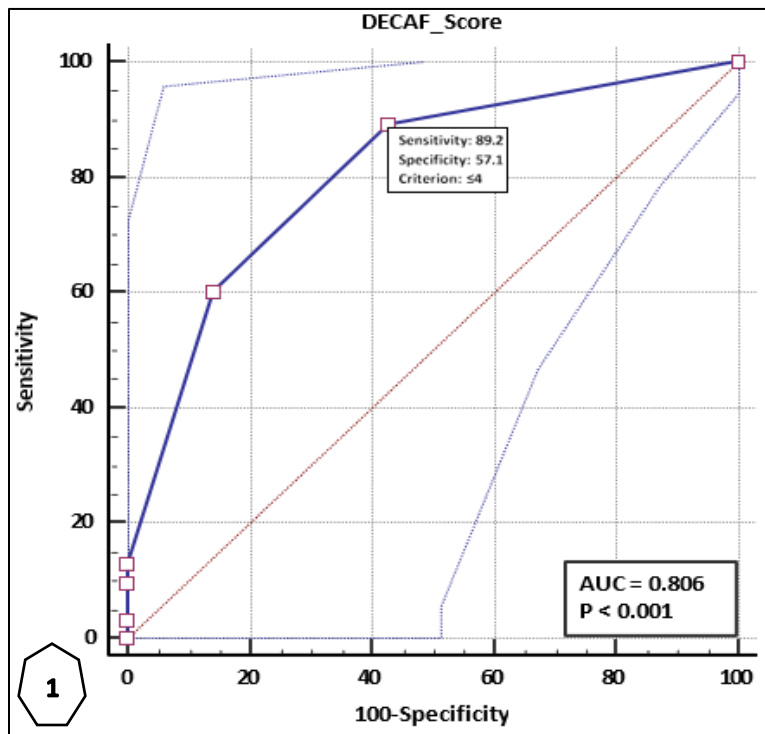


Figure 1. ROC curve analysis of DECAF score for in-hospital mortality

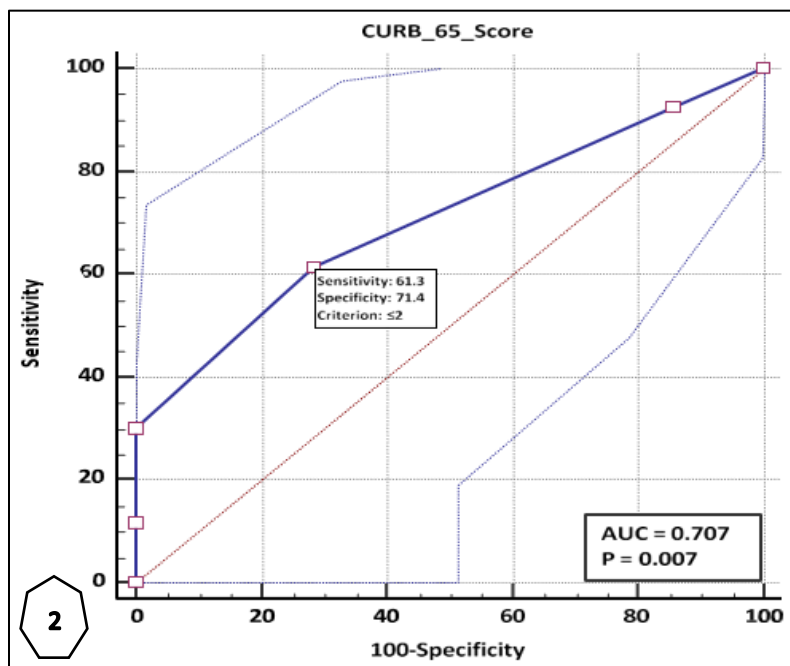


Figure 2. ROC curve analysis of CURB 65 score for in-hospital mortality

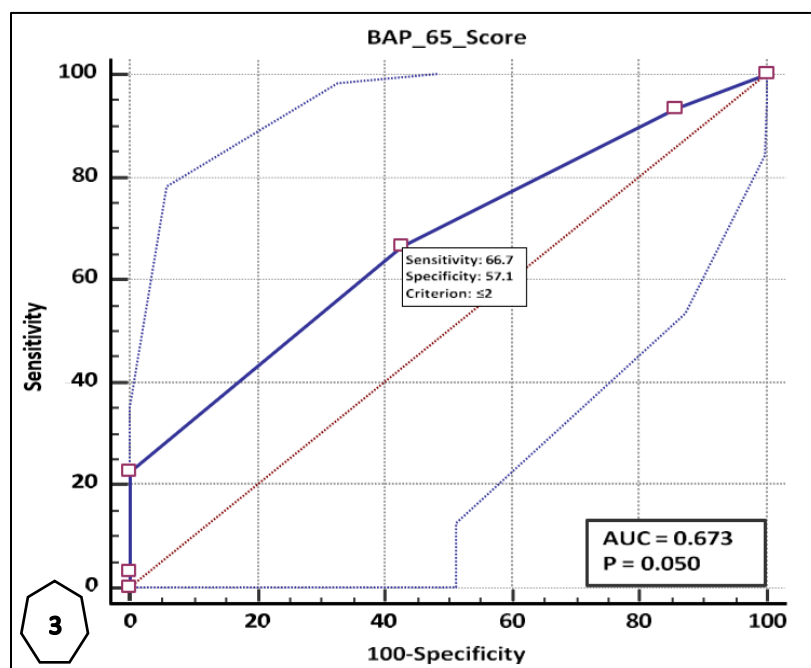


Figure 3. ROC curve analysis of BAP 65 score for in-hospital mortality

Contributions: Shabbir Shekhli, conceptualization, formal analysis, validation, methodology (lead); ¹ Basava Kirana, software, writing – review & editing, data curation.

Conflict of interest: The authors declare no conflict of interest.

Ethical approval: Ethical approval was obtained from the Institute Ethics Committee of Rajrajaeshwari Medical College, India (RRMCH-IEC/32/2024, dated 11-03-2024). Consent was obtained from the study participants.

Availability of data and materials: Data will be accessible upon request to the corresponding author six months post-publication. The sensitive information of study participants will be anonymized.

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Online supplementary materials

DECAF score components and scoring system

BAP-65 score components and scoring system

CURB-65 score components and scoring system

Comparison of DECAF, BAP-65, and CURB-65 scoring systems