

Comparison of DECAF (dyspnoea, eosinopenia, consolidation, acidaemia, and atrial fibrillation) and APACHE II (acute physiology and chronic health evaluation ii) scoring system to predict mortality among patients with acute exacerbation of chronic obstructive pulmonary disease

Wiky Raja, Naseem Ahmed, Nadeem Ahmed Rizvi, Anita Vallacha, Dinesh Kumar

Abstract

Objective: To compare the diagnostic accuracy of two systems in predicting mortality among patients with acute exacerbation of chronic obstructive pulmonary disease.

Method: The cross-sectional study was conducted from November 2017 to June 2018 in the Department of Chest Medicine, Jinnah Postgraduate Medical Centre, Karachi, and comprised patients with acute exacerbation of chronic obstructive pulmonary disease. Dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation system was compared with acute physiology and chronic health evaluation II scoring system after mortality scores were calculated for each patient. Data was analysed using SPSS 21.

Results: Of the 210 patients, 147(70%) were males and 63(30%) were females. Overall, 59(28.1%) patients died during hospital stay. The mean dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation score was 2.31 ± 0.93 while the mean acute physiology and chronic health evaluation II score was 15.8 ± 7.2 . A decision threshold of dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation score >2 had a sensitivity of 84.6% and specificity of 82.3% while acute physiology and chronic health evaluation II score had sensitivity of 53.9% and specificity of 76.5%.

Conclusion: Both scoring systems were found to be good predictors of mortality, but dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation score was a simpler and effective clinical tool.

Keywords: AECOPD, DECAF, APACHE II, Sensitivity, Specificity. (JPMA 71: 1935; 2021)

DOI: <https://doi.org/10.47391/JPMA.618>

Introduction

Chronic obstructive pulmonary disease (COPD) is a major public health problem. The disease is one of the most important causes of death worldwide. The Global Burden of Disease study projected it to become the third leading cause of death globally by 2020, while a newer projection estimated it to be the fourth one by 2030.¹ Exacerbations are infrequent in early COPD and are largely a feature of moderate-to-severe disease.² The American Thoracic Society (ATS) and the European Respiratory Society (ERS) define COPD exacerbation as an acute change in patient's dyspnoea, cough, or sputum that is beyond normal variability and that is sufficient to warrant a change in therapy.³

Acute exacerbations of COPD (AE-COPD) are both common and often fatal.⁴ AE-COPDs are major events in the long-term course of the disease since their repetition is associated with impaired lung function, health status and survival and markedly increased healthcare costs.⁵ A large number of scales and scores have been developed for

AE-COPD, like dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation (DECAF),⁴ modified DECAF, CAPS4 (The COPD and Asthma Physiology Score).⁶ Scores like confusion urea-respiratory rate-blood pressure-age 65 (CURB-65),⁷ which was initially developed for pneumonia, has also been used in AE-COPD, and general intensive care unit (ICU) scoring systems, like acute physiology and chronic health evaluation-II (APACHE-II)⁸ has been used to predict mortality. Many studies comparing these systems have also been done on various populations with different results.^{9,10}

Steer et al.⁴ derived the DECAF score to accurately predict in-hospital mortality for patients with AE-COPD.¹¹ The DECAF score is a simple prognostic tool that combines clinical and laboratory information routinely obtained on admission to hospitalised AE-COPD patients.⁴ Son et al.¹² and Steer et al.⁴ showed that the DECAF score was excellent in discrimination for in-hospital mortality. Furthermore, the DECAF score performed significantly better in predicting in-hospital mortality. In a study, a decision threshold of DECAF score >2 was found to have a 50% sensitivity, 81% specificity, and 73.3% accuracy. Mortality in patients with less scores was 17%, while with score >2 , it was 47.5%.¹³ In a Chinese study, the best

Department of Pulmonology, Jinnah Postgraduate Medical Center, Karachi, Pakistan.

Correspondence: Wiky Raja. e-mail: sachdev_vik@hotmail.com

threshold value for APACHE-II score for predicting prognosis was 17 points, and its sensitivity and specificity were 69.6% and 91.7% respectively.¹⁴ Ahmed et al. also reported that the DECAF scores had promise for the risk stratification of patients hospitalised for each grade of the DECAF score with risk categories.¹⁵

The current study was planned to compare the diagnostic accuracy of DECAF and APACHE-II scoring systems in predicting mortality among AE-COPD patients.

Patients and Methods

The prospective cross-sectional study was conducted from November 2017 to June 2018 at the Department of Chest Medicine, Jinnah Postgraduate Medical Centre (JPMC), Karachi. After approval from the institutional ethics review committee, the sample size was calculated using diagnostic accuracy calculator¹⁶ with Sn=50%, Sp=81%, margin of error 10% and prevalence for detecting mortality 0.475. The sample was raised using non-probability consecutive sampling technique from among male and female patients aged 40-70 years, previously diagnosed with COPD for >6 months, and admitted with primary diagnosis of AE-COPD. Patients with myocardial infarction (MI), positive troponin-I, chronic kidney disease (CKD), creatinine >1.5, and malignancy were excluded.

After taking written informed consent, detailed history was recorded and both DECAF and APACHE-II scores were calculated for all the subjects. Clinical examination included assessment of mental state consciousness level, signs of exacerbation, chest radiological examination, electrocardiogram (ECG), arterial blood gas (ABG) analysis, measurement of serum creatinine and complete blood count (CBC). Mortality scores for AE-COPD were calculated for each patient and the individual parameters used in calculating the scores were also recorded. DECAF has 5 variables; extended Medical Research Council dyspnoea (eMRCD) 5a or 5b, eosinopenia <0.05x10³/dL, consolidation, acidaemia with potential of hydrogen (pH)<7.3, and atrial fibrillation (AF), with a maximum score of 64. APACHE-II was scored out of a maximum of 71 based on 12 physiological variables, age and chronic health as per operational definition.⁸ At the time of discharge or death, the score were compared for in-hospital mortality.

Data was analysed using SPSS 21. Frequencies and percentages were computed for categorical variables, like gender, smoking status, DECAF and APACHE-II scores and in-hospital mortality. Quantitative variables were presented as mean±standard deviation (SD), like age, duration of COPD, duration of AE-COPD. Open-epi 2x2 table was used to calculate sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic

accuracy of DECAF and APACHE-II for in-hospital mortality.¹⁷ Effect modifiers, like age, gender, duration of COPD, and duration of AE-COPD, were controlled through strictly following the inclusion-exclusion criteria and stratification. Normality of data was checked with Kolmogorov-Smirnov test, while chi-square and Mann Whitney U tests were used for comparison. P<0.05 was considered statistically significant.

Results

Of the 210 patients, 147(70%) were males and 63(30%) were females, 63(30%) were current smokers, 91(43.3%) were ex-smokers and 56(26.7%) were non-smokers. The overall mean age was 60±9 years, and 59(28.1%) patients

Table-1: Patient characteristics and in-hospital mortality.

	In hospital-mortality		p-value
	Positive	Negative	
Gender	n (%)	n (%)	
Male	43(29.3)	104(70.7)	0.569 ^a
Female	16(25.4)	47(74.6)	
Smoking Status	n (%)	n (%)	
Smoker	19(30.2)	44(69.8)	0.873 ^a
Ex-Smoker	24(26.4)	67(73.6)	
Non Smoker	16(28.6)	40(71.4)	
Duration of COPD	(months)	(months)	
Mean±SD	5.15±2.79	4.6±2.8	<0.192 ^b
Median (IQR)	5 (6)	5 (3)	
Duration of AE-COPD	(hours)	(hours)	
Mean±SD	3.0±0.83	3.53±1.5	<0.002 ^b
Median (IQR)	3 (2)	4 (2.75)	
Age	(years)	(years)	
Mean (sd)	62.8 (4.7)	59 (10.3)	<0.131 ^b
Median (IQR)	62 (8)	62 (5)	

^a Chi-square test, ^b Mann Whitney U test, SD: Standard Deviation; COPD: Chronic obstructive pulmonary disease; AE-COPD: Acute exacerbation of chronic obstructive pulmonary disease. IQR: Interquartile Range

Table-2: Differentiation between in-hospital mortality with DECAF and APACHEII Scores.

	In hospital-mortality		p-value
	Positive	Negative	
DECAF	n(%)	n(%)	
Positive (> 2)	59(60.2)	39(39.8)	<0.001 ^a
Negative	0(0)	112(100)	
APACHE II	n(%)	n(%)	
Positive (> 17)	44(57.1)	33(42.9)	<0.001 ^b
Negative	15(11.3)	118(88.7)	
DECAF	Score	Score	
Mean±SD	3.25±0.44	1.95±0.81	<0.001 ^c
Median (IQR)	3 (1)	2 (1)	
APACHE II	Score	Score	
Mean±SD	22.3±5.6	13.3±5.5	<0.001 ^c
Median (IQR)	21 (9)	13 (9)	

^a Fisher Exact Test, ^b Chi-square test, ^c Mann Whitney U test

SD: Standard Deviation; DECAF: Dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation; APACHE: Acute physiology and chronic health evaluation.

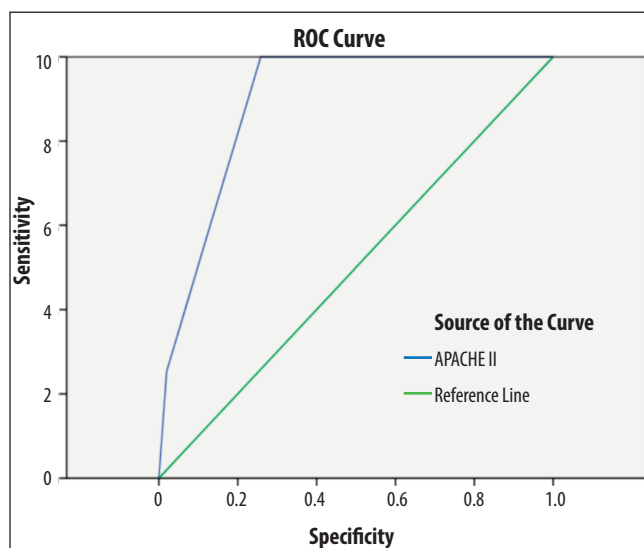


Figure-1: Receiver operator characteristic (ROC) curves of dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation (DECAF) scores for in-hospital mortality.

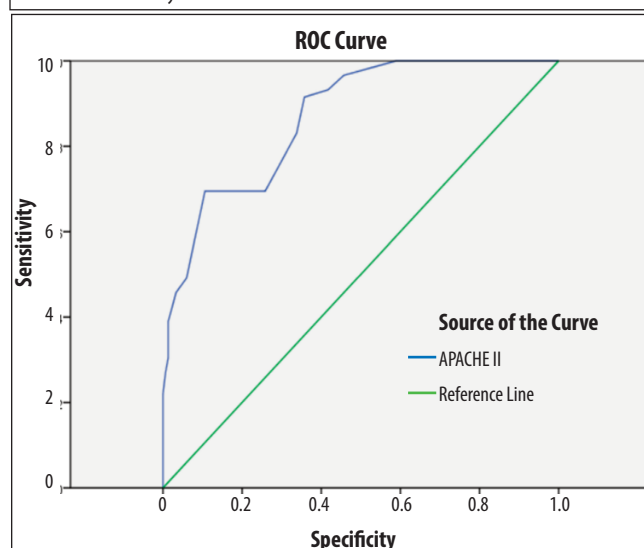


Figure-2: Receiver operator characteristic (ROC) curves of acute physiology and chronic health evaluation (APACHE) II scores for in-hospital mortality.

died during their hospital stay.

The mean DECAF score was 2.31 ± 0.93 and mean APACHE-II score was 15.8 ± 7.2 . The duration of COPD in the enrolled patients was 4.76 ± 2.83 months and duration of AE-COPD was 3.4 ± 1.3 hours (Table 1). DECAF score >2 was recorded in 98(46.7%) patients, while APACHE-II score >17 was recorded in 77(36.7%). There was significant difference between survivors and those who died in hospital (Table 2).

Area under receiver operator characteristic (AUROC) >0.70 indicates a fairly accurate test, and it was 0.894 for DECAF

Table-3: Area under receiver operator characteristic (AUROC) of the two scoring systems.

	AUC	SE	95% CI
DECAF	0.894	0.021	0.853 – 0.935
APACHE II	0.869	0.025	0.820 – 0.919

^a Chi-square test, ^b Mann Whitney U test

AUC: Area under the curve; SE: Standard error; CI: Confidence interval;

DECAF: Dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation;

APACHE: Acute physiology and chronic health evaluation.

Table-4: Screening test evaluation.

Tests	DECAF (95% CI)	APACHE II (95% CI)
Sensitivity	100% (93.94 - 100)	74.58% (61.56 - 85.02)
Specificity	74.17 % (66.43 - 80.94)	78.15 % (70.70 - 84.45)
PPV	60.20% (53.5 - 66.47)	57.14% (48.78 - 65.11)
NPV	100 %	88.72 % (83.45 - 92.47)
Accuracy	81.43% (75.5 - 86.45)	77.14% (70.86 - 82.64)

PPV: Positive predictive value; NPV: Negative predictive value; CI: Confidence interval;

DECAF: Dyspnoea-eosinopenia-consolidation-acidaemia-atrial fibrillation;

APACHE: Acute physiology and chronic health evaluation.

and 0.869 for APACHE-II (Figures 1-2). The difference between the scoring methods was not significant (Table 3).

A decision threshold of DECAF score >2 had sensitivity 84.6% and specificity 82.3% while APACHE-II had sensitivity 53.9% and specificity 76.5% (Table 4).

Discussion

Despite improvements in care, death during hospitalisation for AE-COPD is a challenging issue.⁹ AE-COPD is a common cause of admission to ICUs, but appropriate level of treatment of patients presenting to ICU with AE-COPD is still debatable.^{8,19} Several AE-COPD severity scores have been developed and are being used to predict in-hospital mortality from that condition. Also, a number of studies have been published in this regard.^{4,18-20} Various studies have been conducted locally to assess the prediction of mortality scores, specifically APACHE-II, in different clinical settings.^{21,22} The current study compared DECAF and APACHE-II scores, which are widely-used scoring systems. According to a study, DECAF score is a stronger prognostic score than the CURB-65, APACHE or COPD and asthma physiological score prediction tools.²⁰

The mortality rate in the current study matched findings in literature.^{22,23} Studies^{4,19} have also shown mortality rates of 10.4% and 4%, possibly reflecting the different threshold for hospital admission among different countries. In a study, 41 patients were discharged after treatment and 9(18%) died during the hospital stay.²⁴ Maha et al. reported that during the hospital stay, 20(7.58%) patients died.¹⁰

The current study found no significant difference in terms of smoking status and gender. Morbidity due to COPD was greater in men than women. Male gender and smoking

habit had been known to have a significant correlation with mortality.^{10,25,26} Maha et al. found that the non-surviving group had a statistically significant higher age than the surviving patients.¹⁰ Roche et al.²⁷ found that age was an independent risk factor for in-hospital mortality. The current study found no statistically significance difference between in-hospital mortality and age.

In the current study, DECAF score showed a good discrimination for in-hospital mortality. Also, it was better than the APACHE-II prognostic index in predicting in-hospital mortality. Different studies showed varying AUROC for APACHE-II and DECAF scores in AE-COPD patients.^{4,6,9,28} The current study has some limitations, as it was a single-centre study with a small sample size. Besides, other scoring systems were not compared. Despite the limitations, the study provides valuable clinical information for assessing ICU outcomes of AE-COPD.^{28,29}

Conclusion

Both DECAF and APACHE-II scores were found to be good predictors of mortality, but DECAF score was found to be a simple, effective and quick tool to calculate mortality risk.

Disclaimer: None.

Conflict of interest: None.

Source of Funding: None.

References

- Kumar H, Choubey S. Predictors of mortality in patients of acute exacerbation of chronic obstructive pulmonary disease: A prospective observational study. *Indian J Respir Care* 2018; 7: 77-82.
- BTS guidelines for the management of chronic obstructive pulmonary disease. The COPD Guidelines Group of the Standards of Care Committee of the BTS. *Thorax* 1997; 52 Suppl 5: S1-28.
- Celli BR, MacNee WA, Agusti AA, Anzueto A, Berg B, Buist AS, et al. Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper. *Eur Respir J* 2004; 23: 932-46.
- Steer J, Gibson J, Bourke SC. The DECAF Score: predicting hospital mortality in exacerbations of chronic obstructive pulmonary disease. *Thorax* 2012; 67: 970-6.
- Wedzicha JA, Seemungal TA. COPD exacerbations: defining their cause and prevention. *Lancet* 2007; 370: 786-96.
- Wildman MJ, Harrison DA, Welch CA, Sanderson C. A new measure of acute physiological derangement for patients with exacerbations of obstructive airways disease: the COPD and Asthma Physiology Score. *Respir Med* 2007; 101: 1994-2002.
- Zhang M, Zhao YF, Luo YM, Wang XH, Yang Y, Lin Y. The value of coexisting pneumonia and British Thoracic Society CURB-65 score in predicting early mortality rate in patients with acute exacerbation of chronic obstructive pulmonary disease. *Chinese J Tuberculosis Respir Dis* 2013; 36: 269-73.
- Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. *Crit Care Med* 1985; 13: 818-29.
- Nafae R, Embarak S, Gad DM. Value of the DECAF score in predicting hospital mortality in patients with acute exacerbation of chronic obstructive pulmonary disease admitted to Zagazig University Hospitals, Egypt. *Egypt J Chest Dis Tuberculosis* 2015; 64: 35-40.
- Yousif M, El Wahsh RA. Predicting in-hospital mortality in acute exacerbation of COPD: Is there a golden score?. *Egypt J Chest Dis Tuberculosis* 2016; 65: 579-84.
- Predicting Survival From COPD Exacerbations: DECAF Score Shows Promise. [Online] [Cited 2020 Oct 20]. Available from: URL: <https://pulmccm.org/critical-care-review/how-dangerous-is-this-patients-copd-exacerbation-decaf-score-may-help-predict-thorax>.
- Son JH, Lee JY, Yang YM, Sung WY, Seo SW, Kim JC, et al. Utility of the DECAF Score in Patients Admitted to Emergency Department with Acute Exacerbation of Chronic Obstructive Pulmonary Disease. *Korean J Crit Care Med* 2013; 28: 255-65.
- Martínez-García MA, de la Rosa Carrillo D, Soler-Cataluña JJ, Donat-Sanz Y, Serra PC, Lerma MA, et al. Prognostic value of bronchiectasis in patients with moderate-to-severe chronic obstructive pulmonary disease. *Am J Respir Crit Care Med* 2013; 187: 823-31.
- Moreno A, Montón C, Belmonte Y, Gallego M, Pomares X, Real J. Causes of death and risk factors for mortality in patients with severe chronic obstructive pulmonary disease. *Arch Bronconeumol* 2009; 45: 181-6.
- Mobin Ahmed M, Faryal S, Sheikh K. Complex DECAF scores prolong the hospital stay of patients suffering from COPD. *Int J Endorsing Health Sci Res* 2017; 5: 52-5.
- Schoonjans F. Medcalc's Diagnostic Test Evaluation Calculator. [Online] 2020 [Cited 2020 Oct 20]. Available from: URL: https://www.medcalc.org/calc/diagnostic_test.php
- Sullivan KM, Dean A, Soe MM. OpenEpi: a web-based epidemiologic and statistical calculator for public health. *Public Health Rep* 2009; 124: 471-4.
- Zidan MH, Rabie AK, Megahed MM, Abdel-Khaleq MY. The usefulness of the DECAF score in predicting hospital mortality in Acute Exacerbations of Chronic Obstructive Pulmonary Disease. *Egypt J Chest Dis Tuberculosis* 2015; 64: 75-80.
- Shorr AF, Sun X, Johannes RS, Yaitanes A, Tabak YP. Validation of a novel risk score for severity of illness in acute exacerbations of COPD. *Chest* 2011; 140: 1177-83.
- Roche N, Zureik M, Soussan D, Neukirch F, Perrotin D. Predictors of outcomes in COPD exacerbation cases presenting to the emergency department. *Eur Respir J* 2008; 32: 953-61.
- Haidri FR, Rizvi N, Motiani B. Role of APACHE score in predicting mortality in chest ICU. *J Pak Med Assoc* 2011; 61: 589-92.
- Hashmi M, Asghar A, Rashid S, Hameed F. APACHE II analysis of a surgical intensive care unit population in a tertiary care hospital in Karachi (Pakistan). *Anaesth Pain & Intensive Care* 2014; 18: 338-44.
- Vogelmeier CF, Criner GJ, Martinez FJ, Anzueto A, Barnes PJ, Bourbeau J, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease 2017 report. GOLD executive summary. *Am J Respir Crit Care Med* 2017; 195: 557-82.
- Sangwan V, Chaudhry D, Malik R. Dyspnea, Eosinopenia, Consolidation, Acidemia and Atrial Fibrillation Score and BAP-65 Score, Tools for Prediction of Mortality in Acute Exacerbations of Chronic Obstructive Pulmonary Disease: A Comparative Pilot Study. *Indian J Crit Care Med* 2017; 21: 671-7.
- Patil SP, Krishnan JA, Lechtzin N, Diette GB. In-hospital mortality following acute exacerbations of chronic obstructive pulmonary disease. *Arch Intern Med* 2003; 163: 1180-6.

26. Hardin M, Foreman M, Dransfield MT, Hansel N, Han MK, Cho MH, et al. Sex-specific features of emphysema among current and former smokers with COPD. *Eur Respir J* 2016; 47: 104-12.
 27. Roche N, Chavaillon JM, Maurer C, Zureik M, Piquet J. A clinical in-hospital prognostic score for acute exacerbations of COPD. *Respir Res* 2014; 15: 99.
 28. Bustamante-Fermosel A, De Miguel-Yanes JM, Duffort-Falcó M, Muñoz J. Mortality-related factors after hospitalization for acute exacerbation of chronic obstructive pulmonary disease: the burden of clinical features. *Am J Emerg Med* 2007; 25: 515-22.
 29. Lindberg A, Sawalha S, Hedman L, Larsson LG, Lundbäck B, Rönmark E. Subjects with COPD and productive cough have an increased risk for exacerbations and death. *Respir Med* 2015; 109: 88-95
-