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Performance of risk scores in patients with acute exacerbations of COPD

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ABSTRACT

Objective: Acute exacerbations of COPD (AECOPD) are common causes of hospitalization. Various scoring systems have been proposed to classify the risk of clinical deterioration or mortality in hospitalized patients with AECOPD. We sought to investigate whether clinical deterioration and mortality scores at admission can predict adverse events occurring during hospitalization and after discharge of patients with AECOPD. **Methods:** We performed a retrospective study of patients admitted with AECOPD. The National Early Warning Score 2 (NEWS2), the $NEWS2_{88-92\%}$, the **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation (DECAF) score, and the modified DECAF (mDECAF) score were calculated at admission. We assessed the sensitivity, specificity, and overall performance of the scores for the following outcomes: in-hospital mortality; need for invasive mechanical ventilation or noninvasive ventilation (NIV); long hospital stays; hospital readmissions; and future AECOPD. **Results:** We included 119 patients admitted with AECOPD. The median age was 75 years, and 87.9% were male. The $NEWS2_{88-92\%}$ was associated with an 8.9% reduction in the number of individuals classified as requiring close, continuous observation, without an increased risk of death in the group of individuals classified as being low-risk patients. The $NEWS2_{88-92\%}$ and NEWS2 scores were found to be adequate in predicting the need for acute NIV and longer hospital stays. The DECAF and mDECAF scores were found to be better at predicting in-hospital mortality than the NEWS2 and $NEWS2_{88-92\%}$. **Conclusions:** The $NEWS2_{88-92\%}$ safely reduces the need for clinical monitoring in patients with AECOPD when compared with the NEWS2. The NEWS2 and $NEWS2_{88-92\%}$ appear to be good predictors of the length of hospital stay and need for NIV, but they do not replace the DECAF and mDECAF scores as predictors of mortality.

Keywords: Pulmonary disease, chronic obstructive/mortality; Symptom flare up; Early warning score; Length of stay; Patient readmission.

INTRODUCTION

COPD is one of the three leading causes of death worldwide. The prevalence and burden of COPD are expected to rise, prompting an increased number of hospital admissions for acute exacerbations of COPD (AECOPD).[1] AECOPD lead to disease progression and hospitalization, being associated with poor prognosis and increased mortality.[2] Therefore, various scoring systems have been proposed to classify the risk of clinical deterioration or mortality in patients with AECOPD.[3,4]

The National Early Warning Score (NEWS) is widely used in the United Kingdom to identify clinical deterioration in hospitalized patients with acute disease and is based on repeated assessment of RR, SpO_2, systolic blood pressure, pulse rate, level of consciousness, and temperature. It classifies patients as having a low, moderate, or high risk of deterioration.[5] The National Early Warning Score 2 (NEWS2) added the parameter *confusion* to the assessment of consciousness, as well as a new classification system for SpO_2. The original NEWS had a single scale for SpO_2, with worse scores being assigned to patients with an SpO_2 of < 96%, leading to titration of oxygen therapy to a target SpO_2 ≥ 96%.[5] However, providing excess oxygen to patients with AECOPD increases the need for ventilation as well as mortality.[6,7] Another problem is that COPD patients commonly have chronic hypoxemia, leading to false alerts. Therefore, the NEWS2 includes two SpO_2 scales: the original scale for patients with hypoxemic respiratory failure and a new scale for patients with hypercapnic respiratory failure (Table S1).[5] However, as expert societies recommend a target SpO_2 of 88-92% for all COPD patients,[1,8,9] a single-scale NEWS2 ($NEWS2_{88-92\%}$) was devised to simplify the application of the score and reduce the risk of providing excess oxygen.

Regarding mortality scores, the **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation (DECAF) score is a validated tool to predict in-hospital mortality in patients with AECOPD, classifying patients as being low-, moderate-, or high-risk patients at admission.[10,11] Given that the occurrence of an AECOPD in the previous year is the best predictor of new AECOPD and is associated with increased mortality, a modified DECAF score (mDECAF) has been developed, assessing exacerbations in the previous year rather than atrial fibrillation.[1,12]

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Although the NEWS and mortality scores have been used in the context of AECOPD, their role in predicting different types of events (e.g., ventilation, long stays, readmissions, and future AECOPD) during hospitalization and after discharge of patients with AECOPD has yet to be fully studied. Therefore, the objectives of the present study were to investigate whether the NEWS2 and DECAF scores calculated at admission can be predictors of events occurring during hospitalization and after discharge of patients with AECOPD and to understand the extent to which the modified versions of the NEWS2 and the DECAF score (the $NEWS2_{88-92\%}$ and the mDECAF score, respectively) are comparable to the original versions.

METHODS

In this retrospective study, we analyzed data obtained from the medical records of a consecutive sample of patients with AECOPD admitted to the Pulmonology Department of the *Centro Hospitalar e Universitário de Coimbra*, in the city of Coimbra, Portugal, between January of 2017 and November of 2018. We included hospitalized patients diagnosed with COPD in accordance with the GOLD criteria,[1] excluding patients with other respiratory conditions (e.g., asthma and interstitial lung disease). The present study was approved by the Research Ethics Committee of the *Centro Hospitalar e Universitário de Coimbra* (Protocol no. OBS.SF.180-2022).

The NEWS2 and DECAF scores were calculated on the basis of patient data at hospital admission. The NEWS2 scores were calculated by assessing RR, SpO_2, systolic blood pressure, pulse rate, level of consciousness, and temperature. Patients with a NEWS2 score of 0-4 were classified as being low-risk patients, those with a NEWS2 score of 5 or 6 were classified as being moderate-risk patients, and those with a NEWS2 score of 7 or higher were classified as being high-risk patients. A NEWS2 score of 5 or higher should prompt hourly observations, whereas a NEWS2 score of 7 or higher should prompt close, continuous observation.[6] Of note, because NEWS2 scores were calculated retrospectively for this study, the classification had no impact on how patients were managed during hospitalization. The NEWS2 score was calculated with the use of scale 1 for hypoxemic patients and scale 2 for hypercapnic patients. The $NEWS2_{88-92\%}$ score was calculated with the use of scale 2 for all patients.

The DECAF score was retrospectively calculated on the basis of the extended Medical Research Council dyspnea scale score (5a or 5b), eosinopenia (< 0.05 × 10^9/L), consolidation, acidemia (pH < 7.3), and atrial fibrillation; the mDECAF score was calculated by assessing the same parameters, the exception being atrial fibrillation, which was replaced by the occurrence of an AECOPD in the previous year. Patients with a DECAF score of 0 or 1 were classified as being low-risk patients, those with a DECAF score of 2 were classified as being moderate-risk patients, and those with a DECAF score of 3-6 were classified as being high-risk patients.[10,11]

We assessed and compared the aforementioned scores for the following outcomes: in-hospital mortality, use of invasive mechanical ventilation (IMV), use of noninvasive ventilation (NIV), a length of stay (LOS) > 14 days (i.e., a LOS above the 75th percentile), hospital readmissions, and future AECOPD. In addition, we assessed the sensitivity and specificity of the scores, as well as their overall performance.

Statistical analysis

Quantitative variables with normal distribution were expressed as means and standard deviations, and variables with non-normal distribution were expressed as medians and interquartile ranges. Categorical variables were expressed as absolute and relative frequencies. Continuous variables with normal distribution were compared by means of t-tests, and those with non-normal distribution were compared by means of the Mann-Whitney test. Categorical variables were compared be means of the chi-square test.

The performance of the NEWS2, $NEWS2_{88-92\%}$, DECAF, and mDECAF scores for the aforementioned outcomes was assessed and compared by means of ROC curves. We calculated the performance of the NEWS2 and $NEWS2_{88-92\%}$ using low-risk and high-risk thresholds (5 and 7, respectively).

We did not perform sample size calculation. We included all of the patients that met the eligibility criteria during the study period.

A value of $p < 0.05$ was considered statistically significant. All statistical analyses were performed with the IBM SPSS Statistics software package, version 26.0 (IBM Corporation, Armonk, NY, USA).

RESULTS

A total of 119 patients admitted with AECOPD were included in the present study (Figure S1). Their characteristics are described in Table 1. The median age of participants was 75 years (IQR, 10), and 87.9% were male. Of the 119 study participants, 5% had GOLD stage I COPD, 35% had GOLD stage II COPD, 42% had GOLD stage III COPD, and 18% had GOLD stage IV COPD. The median percent predicted FEV_1 was 44.8% (IQR, 25.8%), corresponding to severe obstruction. The overall in-hospital mortality rate was 6.7%. A total of 42 patients (35.3%) required NIV, and 3 (2.5%) required IMV. The median LOS was 8 days (IQR, 6), and 26.1% of the patients had a long LOS. Readmission rates ranged from 13.8% at 30 days after discharge to 34.9% at 180 days after discharge. Sixty-three percent of the patients had a new AECOPD, and 42.9% had a severe AECOPD in the following year.

Patient risk classification based on the NEWS2 and $NEWS2_{88-92\%}$ scores is shown in Figure 1. Of the total of patients, 63.0% and 54.1%, respectively,

Table 1. Characteristics of the study participants.[a]

Variable	Total sample (N = 119)
Age, years	75 [10]
Sex	
Male	101 (84.9%)
Female	18 (15.1%)
Smoking history, pack-years	48 [67]
Smoking status	
Never smoker	26 (21.8%)
Former smoker	69 (58.0%)
Current smoker	24 (20.2%)
COPD, GOLD stage	
I	6 (5.0%)
II	42 (35.3%)
III	50 (42.0%)
IV	21 (17.6%)
FEV_1, % predicted	44.8 [25.8]
AECOPD in the previous year	34 (28.6%)
Consolidation	55 (46.2%)
Acidemia, pH < 7.3	20 (16.8%)
Hypercapnia	49 (53.8%)
NIV	42 (35.3%)
IMV	3 (2.5%)
Antibiotic therapy	106 (89.1%)
Patient risk classification NEWS2 score	
Low risk, 0-4	41 (36.9%)
Moderate risk, 5 or 6	24 (21.6%)
High risk, ≥ 7	46 (38.7%)
$NEWS2_{88-92\%}$ score	
Low risk, 0-4	51 (45.9%)
Moderate risk, 5 or 6	24 (21.6%)
High risk, ≥ 7	36 (32.4%)
DECAF score	
Low risk	3 (2.5%)
Moderate risk	31 (26.1%)
High risk	85 (71.4%)
mDECAF score	
Low risk	1 (0.8%)
Moderate risk	24 (20.2%)
High risk	94 (79.0%)
LOS, days	8 [6]
Long LOS	31 (26.1%)
Death	8 (6.7%)
Readmission at 30 days	15 (13.8%)
Readmission at 60 days	19 (17.4%)
Readmission at 90 days	25 (22.9%)
Readmission at 180 days	38 (34.9%)
AECOPD in the following year	
Total	75 (63.0%)
Severe	51 (42.9%)

AECOPD: acute exacerbation(s) of COPD; NIV: noninvasive ventilation; IMV: invasive mechanical ventilation; NEWS2: National Early Warning Score 2; DECAF: **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation; mDECAF: modified DECAF; and LOS: length of stay. [a]Data presented as n (%) or median [IQR].

were classified as having a moderate or high risk (i.e., requiring close, continuous observation) on the basis of their NEWS2 and $NEWS2_{88-92\%}$ scores. This corresponds to an 8.9% reduction in the number of patients requiring close, continuous observation on the basis of the $NEWS2_{88-92\%}$ score. The $NEWS2_{88-92\%}$ tended to be associated with reduced scores, tending to classify patients as having a lower risk in comparison with the NEWS2 (Figure S2).

The distribution of the outcome variables by risk group as assessed by the different scores is shown in Table 2. Although the $NEWS2_{88-92\%}$ classified a greater number of patients as being low-risk patients, there was no significant difference in mortality between patients classified as being low-risk patients by the NEWS2 and those classified as being low-risk patients by the $NEWS2_{88-92\%}$ (2.4% vs. 4.0%; p = 0.331). In fact, none of the patients classified as being low-risk patients died on the day of admission.

Regarding the LOS, the patients who were not classified as being low-risk patients by the NEWS2 and who were reclassified as being low-risk patients by the $NEWS2_{88-92\%}$ showed no difference in the median LOS when compared with patients already belonging to the low-risk group for both scores. Patients classified as being high-risk patients by the NEWS2 or $NEWS2_{88-92\%}$ had a significantly longer LOS than did those in the low- or moderate-risk group. The same was true for NIV during hospitalization, which was significantly more used in moderate- and high-risk patients than in low-risk patients for both scores (Table 2). There were no significant differences regarding the other outcomes.

Patient risk classification on the basis of the DECAF and mDECAF scores is shown in Figure 1. There were no significant differences in any of the outcomes studied between the DECAF and mDECAF scores (Table 2).

The $NEWS2_{88-92\%}$ and the NEWS2 had, respectively, good and adequate discriminatory power to predict NIV use (AUC = 0.70; 95% CI, 0.60-0.80 vs. AUC = 0.66; 95% CI, 0.56-0.77) and IMV use (AUC = 0.81; 95% CI, 0.62-0.99 vs. AUC = 0.77; 95% CI, 0.54-0.99). Both scores had good discriminatory power to predict a longer LOS (AUC = 0.74; 95% CI, 0.63-0.85 vs. AUC = 0.72; 95% CI, 0.61-0.83). In contrast, neither score had discriminatory power to predict future AECOPD or hospital readmissions, and their accuracy in predicting mortality was low (Table S2).

The mDECAF score showed good discriminatory power to predict mortality (AUC = 0.77; 95% CI, 0.62-0.92), whereas no significant results were observed for the DECAF score. The DECAF and mDECAF scores had high discriminatory power to predict IMV use (AUC = 0.89; 95% CI, 0.72-1.00 vs. AUC = 0.88; 95% CI, 0.69-1.00), but not NIV use, future AECOPD, or hospital readmissions (Table S2).

Table 3A shows the performance of the NEWS2 and $NEWS2_{88-92\%}$ at low- and high-risk thresholds (5 and 7, respectively). The performance of the mDECAF score at a high-risk threshold (= 3) is shown in Table 3B. The sensitivity and specificity of the DECAF scores for low-risk groups (a threshold of 2) were not calculated,

Table 2. Outcomes by risk group, as assessed by the National Early Warning Score 2 and Dyspnea, Eosinopenia, Consolidation, Acidemia, and atrial Fibrillation scores.[a]

Variable	Low risk	Moderate risk	High risk	p
Death				
NEWS2	1/41 (2.4%)	2/24 (8.3%)	4/46 (8.7%)	0.438
$NEWS2_{88-92\%}$	2/50 (4.0%)	1/25 (0.0%)	4/35 (11.4%)	0.331
DECAF score	*	1/31 (3.2%)	7/85 (8.2%)	0.560
mDECAF score	**	1/24 (4.2%)	7/94 (7.4%)	0.818
LOS, days				
NEWS2	7 [6]	7 [10]	10 [7]	0.001
$NEWS2_{88-92\%}$	7 [6]	8 [7]	13 [9]	0.002
DECAF score	17 [17]	7 [9]	10 [8]	0.160
mDECAF score	**	7 [9]	9 [8]	0.392
NIV				
NEWS2	10/41 (24.4%)	7/24 (29.2%)	25/46 (54.3%)	0.01
$NEWS2_{88-92\%}$	12/50 (24.0%)	8/25 (32.0%)	22/35 (62.9%)	0.001
DECAF score	*	10/31 (32.3%)	32/85 (37.6%)	0.374
mDECAF score	**	12/24 (50.0%)	29/94 (30.9%)	0.875
IMV				
NEWS2	0/41 (0.0%)	0/24 (0.0%)	2/46 (4.3%)	0.237
$NEWS2_{88-92\%}$	0/50 (0.0%)	0/25 (0.0%)	2/35 (5.7%)	0.113
DECAF score	*	1/31 (3.2%)	2/85 (2.4%)	0.928
mDECAF score	**	0/24 (0.0%)	3/94 (3.2%)	0.664
AECOPD in the following year				
NEWS2	25/40 (62.5%)	16/22 (72.7%)	30/41 (73.2%)	0.531
$NEWS2_{88-92\%}$	30/48 (62.5%)	17/23 (73.9%)	23/31 (74.2%)	0.453
DECAF score	*	23/30 (76.7%)	51/77 (66.2%)	0.245
mDECAF score	**	17/22 (77.3%)	57/87 (65.5%)	0.452
Severe AECOPD in the following year				
NEWS2	18/40 (38.8%)	10/22 (45.5%)	22/41 (53.7%)	0.700
$NEWS2_{88-92\%}$	21/48 (43.8%)	12/23 (52.2%)	16/31 (51.6%)	0.715
DECAF score	*	17/30 (56.7%)	34/77 (44.2%)	0.134
mDECAF score	**	11/22 (50.0%)	39/87 (44.8%)	0.508
Readmission at 30 days				
NEWS2	4/40 (10.0%)	4/22 (18.2%)	7/40 (17.5%)	0.568
$NEWS2_{88-92\%}$	4/48 (8.3%)	4/23 (17.4%)	6/30 (20.0%)	0.290
DECAF score	*	5/30 (16.7%)	10/76 (13.2%)	0.699
mDECAF score	**	4/22 (18.2%)	10/86 (11.6%)	0.031
Readmission at 60 days				
NEWS2	6/40 (15.0%)	4/22 (18.2%)	9/40 (22.5%)	0.689
$NEWS2_{88-92\%}$	6/48 (12.5%)	4/23 (17.4%)	8/30 (26.7%)	0.280
DECAF score	*	6/30 (20.0%)	13/76 (17.1%)	0.678
mDECAF score	**	5/22 (22.7%)	13/86 (15.1%)	0.064
Readmission at 90 days				
NEWS2	8/40 (20.0%)	6/22 (27.3%)	11/40 (27.5%)	0.696
$NEWS2_{88-92\%}$	8/48 (16.7%)	6/23 (26.1%)	10/30 (33.3%)	0.232
DECAF score	*	8/30 (26.7%)	17/76 (22.4%)	0.565
mDECAF	**	5/22 (22.7%)	19/86 (22.1%)	0.183
Readmission at 180 days				
NEWS2	14/40 (35.0%)	7/22 (31.8%)	17/40 (42.5%)	0.658
$NEWS2_{88-92\%}$	14/48 (29.2%)	8/23 (34.8%)	15/30 (50.0%)	0.174
DECAF score	*	11/30 (36.7%)	27/76 (35.5%)	0.435
mDECAF score	**	7/22 (31.8%)	30/86 (34.9%)	0.376

AECOPD, acute exacerbation(s) of COPD; NIV: noninvasive ventilation; IMV: invasive mechanical ventilation; NEWS2: National Early Warning Score 2; DECAF: **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation; mDECAF: modified DECAF; and LOS: length of stay. [a]Data presented as n/total (%) or median [IQR]. *Analysis was not performed, because only 3 patients were classified as being low-risk patients by the DECAF score. **Analysis was not performed, because only 1 patient was classified as being a low-risk patient by the mDECAF score.

because only 1 and 3 patients were classified as being low-risk patients by the DECAF and mDECAF scores, respectively.

The NEWS2 had a high sensitivity for mortality, whereas the NEWS2 and $NEWS2_{88-92\%}$ had a high sensitivity for a longer LOS and the need for NIV. The

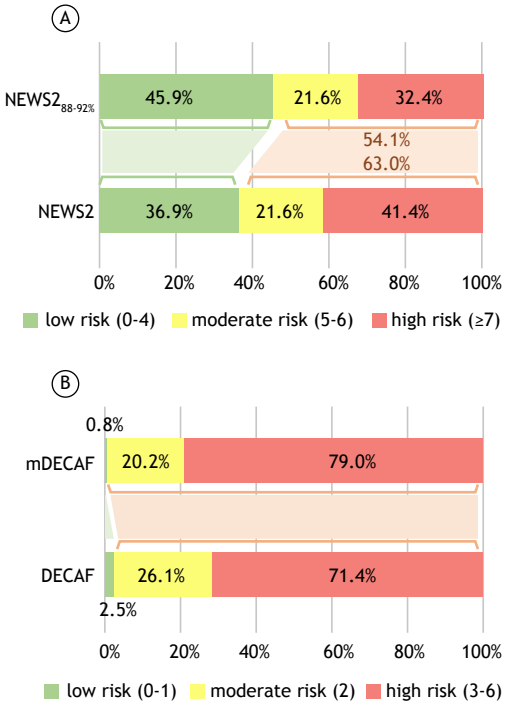

Figure 1. Patients classified as being low-, moderate-, or high-risk patients on the basis of the National Early Warning Score 2 (NEWS2) and NEWS2$_{88-92\%}$ scores (in A), and on the basis of the **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation (DECAF) and modified DECAF (mDECAF) scores (in B). Note: Risk categories were compared between scores (e.g., low risk on the basis of the NEWS2 score vs. low risk on the basis of the NEWS2$_{88-92\%}$ score). Values of p were calculated by means of Fisher's exact test ($p < 0.001$).

NEWS2 and NEWS2$_{88-92\%}$ had a high specificity for mortality, a longer LOS, and NIV use, the NEWS2$_{88-92\%}$ showing better results than the NEWS2.

DISCUSSION

In the present study, the NEWS2 and NEWS2$_{88-92\%}$ scores were moderately accurate in predicting a longer LOS and the need for NIV or IMV, but not mortality. In contrast, the mDECAF score was able to predict mortality, albeit not necessarily accurately, and the need for IMV. However, none of the scores were good at predicting outcomes after discharge.

Patients hospitalized for AECOPD have an in-hospital mortality rate that is not negligible. In our sample, there was an in-hospital mortality rate of 7%, which is consistent with the literature (4-8%).[10,11]

In our study, the DECAF and mDECAF scores performed better than the NEWS2 and NEWS2$_{88-92\%}$ in predicting in-hospital mortality in patients admitted with AECOPD. Although the NEWS2 score at admission has been used as a mortality predictor in the United Kingdom, our results suggest that such scores should not be used for this purpose, being consistent with those of other studies.[13] Unlike the NEWS scores, the DECAF score has been validated as a predictor of in-hospital mortality at admission for AECOPD.[10,11] Furthermore, our results show that the mDECAF score performed better than the original DECAF score. This is consistent with recent studies showing the prognostic impact of an AECOPD in the previous year.[12,14]

Although the NEWS2 is calculated on the basis of common clinical parameters, it presupposes a blood gas analysis at evaluation or knowledge of the type of respiratory failure that the patient experienced. The use of the NEWS2$_{88-92\%}$ in all of the patients in the present study, regardless of the type of respiratory failure, was associated with a reduction of 8.9% in the number of individuals requiring close, continuous observation in comparison with the NEWS2, without a significant increase in mortality in individuals reclassified as being low-risk patients. In fact, none of the patients classified as being low-risk patients died on the same day the score was applied. Echevarria et al. compared the NEWS2 and NEWS2$_{88-92\%}$ and found no differences in mortality.[13] In fact, several guidelines advise titration of oxygen saturation to a target of 88-82% in patients with AECOPD, a value that is associated with reduced mortality, hypercapnia, and respiratory acidosis.[1,8,9,15]

In addition to supporting previous results regarding in-hospital mortality, our study is, to the best of our knowledge, the first to compare the performance of the NEWS2, NEWS2$_{88-92\%}$, and DECAF scores in predicting the need for NIV, the use of IMV, and the LOS. The NEWS2 and NEWS2$_{88-92\%}$ were found to perform better than the DECAF scores in predicting the need for NIV, the need for IMV, and a longer LOS. This finding should be explored in future studies involving a larger sample size. If confirmed, it can have implications for patient management, including prediction of the resources required and admission of patients on the basis of the required level of care. The NEWS2/NEWS2$_{88-92\%}$ and DECAF scores were not good at predicting long-term outcomes such as future AECOPD and hospital readmissions, reflecting the fact that they have been developed for different purposes.

Our study has some limitations. Because this was a retrospective study, there are some missing data. In addition, the NEWS2 and NEWS2$_{88-92\%}$ scores were calculated on the basis of patient data collected at the time of admission, because data from other time points were unavailable. Finally, the fact that this was a single-center study and that the sample size was small might have led to reduced accuracy of the estimates and type II errors. Despite the aforementioned limitations, key strengths of our study include the fact that all of the patients presenting with AECOPD were consecutively included and the fact that this was the first study to compare the performance of the NEWS and DECAF scores in predicting the need for acute NIV, the need for IMV, and the LOS.

Future larger, multicenter prospective studies are warranted, as are studies evaluating the use of the NEWS2 and NEWS2$_{88-92\%}$ during the entire LOS, in order to investigate whether titrating oxygen saturation to 88-92% in all patients has implications for clinical course,

Table 3. Sensitivity and specificity of the categories defined by low-risk and high-risk thresholds on the basis of the National Early Warning Score 2 scores (part A) and the Dyspnea, Eosinopenia, Consolidation, Acidemia, and atrial Fibrillation scores (part B).

Part A								
	Score ≥ 5 (moderate risk)				Score ≥ 7 (high risk)			
	NEWS2		$NEWS2_{88-92\%}$		NEWS2		$NEWS2_{88-92\%}$	
	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)
Death	0.86 (0.79-0.92)	0.39 (0.29-0.48)	0.71 (0.63-0.80)	0.47 (0.38-0.56)	0.57 (0.48-0.67)	0.60 (0.51-0.69)	0.57 (0.48-0.66)	0.69 (0.61-0.78)
LOS >14 days	0.86 (0.79-0.92)	0.45 (0.35-0.54)	0.82 (0.75-0.90)	0.55 (0.46-0.65)	0.64 (0.55-0.73)	0.66 (0.58-0.75)	0.61 (0.52-0.70)	0.77 (0.69-0.85)
NIV	0.76 (0.68-0.84)	0.45 (0.36-0.54)	0.71 (0.63-0.80)	0.57 (0.47-0.66)	0.60 (0.50-0.69)	0.70 (0.61-0.78)	0.53 (0.43-0.62)	0.80 (0.72-0.87)
IMV	1.00 (1.00-1.00)	0.38 (0.29-0.47)	1.00 (1.00-1.00)	0.47 (0.38-0.56)	0.04 (0.01-0.08)	1.00 (1.00-1.00)	0.06 (0.01-0.10)	1.00 (1.00-1.00)
AECOPD in the following year	0.65 (0.56-0.74)	0.47 (0.37-0.57)	0.56 (0.47-0.66)	0.56 (0.47-0.66)	0.42 (0.33-0.52)	0.66 (0.57-0.75)	0.34 (0.25-0.43)	0.75 (0.67-0.83)
Severe AECOPD in the following year	0.64 (0.55-0.73)	0.42 (0.32-0.51)	0.58 (0.49-0.68)	0.53 (0.43-0.63)	0.44 (0.34-0.54)	0.64 (0.55-0.73)	0.34 (0.25-0.43)	0.72 (0.63-0.80)
Readmission at 30 days	0.73 (0.65-0.82)	0.41 (0.32-0.51)	0.73 (0.65-0.82)	0.52 (0.42-0.61)	0.47 (0.37-0.56)	0.62 (0.53-0.72)	0.47 (0.37-0.56)	0.72 (0.64-0.81)
Readmission at 60 days	0.68 (0.59-0.77)	0.41 (0.31-0.51)	0.68 (0.59-0.77)	0.52 (0.42-0.62)	0.47 (0.38-0.57)	0.63 (0.53-0.72)	0.47 (0.38-0.57)	0.74 (0.65-0.82)
Readmission at 90 days	0.68 (0.59-0.77)	0.42 (0.32-0.51)	0.68 (0.59-0.77)	0.53 (0.44-0.63)	0.44 (0.34-0.54)	0.62 (0.53-0.72)	0.44 (0.34-0.54)	0.74 (0.66-0.83)
Readmission at 180 days	0.63 (0.54-0.73)	0.41 (0.31-0.50)	0.63 (0.54-0.73)	0.55 (0.45-0.64)	0.45 (0.35-0.54)	0.64 (0.55-0.73)	0.42 (0.33-0.52)	0.77 (0.68-0.85)
Part B								
	Score ≥ 2 (moderate risk)				Score ≥ 3 (high risk)			
	DECAF		mDECAF		DECAF		mDECAF	
	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)	Sn (95% CI)	Sp (95% CI)
Mortality	-	-	-	-	0.86 (0.65-1.10)	0.29 (0.20-0.37)	0.88 (0.65-1.10)	0.22 (0.14-0.29)
LOS > 14 days	-	-	-	-	0.71 (0.55-0.87)	0.27 (0.18-0.37)	0.81 (0.67-0.95)	0.22 (0.13-0.30)
NIV	-	-	-	-	0.24 (0.11-0.37)	0.30 (0.20-0.40)	0.69 (0.55-0.83)	0.16 (0.07-0.24)
IMV	-	-	-	-	0.67 (0.13-1.20)	0.28 (0.19-0.36)	1.00 (1.00-1.00)	0.22 (0.14-0.29)
AECOPD in the following year	-	-	-	-	0.69 (0.59-0.80)	0.26 (0.11-0.40)	0.76 (0.66-0.86)	0.14 (0.03-0.26)
Severe AECOPD in the following year	-	-	-	-	0.69 (0.56-0.81)	0.27 (0.16-0.38)	0.76 (0.65-0.88)	0.19 (0.09-0.29)
Readmission at 30 days	-	-	-	-	0.67 (0.43-0.91)	0.29 (0.20-0.38)	0.67 (0.43-0.91)	0.19 (0.11-0.27)
Readmission at 60 days	-	-	-	-	0.68 (0.48-0.89)	0.29 (0.20-0.38)	0.68 (0.48-0.89)	0.19 (0.11-0.27)
Readmission at 90 days	-	-	-	-	0.72 (0.54-0.90)	0.30 (0.20-0.40)	0.76 (0.59-0.93)	0.20 (0.11-0.29)
Readmission at 180 days	-	-	-	-	0.74 (0.60-0.88)	0.31 (0.20-0.42)	0.79 (0.66-0.92)	0.21 (0.12-0.31)

NEWS2: National Early Warning Score 2; Sn: sensitivity; Sp: specificity; NIV: noninvasive ventilation; IMV: invasive mechanical ventilation; AECOPD: acute exacerbation(s) of COPD; DECAF: **D**yspnea, **E**osinopenia, **C**onsolidation, **A**cidemia, and atrial **F**ibrillation; and mDECAF: modified DECAF.

reducing or increasing the frequency of observations on the basis of patient risk classification and, ultimately, the associated financial costs.

In conclusion, the NEWS2 and $NEWS2_{88-92\%}$ scores calculated at admission in patients presenting with AECOPD appear to be adequate in predicting the need for acute NIV and a longer LOS. In addition, it is unlikely that the use of the $NEWS2_{88-92\%}$ would have resulted in an increased risk of death in the low-risk group. In fact, the use of the $NEWS_{88-92\%}$ can reduce the number of patients requiring closer clinical surveillance, reducing human resource costs and hospital expenses without compromising patient safety. The DECAF and mDECAF scores calculated at admission in patients presenting with AECOPD appear to be better predictors of in-hospital mortality than the NEWS2 and $NEWS2_{88-92\%}$ scores.

AUTHOR CONTRIBUTIONS

LG, BS-P, and CR: design of the study. LG and BS-P: analysis of the data and writing of the manuscript. LG, SP, BS-P, and CR: critical revision of the manuscript for important intellectual content. All authors read and approved the final manuscript.

CONFLICTS OF INTEREST

None declared.

REFERENCES

1. Global Initiative for Chronic Obstructive Lung Disease (GOLD) [homepage on the Internet]. Bethesda: GOLD [cited 2023 Jan 1]. 2020 Global Strategy for Prevention, Diagnosis and Management of COPD: 2022 Report. Available from: https://goldcopd.org/2022-gold-reports-2/
2. Soler-Cataluña JJ, Martínez-García MA, Román Sánchez P, Salcedo E, Navarro M, Ochando R. Severe acute exacerbations and mortality in patients with chronic obstructive pulmonary disease. Thorax. 2005;60(11):925-931. https://doi.org/10.1136/thx.2005.040527
3. Stone PW, Minelli C, Feary J, Roberts CM, Quint JK, Hurst JR. "NEWS2" as an Objective Assessment of Hospitalised COPD Exacerbation Severity. Int J Chron Obstruct Pulmon Dis. 2022;17:763-772. https://doi.org/10.2147/COPD.S359123
4. Celli BR, Fabbri LM, Aaron SD, Agusti A, Brook R, Criner GJ, et al. An Updated Definition and Severity Classification of Chronic Obstructive Pulmonary Disease Exacerbations: The Rome Proposal. Am J Respir Crit Care Med. 2021;204(11):1251-1258. https://doi.org/10.1164/rccm.202108-1819PP
5. The Royal College of Physicians [homepage on the Internet]. London: the College; c2022; [updated 2017 Dec 19; cited 2023 Jan 1]. National Early Warning Score (NEWS) 2. Available from: https://www.rcplondon.ac.uk/projects/outputs/national-early-warning-score-news-2
6. Rocker G. Harms of overoxygenation in patients with exacerbation of chronic obstructive pulmonary disease [published correction appears in CMAJ. 2017 Jun 26;189(25):E872]. CMAJ. 2017;189(22):E762-E763. https://doi.org/10.1503/cmaj.170196
7. Echevarria C, Steer J, Wason J, Bourke S. Oxygen therapy and inpatient mortality in COPD exacerbation. Emerg Med J. 2021;38(3):170-177. https://doi.org/10.1136/emermed-2019-209257
8. República Portuguesa. Ministério da Saúde. Serviço Nacional de Saúde. Direção-Geral da Saúde [homepage on the Internet]; c2023 [updated 2019 Aug 26; cited 2023 Jan 1] NORMA CLÍNICA: 005/2019. Diagnóstico e Tratamento da Doença Pulmonar Obstrutiva Crônica no Adulto. Adobe Acrobat document; 18p.]. Available from: https://normas.dgs.min-saude.pt/wp-content/uploads/2019/08/diagnostico-tratamento-doenca-pulmonar-obstrutiva-cronica-adulto-2019.pdf
9. O'Driscoll BR, Howard LS, Earis J, Mak V; British Thoracic Society Emergency Oxygen Guideline Group; BTS Emergency Oxygen Guideline Development Group. BTS guideline for oxygen use in adults in healthcare and emergency settings. Thorax. 2017;72(Suppl 1):ii1-ii90. https://doi.org/10.1136/thoraxjnl-2016-209729
10. Echevarria C, Steer J, Heslop-Marshall K, Stenton SC, Hickey PM, Hughes R, et al. Validation of the DECAF score to predict hospital mortality in acute exacerbations of COPD. Thorax. 2016;71(2):133-140. https://doi.org/10.1136/thoraxjnl-2015-207775
11. Steer J, Gibson J, Bourke SC. The DECAF Score: predicting hospital mortality in exacerbations of chronic obstructive pulmonary disease. Thorax. 2012;67(11):970-976. https://doi.org/10.1136/thoraxjnl-2012-202103
12. 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 Tuberc. 2015;64(1):75-80. https://doi.org/10.1016/j.ejcdt.2014.11.006
13. Echevarria C, Steer J, Bourke SC. Comparison of early warning scores in patients with COPD exacerbation: DECAF and NEWS score. Thorax. 2019;74(10):941-946. https://doi.org/10.1136/thoraxjnl-2019-213470
14. Sharma S, Khan K, Yadav G, Koolwal S. A study of modified DECAF score in predicting hospital outcomes in patients of acute exacerbation of chronic obstructive pulmonary disease at SMS Medical College, Jaipur. Adv Human Biol. 2020;10(3):171. https://doi.org/10.4103/AIHB.AIHB_35_20
15. Austin MA, Wills KE, Blizzard L, Walters EH, Wood-Baker R. Effect of high flow oxygen on mortality in chronic obstructive pulmonary disease patients in prehospital setting: randomised controlled trial. BMJ. 2010;341:c5462. https://doi.org/10.1136/bmj.c5462