Observational Study

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Readmission rates within the first 30 and 90 days after severe COPD exacerbations (RACE study)

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Abstract

Chronic obstructive pulmonary disease (COPD) frequently results in hospital readmission and contributes to increased morbidity and mortality. This multicenter prospective study aimed to identify factors that increase the risk of readmission within 30 to 90 days of severe COPD exacerbation. A total of 415 patients admitted to the emergency department (ED) or general pulmonology ward after discharge due to severe exacerbations from 13 tertiary centers in Turkey were included. Of the participants, 346 (83.4%) were male and 69 (16.6%) were female, with an average age of 69.0 ± 9.1 years. Readmissions within 30 and 90 days after the initial hospitalization occurred in 176 (42.4%) and 191 (46%) patients, respectively. Prospective data collection focused on exacerbation severity, disease severity, and the utility of initial admissions. Factors for 30 to 90 day readmission were analyzed using univariate and multivariate regression models. A 30-day readmission correlated significantly with Hospital Anxiety Depression Scale scores above 16 [odds ratio [OR] 95% confidence intervals [CI]: 1.9 (1.1–3.6); $P = .042$], severe exacerbation history in the previous year [OR 95% CI: 1.7 (1.1–2.9); $P = .038$], hospital-acquired pneumonia [OR 95% CI: 1.9 (1–4.1); $P = .049$)], and frequent antibiotic use in the previous year [OR 95% CI: 1.8 (1.2–2.7); $P = .007$]. Risk factors for 90-day readmissions included: Grades 3 to 4 tricuspid regurgitation [OR 95% CI: 2.2 (1.1–4.4); $P = .024$], 2 or more moderate COPD exacerbations [OR 95% CI: 1.9 (1.2–3.1); $P = .010$], severe exacerbation history in the previous year [OR 95% CI: 2.5 (1.5–4.2); $P = .001$], immunosuppression [OR 95% CI: 2.7 (1.2–5.7); $P = .013$], frequent antibiotic use the previous year [OR 95% CI: 1.5 (1–2.4); $P = .048$], hospitalization via the ED [OR 95% CI: 1.6 (1.1–2.6); $P = .028$]. To mitigate complications and readmissions, patients with a history of frequent severe COPD exacerbations, high anxiety and depression scores, frequent antibiotic requirements, immunosuppression, tricuspid regurgitation, hospital-acquired pneumonia, and those admitted to the ED should be prioritized for remote monitoring after initial discharge.

Abbreviations: CI = confidence intervals, COPD = chronic obstructive pulmonary disease, DIMECO = difficult to manage COPD exacerbation, ECHO = echocardiography, ED = emergency department, GOLD = Global Initiative for Chronic Obstructive Lung Disease, HADS = Hospital Anxiety and Depression Scale, ICU = intensive care unit, NIMV = noninvasive mechanical ventilation, OR = odds ratio, OSA = obstructive sleep apnea, sPAP = systolic pulmonary artery pressure, TR = tricuspid regurgitation.

Keywords: antibiotic use, anxiety, COPD, depression, exacerbations, immunosuppression, readmission, risk factors

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The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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Key points

- Reducing healthcare costs and mortality associated with readmissions within the first 3 months after severe COPD exacerbations is paramount.
- Therefore, it is imperative to identify high-risk groups.
- This study indicated that the high-risk group comprised patients with a history of multiple severe exacerbations, hospitalization post-ED admission, elevated anxiety and depression scores, frequent antibiotic use, immunosuppression, tricuspid regurgitation, and hospital-acquired pneumonia.
- Emphasis should be placed on the rigorous follow-up of these patients.

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a common and debilitating respiratory disease affecting millions of people worldwide. It is characterized by persistent airflow limitation and is usually progressive in nature. Exacerbation, also known as acute worsening of symptoms, is common in patients with COPD and is associated with high morbidity, mortality, and medical expense rates. COPD is one of the diseases with the highest rate of readmission within 30 days, along with congestive heart failure and pneumonia.[1] Readmissions following hospital discharge are a serious concern for patients, caregivers, and healthcare professionals because severe COPD exacerbations frequently necessitate hospitalization.[1–3]

Hospital readmissions after COPD exacerbations have been found to be associated with several factors, including disease severity, comorbidities, inadequate follow-up care, and poor medication adherence, resulting in increased healthcare costs, reduced quality of life, and increased mortality.[4–7]

Several studies have investigated the predictors of readmission following severe COPD exacerbations. Older age, low socioeconomic status, and lower educational levels have been associated with a higher risk of readmission. Comorbidities, such as heart failure, renal failure, and diabetes have also been found to increase the risk of readmission. Patients with more severe COPD, as measured by lung function tests, are also at a higher risk of readmission following exacerbation.[8–10] Antibiotic therapy has been found to be effective in reducing the risk of readmission in patients with severe COPD exacerbations. However, the overuse of antibiotics has been associated with the emergence of antibiotic-resistant bacteria as well as an increased risk of adverse drug reactions.[11–13]

Several interventions have been developed to reduce readmission rates following severe COPD exacerbation. Pulmonary rehabilitation, which includes exercise training, education, and breathing techniques, has been shown to reduce hospital readmissions and improve patient outcomes. Self-management interventions, including patient education, medication adherence support, and symptom monitoring have also been found to be effective in reducing readmissions. Telemedicine, which enables remote monitoring of patient symptoms and vital signs, has been found to reduce hospital readmissions.[14–17]

In summary, readmission following severe COPD exacerbations is a significant healthcare burden and several risk factors have been identified. The accuracy of the risk factor calculation determines the prognosis and cost-effectiveness of preventing readmission after exacerbation. Identifying the characteristics that increase the likelihood of readmission within 30 to 90 days following severe COPD exacerbation is the major goal of this study that is being presented.

2. Subjects and methods

2.1. Ethical approval and participants' consent statement

This multicenter, prospective, observational registry study was approved by the local institutional ethics committee of the Gazi University (approval no. 687/2018). Informed consent was obtained from all participants before participating in the study. All procedures performed in the study involving human participants were in accordance with the ethical standards of the hospital, national research committee, and 1964 Helsinki Declaration.

2.2. Study design and participants

We consecutively enrolled 434 patients hospitalized due to severe COPD exacerbation from 13 different hospital clinics in Turkey between October 1, 2018, and September 30, 2019, and prospectively followed-up for 3 months. Of these, 415 completed the follow-up and were considered for analysis. All the researchers received training on the standard methodology.

The power of the study was analyzed for the primary outcome of "difficult to manage COPD exacerbation" (DIMECO) study which is under submission currently. This work was supported by the Turkish Thoracic Society COPD Assembly and Turkish Thoracic Society. The current study was a prospective post hoc analysis of the DIMECO study to evaluate readmission rates after discharge for COPD exacerbation.[18]

Participation was included from 3 geographical regions and 5 provinces of Turkey and categorized according to the first level of the Nomenclature of Territorial Units for Statistics system and from one province of the Turkish Republic of Northern Cyprus. The participants did not receive financial support.

Inclusion criteria:

(1) Consent to participate.
(2) Patients over 40 years of age.
(3) Diagnosis of COPD (if the most recent 1-year lung function test results are consistent with COPD according to the Global Initiative Obstructive Lung Disease (GOLD).[1]
(4) Hospitalized due to severe COPD exacerbation according to GOLD criteria.[1]

Exclusion criteria:

(1) Patients who were aged <40 years.
(2) Patients did not have a pulmonary function test in the last 1 year.
(3) Patients admitted directly to the intensive care unit (ICU) or transferred from the ICU to the general ward.
(4) Patients with stable COPD were hospitalized primarily for other reasons such as pneumonia, heart failure, and lung cancer.
(5) Refuse to participate to the study.

2.3. Variables, measurement, and outcomes

Patient data were prospectively collected consisted of 4 main domains. The first domain included patients' medical data (a complete medical history including smoking history, gender, age, and sociodemographic data; comorbidities; Hospital Anxiety and Depression Scale [HADS], an obstructive sleep apnea questionnaire [STOP-BANG], COPD related comorbidity index [COTE], etc), the second domain included the data for the exacerbation and disease properties (GOLD stage, current symptoms, the number of COPD exacerbations in previous year, the severity of previous exacerbations, the results of posteroanterior chest X-ray and computerized chest tomography, the co-existence of pneumonia at admission/during hospitalization, the microbiological culture result of sputum, co-existence of urinary tract infection, complete blood count, inflammatory

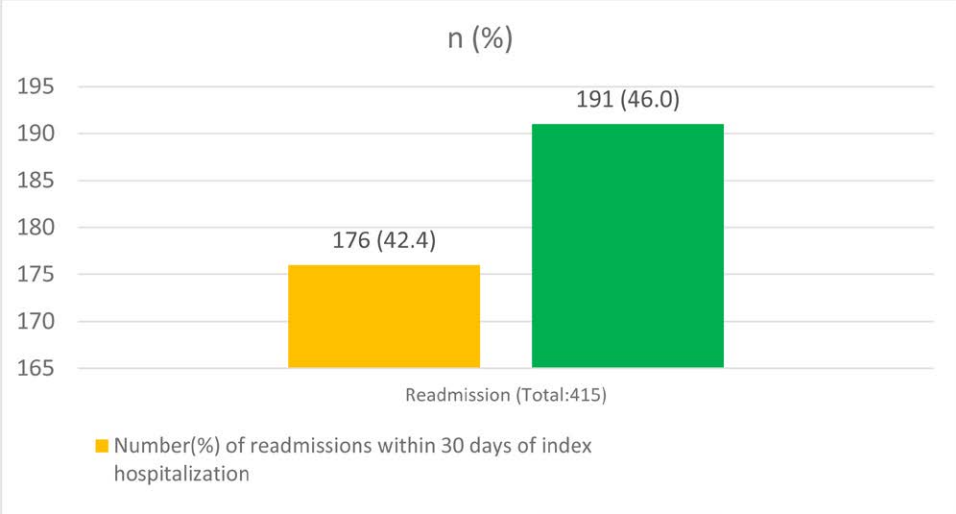


Figure 1. The readmissions in 30th and 90th days after severe COPD exacerbation. COPD = chronic obstructive pulmonary disease.

biomarkers, etc), the third domain included the treatment modalities during hospitalization, treatment adherence in stable period, presence of immunosuppression, history of antibiotic therapy, need for diuresis during hospitalization, need for additional dose of steroid, need for theophylline, need for oxygen therapy/noninvasive mechanical ventilation [NIMV]/nutritional support and physiotherapy during hospitalization), the forth domain included data about hospital utilities, length of hospital stays, inability to discharge due to delay hospital services, etc. The risk factors for prolonged hospital stay have been investigated elsewhere.

After discharge, all patients were prospectively followed up to determine readmissions within 30- and 90-day after the index hospitalization. The patients were phone-called on the 90th day after discharge. After obtaining verbal consent from the volunteers, they were asked if they had been admitted to the hospital or emergency department (ED). If so, the date, symptoms, and conditions that caused them to visit the hospital were noted during the post-discharge 90 days period. Risk factors for readmission within 30 and 90 days of index hospitalization were evaluated.

2.4. Tool kits

All patients hospitalized in COPD exacerbation clinics were included in the study. The GOLD 2017 definition is considered an exacerbation criterion for patients. If a patient has an increase in symptoms that require a change in treatment, it is accompanied by signs of respiratory failure, and/or the presence of serious comorbidities or symptoms indicates severe COPD exacerbation, the patient is treated as an inpatient.

The socioeconomic level was determined using questions and answers designed according to the features of the proxi scale in determining the socioeconomic level questionnaire.[19,20]

The HADS is a self-report questionnaire used to assess symptoms of anxiety and depression in patients with physical illness. It consisted of 14 items. Each item is scored on a four-point scale, and the total score ranges from 0 to 42, with higher scores indicating more severe symptoms.[21] The threshold values identified for optimal balance between sensitivity and specificity were 8+, defined as the cutoff for "possible cases" suggested by Zigmond and Snaith in their original paper on HADS.[22]

The STOP-BANG score is a widely used screening tool for evaluating the risk of obstructive sleep apnea (OSA) in patients. It comprises 8 items, and patients can be classified according to the OSA risk based on their respective scores. The sensitivity of the STOP-Bang scores for the detection of moderate-to-severe OSA (apnea-hypopnea index > 15) and severe OSA (apnea-hypopnea index > 30) were 93% and 100%, respectively.[23,24]

The GOLD guideline criteria were used to prescribe NIMV and long term oxygen treatment.[1]

Bias: All patients admitted to the participating centers were consecutively included in the study. Only patients who were directly admitted to intensive care were excluded from the study.

2.5. Data analysis

All analyses were performed using IBM SPSS Statistics for Windows, version 23. Descriptive statistics for continuous variables were presented as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. While the association between 2 dependent categorical variables was examined using McNemar test for independent categorical variables, Pearson *chi*-squared test or Fisher–Freeman–Halton test was performed. Moreover, if a significant difference was found among the independent groups, the column proportions were compared for pairwise comparisons using Bonferroni adjustment. Logistic regression analysis was used to determine the significant variables for readmission. First, univariate logistic regression was conducted, and variables with P-value ≤ .25 were specified as candidate variables. Using candidate variables, multiple logistic regression analysis was performed with backward elimination to determine the final model. In the multivariate analysis, variables were selected based on their significance in univariate analysis. Binary logistic regression analyses were performed to estimate ICU admission risk and calculate odds ratios (ORs) and 95% confidence intervals. P-value < .05 was considered statistically significant.

3. Results

3.1. The prevalence of readmission within 30 and 90 days of index hospitalization

The percentage of readmissions within 30 days of index hospitalization was 42.4% (n = 176). The prevalence within 90 days post-index hospitalization was 46% (n = 191) (Fig. 1). Of those who experienced readmission within 30 days of index hospitalization, 136 (77.27%) had readmission within 90 days of index hospitalization.

3.2. Baseline characteristics

Patients had an average age of 69.0 ± 9.1 years with 16.6% (n = 69) being female and 83.4% (n = 346) male. Outcomes post-index hospitalization were as follows: 4 deaths, 5 transfers to other departments, and 406 discharges. Of the discharged patients, 42.4% (n = 176) experienced readmission within 30 days, and 46% (n = 191) within 90 days. Remarkably, 77.27% (n = 136) of those readmitted within 30 days also returned within 90-day period. Detailed sociodemographic characteristics are shown in Table 1.

The predominant comorbidity among the patients was hypertension, followed by coronary artery disease, and diabetes mellitus. The comprehensive data on patient comorbidities are shown in Table 2.

In this study, data from 272 patients with index echocardiography (ECHO) and 398 patients with index electrocardiography were assessed, as shown in Figure 2 and Table S1, Supplemental Digital Content, http://links.lww.com/MD/O61, respectively. Of the 199 patients in whom systolic pap could be measured on ECHO; 114 (57.3%) had a maximum systolic pulmonary artery pressure (sPAP) >40 mm Hg. Among those readmitted within 30 days after the index hospitalization, 50% (n = 57) recorded an sPAP > 40 mm Hg, whereas only 35.3% (n = 30) of patients who were not readmitted during this interval exhibited a comparable sPAP (P = .039). Among those

Table 1

Assessment of patient-related readmission status.

		Readmission within 30 days of index hospitalization‡ n = 176		Readmission within 90 days of index hospitalization‡ n = 191	
	Total† N = 415	§A/B: Readmission within 30 days of index hospitalisation/non	*P*	‖C/D: Readmission within 90 days of index hospitalisation/non	*P*
Age, years					
Mean ± SS	69.0 ± 9.1	68.7 ± 9.0/69.2 ± 9.2§	.610*	69.4 ± 9.7/68.6 ± 8.6‖	.355*
Gender, n (%)					
Male	346 (83.4)	147 (42.5)	.944**	158 (45.7)	.742**
Female	69 (16.6)	29 (42.0)		33 (47.8)	
Socioeconomic status (n = 374), n (%)					
Low	103 (27.5)	48 (46.6)	.663**	65 (63.1)	**.003****
Medium	239 (63.9)	107 (44.8)		104 (43.5)	
High	32 (8.6)	12 (37.5)		13 (40.6)	
Cigarette, n (%)					
Never	20 (4.8)	6 (30.0)	**.012****	10 (50.0)	.360**
Quitted	290 (69,9)	129 (44.5)		132 (45.5)	
Passive smoker	13 (3,1)	10 (76.9)		9 (69.2)	
Active smoker	92 (22,2)	34 (33.7)		40 (43.5)	
Comorbidities, n (%)					
Yes	343 (82.7)	153 (44.6)	**.048****	160 (46.6)	.578**
Reluctance to discharge, n (%)					
Yes	20 (4,8)	8 (40,0)	1.000**	14 (70,0)	**.048****
History of LTOT usage, n (%)					
Yes	194 (46,7)	103 (53.1)	**<.001****	99 (51.0)	.055**
History of NIMV usage, n (%)					
Yes	89 (21,4)	48 (53.9)	**.013****	52 (58.4)	**.011****
History of nebulizer usage, n (%)					
Yes	274 (66.0)	132 (48.2)	**.001****	142 (51.8)	**.001****
HADS total score					
Mean ± SS	16.5 ± 7.9	18.1 ± 7.8/15.4 ± 7.9§	**<.001*****	18.1 ± 8.0/15.2 ± 7.7‖	**<.001*****
HADS (n = 382), *n* (%)					
<16 (median)	172 (45.0)	54 (31.4)	**<.001****	61 (35.5)	**.001****
≥16 (median)	210 (55.0)	103 (49.0)		110 (52.4)	
Stop-BANG, n (%)			.216**		**.041****
Low/medium risk OSAS	261 (67.3)	102 (39.1)		109 (41.8)	
High risk OSAS	127 (32.7)	58 (45.7)		67 (52.8)	

HADS = Hospital Anxiety and Depression Scale, LTOT = long-term oxygen therapy, NIMV = noninvasive mechanical ventilation.

† Column percentage.

‡ Row percentage.

§ Readmission within 30 days of index hospitalization/non-readmission within 30 days of index hospitalization.

‖ Readmission within 90 days of index hospitalization/non-readmission within 90 days of index hospitalization.

* Student *t* test.

** Chi-Square test.

*** Mann–Whitney *U* test.

Table 2

Comorbidities.

	Total† N = 415	Readmission within 30 days of index hospitalization‡ n = 176	P§	Readmission within 90 days of index Hospitalization‡ n = 191	P‖
Diabetes, n (%)	117 (28.2)	54 (46.2)	.334*	67 (57.3)	.004*
Heart failure, n (%)	99 (23.9)	50 (50.5)	.062*	54 (54.5)	.051*
Hypertension, n (%)	224 (54.0)	101 (45.1)	.239*	107 (47.8)	.440*
Arrhythmia, n (%)	69 (16.6)	34 (49.3)	.206*	42 (60.9)	**.007***
Coronary artery disease, n (%)	138 (33.3)	55 (39.9)	.457*	66 (47.8)	.603*
Chronic renal failure n (%)	36 (8.7)	22 (61.1)	**.028***	27 (75.0)	**.001***
Acute renal failure, n (%)	11 (2.7)	4 (36.4)	.919*	3 (27.3)	.338*
Pulmonary thromboembolism, n (%)	27 (6.5)	13 (48.1)	.673*	13 (48.1)	.844*
History of tuberculosis, n(%)	27 (6.5)	14 (51.9)	.409*	14 (51.9)	.668*
Bronchiectasis, n (%)	42 (10.1)	19 (45.2)	.821*	21 (50.0)	.702*
Interstitial lung disease, n (%)	6 (1.4)	2 (33.3)	1.000*	3 (50.0)	1.000*
Lung cancer, n (%)	21 (5,1)	11 (52.4)	.470*	7 (33.3)	.331*
Other malignities, n (%)	29 (7.0)	12 (41.4)	1.000*	15 (51.7)	.656*
Osteoporosis, n (%)	39 (9.2)	21 (55.3)	.131*	23 (60.5)	.087*
Anemia, n (%)	68 (16.4)	27 (39.7)	.719*	36 (52.9)	.263*

† Column percentage.

‡ Row percentage.

§ Readmission within 30 days of index hospitalization/non-readmission within 30 days of index hospitalization.

‖ Readmission within 90 days of index hospitalization/non-readmission within 90 days of index hospitalization.

* Chi-Square test.

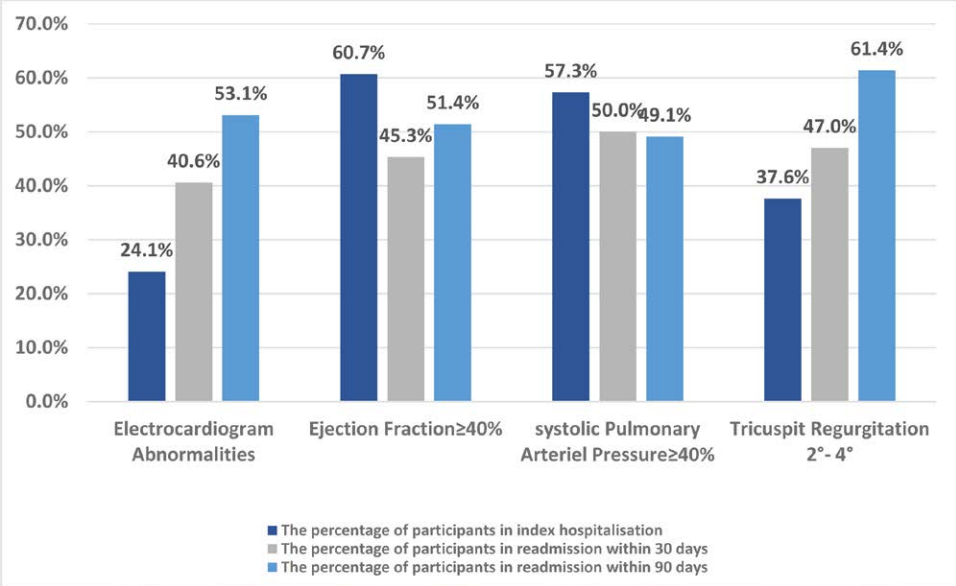


Figure 2. Cardiologic findings of the study group.

readmitted within the initial 90 days, 61.4% (n = 51) had tricuspid regurgitation (TR) levels between 2 to 4. However, only 42.1% (n = 80) of the non-readmitted group displayed a TR of 2 to 4 (P = .001).

The mean frequency of COPD acute exacerbations in the last year was 2.5 + 2.8 in all patients included in the study. In total, 274 (66.2%) patients had severe exacerbations in the previous year. While 275 (67.7%) patients were in the GOLD stage D, 143 (44.5%) had very severe airflow obstruction in the pulmonary function tests. The exacerbation characteristics of the study population are shown in Table 3.

In the cohort, 404 patients underwent chest radiography, while thoracic computerized tomography was available for 228 patients at the time of index hospital admission. Detailed radiological findings are illustrated in Figure 3 and Table S2, Supplemental Digital Content, http://links.lww.com/MD/O61.

Within 30 days post-index hospitalization, pleural effusion was evident on chest radiography in 29 (55.8%) patients in the readmission group compared to 142 (40.6%) patients who were not readmitted (P = .039).

During the first 90 days post-hospitalization, pulmonary edema was noted on chest radiography in 159 (43.5%) patients in the readmission group and 30 (66.7%) patients in the non-readmission group (P = .005). Concurrently, pleural effusion appeared in 153 (43.7%) readmitted patients compared to 33 (63.5%) non-readmitted patients (P = .012).

Hospital-acquired pneumonia was observed in 15 (3.6%) patients; hospital-acquired pneumonia was observed in 26 (61.9%) patients who were readmitted within 30 days and 26

Table 3

Basal characteristics of according to exacerbations and disease features.

	Total† N = 415	Readmission within 30 days of index hospitalization‡ n = 176	*P*	Readmission within 90 days of index hospitalization‡ n = 191	*P*
		§A/B: Readmission within 30 days of index hospitalization/non		‖C/D: Readmission within 90 days of index hospitalization/non	
Number of moderate exacerbations in the last 1 *year* (n = 413)					
Median (min–max)	2 (0–21)	2 (0–21)/1 (0–15)	**01***	2 (0–21)/1 (0–15)‖	**1***
No (%) *of pts with moderate exacerbations in the last year* (n = 413), n (%)					
<2	178 (43.1)	58 (32.6)	**<.001****	56 (31.5)	**<.001****
≥2	235 (56.9)	117 (49.8)		134 (57.0)	
No of severe exacerbations in the last year (n = 414)			**<.001***		**<.001***
Mean ± SS	1.4 ± 1.7	1.9 ± 1.8/1.1 ± 1.5§		2.0 ± 1.9/1.0 ± 1.4‖	
(%) *of pts with severe exacerbations in the last year* (n = 414), n (%)					
None	140 (33.8)	39 (27.9)	**<.001****	34 (24.3)	**<.001****
≥1	274 (66.2)	137 (50.0)		157 (57.3)	
Index hospitalization days, *days*					
Median (min–max)	9 (1–70)	10 (2–70)/8 (1–64)	**01***	10 (2–70)/8 (1–64)	**.002***
Index hospitalization days, n (%)			**.005****		**.050****
<9	191 (46.0)	67 (35.1)		78 (40.8)	
≥9	224 (54.0)	109 (48.7)		113 (50.4)	
GOLD stage (n = 406), n (%)			**<.001****		**<.001****
A	18 (4.4)	0		0	
B	75 (18.5)	22 (29.3)		22 (29.3)	
C	38 (9.4)	13 (34.2)		18 (47.4)	
D	275 (67.7)	136 (49.5)		146 (53.1)	
GOLD spirometric grade (n = 321), n (%)			**.002****		**.001****
1	10 (3.1)	1 (10)		2 (20)	
2	74 (23.1)	21 (28.4)		22 (29.7)	
3	94 (29.3)	40 (42.6)		44 (46.8)	
4	143 (44.5)	74 (51.7)		79 (55.2)	
ABG Ph (n = 359)			.366*		**.025***
Mean ± SS	7.39 ± 0.06	7.39 ± 0.06/7.40 ± 0.06§		7.39 ± 0.06/7.40 ± 0.6‖	
ABG PO_2 (n = 359)			.330*		**.010***
Mean ± SS	65.1 ± 23.9	67.2 ± 26.5/63.3 ± 21.4§		69.2 ± 26.9/61.3 ± 20.2‖	

ABG = arterial blood gas, GOLD = Global Initiative for Chronic Obstructive Lung Disease.

† Column percentage.

‡ Row percentage.

§ Readmission within 30 days of index hospitalization/non-readmission within 30 days of index hospitalization.

‖ Readmission within 90 days of index hospitalization/non-readmission within 90 days of index hospitalization.

* Mann–Whitney *U* test.

** Chi-Square test.

(61.9%) patients who were readmitted within 90 days; this difference was statistically significant ($P = .011$ and $P = .044$, respectively).

3.3. Predictors of the readmission within the first 30-day after index hospitalization

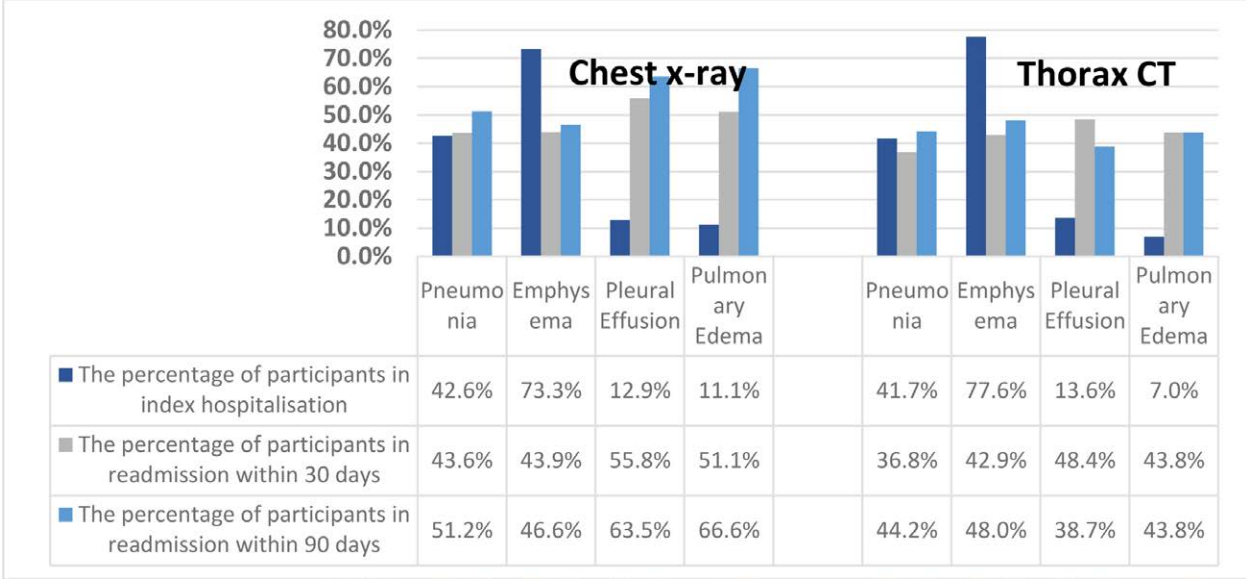
Risk factors collected at index hospitalization for the readmission within 30 days in univariate analysis were determined as; passive smoking ($P = .012$), presence of comorbidity ($P = .048$), long term oxygen treatment ($P < .001$), NIMV ($P = .013$), use of nebulizer at home ($P < .001$), high scores of HADS ($P < .001$), chronic renal failure ($P < .028$), sPAP > 40 mm Hg ($P = .039$), 2 or more moderate exacerbations in the last year ($P < .001$), hospitalization for more than 9 days ($P < .001$), GOLD-D group ($P < .001$), pleural effusion on chest X-ray ($P < .039$), hospital acquired pneumonia ($P < .011$), frequent antibiotic use ($P < .001$), need for antibiotics longer than 7 days ($P = .016$), need for corticosteroids longer than 7 days ($P = .003$), need for additional doses of steroids during hospitalization ($P = .005$), increase in oxygen demand during hospitalization ($P = .002$), need for NIVM during hospitalization ($P = .008$), need for oral/intravenous nutritional support during hospitalization ($P = .012$), delay in discharge due to hospital acquired reasons ($P = .028$) (Tables 1–4).

3.4. Predictors of the readmission within the first 90-day after index hospitalization

Risk factors collected at index hospitalization for the readmissions within 90 days in univariate analysis were determined as; low socioeconomic status ($P = .003$), discharge refusal ($P = .048$), NIMV at home ($P = .011$), use of nebulizer at home ($P = .001$), high HADS score ($P = .001$), high risk of OSA in STOP-BANG questionnaire ($P = .041$), arrhythmia in electrocardiography ($P = .007$), chronic renal failure ($P = .001$), TR 3 to 4 in ECHO ($P = .001$), 2 or more moderate exacerbations in the last year ($P < .001$), hospital stay longer than 9 days ($P = .050$), GOLD-D ($P < .001$), pleural effusion on chest X-ray ($P = .012$), hospital acquired pneumonia ($P = .044$), use of immunosuppressive therapy ($P = .001$), frequent use of antibiotics ($P < .001$), need for corticosteroids longer than 7 days ($P = .006$), use of short acting bronchodilators more than for times per day for more than 3 days during hospitalization ($P = .013$), the need for diuresis at hospitalization ($P = .007$), an increase in oxygen need during hospitalization ($P = .012$), and the initiation of NIVM during hospitalization ($P = .043$) (Tables 1–4).

3.5. Multivariate logistic regression analysis

The risk factors for readmissions within 30 days after the index hospitalization with multivariate logistic regression analysis are



	Pneumonia	Emphysema	Pleural Effusion	Pulmonary Edema	Pneumonia	Emphysema	Pleural Effusion	Pulmonary Edema
The percentage of participants in index hospitalisation	42.6%	73.3%	12.9%	11.1%	41.7%	77.6%	13.6%	7.0%
The percentage of participants in readmission within 30 days	43.6%	43.9%	55.8%	51.1%	36.8%	42.9%	48.4%	43.8%
The percentage of participants in readmission within 90 days	51.2%	46.6%	63.5%	66.6%	44.2%	48.0%	38.7%	43.8%

Figure 3. Radiologic findings of study group.

shown in Table 5A, and the risk factors for readmissions within 90 days after the index hospitalization are shown in Table 5B with the 3 models.

4. Discussion

The present study was a multicenter, comprehensive, real-life study targeting the rate and risk factors for readmissions within 30 and 90 days after severe COPD exacerbation. The rates of readmissions within 30 and 90 days were 42.4% and 46%, respectively. In the multivariate regression models, readmission within the first 30 days was significantly associated with a high HADS score, history of 2 or more moderate or severe exacerbations in the previous year, hospital-acquired pneumonia, and history of frequent antibiotic use in the previous year. Grades 3 to 4 TR, immunosuppressive therapy, frequent use of antibiotics in the previous year, and hospitalization through ED were all found to be significantly associated with readmissions within the first 90 days.

The readmission rates observed in this study for the first 30 and 90 days were 42.4% and 46%, respectively. This contrasts with the rates from the United States in 2016, where the 30-day readmission rate was 20.2% and the 90-day readmission rate was 34%.[25] In the United Kingdom, the 30-day readmission rate was reported to be 18.4%, with another study reporting rates of 38% for 30 days and 56% for 90 days.[26,27] A global meta-analysis showed readmission rates between 8.8% to 26.0% at 30 days and 17.5% to 39.9% at 90 days.[28] Moreover, post-severe COPD exacerbation readmission rates were documented as 20.2% for 30 days, 39.6% for 90 days, and 63.7% for a year after discharge.[29] These discrepancies highlight the need to explore regional, clinical, or healthcare system factors that might influence the higher readmission rates observed in the current study, and disparate variables, such as societal characteristics, socioeconomic standing, and adherence to treatment, could be instrumental in shaping this deviation.

The risk factors for the readmissions within the first 30 days were frequently matter of curiosity. It is anticipated that it will be possible to identify the patients with a high risk of readmission that cause high mortality, morbidity, and health cost. A detailed meta-analysis revealed that comorbidities, previous exacerbations and hospitalizations, and increased length of hospital stay were the major risk factors for readmission at 30 and 90 days.[28] A cohort study concluded that advanced age, male sex, low socioeconomic status, and comorbidities (anemia, congestive heart failure, depression, and psychosis) were independent risk factors for 30-day readmission.[30] The readmission rate within the first 30 days was found to be strongly correlated with male sex, emphysema-predominant COPD, and heart failure.[31]

In the present study, a high HADS score >16 was substantially related to an increased risk of readmission within the first 30 days. According to a recent study, people with COPD who experience frequent exacerbations are more likely to experience depression,[32] and vice versa. Iyer et al discovered a connection between depression and readmission at 30, 90, and 365 days in a retrospective study of hospitalized patients.[33] Another prospective cohort study showed that depressive symptoms and socioeconomic status predicted the risk of readmission and readmission frequency for COPD.[34] In a comparable study examining risk factors for COPD readmissions, anxiety (as indicated by a HADS anxiety score > 8) was identified as an independent factor associated with very frequent readmissions within a year. Notably, 22.7% of patients with frequent readmissions had anxiety, and there was a substantial correlation between anxiety and frequent readmissions, with an OR of 3.97.[35] Considering the current work, this is one of the few studies that specifically addresses the connection between HADS score and COPD readmission and demonstrates it as a risk factor by defining a cutoff value.

Risk factors for readmission within the first 90 days were less commonly investigated. An increase in the likelihood of future COPD exacerbations was shown in a recent study in the presence of pulmonary, hypertension as determined by ECHO.[36] According to a study, dyspnea, as measured by the New York Heart Association scale, is independently linked to a poor outcome even after accounting for all other reasons for readmissions following severe COPD exacerbations.[37] In a 3-year observational cohort study, patients with pulmonary hypertension experienced considerably more exacerbations than those without hypertension.[38] In the present study, TR has drawn attention as a factor that increases the risk of readmission within the first 90 days after index hospitalization. sPAP elevation, which is an indicator of pulmonary hypertension, did not reach statistical significance in the multivariate analysis. Data from the literature regarding the association between COPD and pulmonary hypertension are alarming. No study has specifically shown a connection between TR and readmission for COPD.

Table 4

The treatment modalities in exacerbations and during discharge.

	Total† N = 415	Readmission within 30 days of index hospitalization‡ n = 176	*P*§	Readmission within 90 days of index hospitalization‡ n = 191	*P*‖
Treatment adherence in stable period (n = 413), n (%) Yes	328 (79.4)	140 (42.7)	.899*	147 (44.8)	.341*
Immunsupressive treatment (n = 413), n (%) Yes	41 (9.9)	21 (51.2)	.298*	29 (70.7)	**.001***
Frequent antibiotic usage (n = 412), n (%) Yes	173 (42.0)	92 (53.2)	**<.001***	98 (56.6)	**<.001***
Antibiotic treatment at admission (n = 413), n (%) Yes	368 (89.1)	158 (42.9)	.432*	175 (47.6)	.053*
Antibiotic change during hospitalization (n = 401), n (%) Yes	71 (17.7)	37 (52.1)	.084*	37 (52.1)	.308*
Antibiotic longer than 7 days (n = 404), n (%) Yes	209 (51.7)	102 (48.8)	**.016***	108 (51.7)	.053*
Corticosteroid for more than 7 days (n = 411), n (%) Yes	130 (31.6)	69 (53.1)	**.003***	73 (56.2)	**.006***
Need for additional doses of corticosteroids (n = 413), n (%) Yes	82 (19.9)	46 (56.1)	**.005***	53 (64.6)	**<.001***
More than 3 days of SABA/SAMA (n = 414), n (%) Yes	241 (58.2)	109 (45.2)	.150*	123 (51.0)	**.013***
Theophylline (n = 411), n (%) Yes	81 (19.7)	40 (49.4)	.138*	40 (49.4)	.463*
Antifungal treatment (n = 414), n (%) Yes	8 (1.9)	5 (62.5)	.291*	3 (37.5)	.731*
Antiviral treatment (n = 414), n (%) Yes	40 (9.7)	17 (42.5)	1.000*	18 (45.0)	1.000*
Need for diuresis (n = 412), n (%) Yes	111 (26.9)	54 (48.6)	.109*	63 (56.8)	**.007***
Increased oxygen demand in follow-up (n = 413), n (%) Yes	160 (38.7)	83 (51.9)	**.002***	86 (53.8)	**.012***
Need for NIMV in follow-up (n = 414), n (%) Yes	138 (33.3)	71 (51.4)	**.008***	73 (52.9)	**.043***
Need for NIVM pressure increase in follow up (n = 138), n (%) Yes	66 (47.8)	38 (57.6)	.168*	38 (57.6)	.292*
Oral/IV nutrition support at follow-up (n = 413), n (%) Yes	76 (18.4)	42 (55.3)	**.012***	46 (60.5)	**.005***
Physiotherapy in follow-up (n = 414), n (%) Yes	143 (34.5)	65 (45.5)	.341*	65 (45.5)	.979*
Site of admission to the hospital (n = 414), n (%) Emergency department	269 (65.0)	122 (45.4)	.111*	135 (50.2)	**.024***
Delay in discharge, n (%) Yes	40 (9.6)	24 (60.0)	**.028***	22 (55.0)	.302*

NIMV = noninvasive mechanical ventilation, SABA = short acting β agonists, SAMA = short acting antimuscarinic.

† Column percentage.

‡ Row percentage.

§ Readmission within 30 days of index hospitalization/non-readmission within 30 days of index hospitalization.

‖ Readmission within 90 days of index hospitalization/non-readmission within 90 days of index hospitalization.

* Chi-Square test.

Despite the paucity of studies on the connection between immunoglobulin therapy and COPD readmission,[39,40] a large-scale study seeking to shed light on the connection between immunosuppression and readmission risk could not be detected in the literature review. Our study demonstrated for the first time that immunosuppression increases the probability of readmission in the first 90 days, which is intriguing in this regard.

Various previous studies and reviews have indicated that a history of hospitalization in the year prior to admission was a key predictor of COPD readmissions, along with a new comprehensive meta-analysis.[41–43] It has also been documented that COPD exacerbations cluster in time; thus, an index exacerbation enhances the patient's vulnerability to subsequent episodes, particularly during the high-risk period of 3 months after hospitalization.[44] Frequent exacerbations in the previous year were considered a risk factor in our analysis, in line with the literature, for readmissions both within 30 and 90 days. The data may support the concept of "frequent exacerbation phenotypes " who are prone to readmission, regardless of the severity of illness.

Many studies have investigated the risk factors for COPD readmission, including bronchodilators, ICS and bronchodilator combinations, oral short/long-term corticosteroids, montelukast, psychiatric medications, and vaccination status. However, only a few studies have examined the use of antibiotics as a risk factor. Antibiotic use was found to be associated with a modestly higher incidence of rehospitalization in a population-based cohort study using administrative databases.[45] The data gathered through our research also require verification through further comprehensive studies. Antibiotics may have been taken as

Table 5A

Multivariate logistic regression analysis on risk factors for readmission within 30 days of index hospitalization.

	Multivariate LR model-1		Multivariate LR model-2			Multivariate LR model-3		
	Adjusted OR (95% CI)	*P*	Adjusted OR (95% CI)		*P*	Adjusted OR (95% CI)		*P*
LTOT usage (ref: none)	1.5 (0.8–3.1)	.237	≥2 moderate exacerbations (ref: <2)	1.4 (0.9–2.2)	.180	Frequent antibiotic usage (ref: none)	**1.8 (1.2–2.7)**	**.007**
NIMV usage (ref: none)	0.9 (0.4–1.9)	.705	Presence of severe exacerbation (ref: none)	**1.7 (1.1–2.9)**	**.038**	Antibiotic longer than 7 days (ref: none)	1.1 (0.7–1.8)	.636
Nebulizer usage (ref: none)	1.5 (0.8–3.2)	.236	Hospitalization > 9 gün (ref: ≤9)	1.4 (0.9–2.1)	.166	Corticosteroid for more than 7 days (ref: none)	1.2 (0.7–2.1)	.420
HADS ≥ 16 (ref: <16)	**1.9 (1.1–3.6)**	**.042**	GOLD stage C/D (ref: A/B)	1.8 (0.9–3.5)	.068	Need for additional doses of corticosteroids (ref: none)	1.3 (0.7–2.3)	.410
CRF (ref: none)	1.2 (0.5–3.1)	.666	Hospital acquired pneumonia (ref: none)	**1.9 (1–4.1)**	**.049**	Increased O_2 demand in follow-up (ref: none)	1.3 (0.8–2.0)	.342
sPAP ≥ 40 (ref: <40)	1.5 (0.8–2.8)	.203	Effusion in chest X-ray (ref: none)	1.7 (0.9–3.2)	.097	Need for NIMV (ref: none)	1.4 (0.9–2.3)	.101
						Oral/IV nutrition support at follow-up (ref: none)	1.3 (0.7–2.3)	.356

Model-1: Evaluation of risk factors affecting readmission in the first 30 days after discharge according to patient-induced characteristics.
Model-2: Evaluation of risk factors affecting readmission in the first 30 days after discharge due to exacerbation.
Model-3: Evaluation of risk factors affecting readmission in the first 30 days after discharge due to treatment- and hospital-related conditions.
CI = confidence intervals, CRF = chronic renal failure, GOLD = Global Initiative for Chronic Obstructive Lung Disease, HADS = Hospital Anxiety Depression Scale, IV = intravenous, LTOT = long-term oxygen therapy, NIMV = non-invasive mechanical ventilation, sPAP = systolic pulmonary artery pressure.
* Variables with $P < .05$ as determined by univariate analysis were entered into multivariate logistic regression analysis.

Table 5B

Multivariate logistic regression analysis on risk factors for readmission within 90 days of index hospitalization.

	Multivariate LR model-1		Multivariate LR model-2			Multivariate LR model-3		
	Adjusted OR (95% CI)	*P*	Adjusted OR (95% CI)		*P*	Adjusted OR (95% CI)		*P*
Socioeconomic status (ref: none)			≥2 moderate exacerbations (ref: <2)	**1.9 (1.2–3.1)**	**.010**	Presence of immunosupression (ref: none)	**2.7 (1.2–5.7)**	**.013**
Low	1.7 (0.5–5.9)	.372						
Medium	0.9 (0.3–2.9)	.921						
Reluctance to discharge (ref: none)	1.9 (0.4–10.8)	.457	Presence of severe exacerbation (ref: none)	**2.5 (1.5–4.2)**	**.001**	Frequent antibiotic usage (ref: none)	**1.5 (1–2.4)**	**.048**
NIMV usage (ref: none)	0.7 (0.3–1.7)	.471	Hospitalization > 9 gün (ref: ≤9)	1.2 (0.8–1.9)	.420	Corticosteroid for more than 7 days (ref: none)	1.2 (0.7–2.0)	.411
Nebulizator usage (ref: none)	1.7 (0.9–3.6)	.126	GOLD stage C/D (ref: A/B)	1.8 (0.9–3.4)	.090	Need for additional doses of corticosteroids (ref: none)	1.7 (0.9–3.1)	.077
HADS ≥ 16 (ref: <16)	1.7 (0.9–3.2)	.122	Pulm. edeme in chest X-ray (ref: none)	2.3 (0.9–5.3)	.062	More than 3 days SABA/SAMA usage (ref: none)	1.3 (0.8–2.1)	.224
Stop BANG high risk (ref: low-medium risk OSAS)	1.6 (0.8–3.3)	.175	Effusion in chest X-ray (ref: none)	1.5 (0.7–3.2)	.331	Need for diuresis (ref: none)	1.5 (0.9–2.4)	.116
Arrhythmia (ref: none)	1.6 (0.7–3.4)	.267	Hospital acquired pneumonia (ref: none)	1.4 (0.7–2.9)	.340	Increased O_2 demand in follow-up (ref: none)	1.0 (0.6–1.6)	.975
CRF (ref: none)	2.2 (0.8–6.4)	.142				Need for NIMV (ref: none)	1.1 (0.7–1.7)	.741
TR 3–4 (ref: 1–2)	**2.2 (1.1–4.4)**	**.024**				Oral/IV nutrition support at follow-up (ref: none)	1.4 (0.8–2.4)	.287
						Admission from emergency department (ref: outpatient)	**1.6 (1.1–2.6)**	**.028**

Model-1: Evaluation of risk factors affecting readmission in the first 90 days after discharge according to patient-induced characteristics.
Model-2: Evaluation of risk factors affecting readmission in the first 90 days after discharge due to exacerbation.
Model-3: Evaluation of risk factors affecting readmission in the first 90 days after discharge due to treatment- and hospital-related conditions.
CI = confidence intervals, CRF = chronic renal failure, GOLD = Global Initiative for Chronic Obstructive Lung Disease, HADS = Hospital Anxiety Depression Scale, NIMV = noninvasive mechanical ventilation, OSAS = obstructive sleep apne syndrome, SABA/SAMA = short acting β agonists/short acting antimuscarinic, TR = tricuspid regurgitation.
* Variables with $P < .05$ as determined by univariate analysis were entered into multivariate logistic regression analysis.

a result of mild or unexplained exacerbations, which might be confounding.

Previously, it was discovered that COPD patients with community-acquired pneumonia had a longer hospital stay, more short-term problems such as ICU hospitalization, invasive mechanical ventilation, and higher readmission rate.[46] In contrast, a prospective cohort study found that COPD exacerbations with community-acquired pneumonia had a poorer

6-month survival rate than those without CAP, although community-acquired pneumonia was not linked to readmission.[47] A study also discovered that unilateral pulmonary infiltrates (OR 12.8, 95% confidence intervals 1.9–86.4) increased the risk of early rehospitalization.[48] Another study found that complications during hospitalization, with pneumonia being the most common (10%), were independently associated with an increased risk of frequent readmissions.[31] Based on a literature search, no other study has demonstrated a direct association between hospital-acquired pneumonia and COPD readmission risk has come to light. Our study is noteworthy in this regard.

One of the frequent reasons for admission to the ED for shortness of breath is the exacerbation of COPD. Research evaluating safe discharge and judgments about hospitalization in the evaluation of patients in the ED is scarce, despite the fact that there are studies evaluating the long-term prognosis of hospitalized patients.[49] DIMECO study, which is a prospective study and is currently under submission, concluded that smoking, biomass exposure, not seeking treatment despite symptoms lasting >5 days, spending >1 day in the emergency room, GOLD Stage C or D, high C reactive protein, and having lung cancer are risk factors for prolonged hospitalization.[18] Our analysis found a strong relationship between hospitalization from the ED and 90-day readmissions, and to the best of our knowledge, this is the first paper to address the type of hospitalization site as a risk factor.

This study had both strengths and limitations. Information regarding the risk of readmission following severe COPD exacerbation is lacking. To identify potential readmission predictors, we prospectively monitored patients at 30 and 90 days from multiple centers. We were constrained by the fact that we only conducted the study at once and did not have a second validation cohort; therefore, independent verification of the findings is necessary to ensure their generalizability. The follow-up ended after 90 days, although it would have been beneficial to examine long-term outcomes, including death and readmission, within a year; however, this was outside the scope of the current study. Since the study was a multi-center data collection study, some missing data arising from hospital systematic data transfers/deficiencies in measurements occurred and these are stated in the article. Although our study uses national data, particularly from large cities, it does not reflect the entire nation. Only patients presenting with severe exacerbations were included; therefore, this does not represent the full COPD patient community. Based on one's own notification, there may be potential errors such as forget, recall, and overlook, with regard to readmission information received over the phone.

4. Conclusion

Using these findings, we may identify patients who are at high risk of readmission, and measures must be taken before choosing a discharge strategy. In addition to developing and evaluating an efficient treatment plan for patients with COPD, more research is required to develop reliable techniques for estimating the likelihood of readmission before hospital discharge. Patients who had frequent severe COPD exacerbations in the previous year, those with high anxiety and depression scale scores, those who frequently required antibiotics, those who were immunocompromised, those who had TR and hospital-acquired pneumonia, and those who were hospitalized from the ED could be followed up more closely after discharge to prevent potential complications and readmissions.

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References

[1] Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of COPD. 2021 report. https://goldcopd.org/2021-gold-reports/ [accessed March 28, 2023].
[2] Barnes PJ. Chronic obstructive pulmonary disease: a growing but neglected global epidemic. PLoS Med. 2007;4:e112.
[3] Wedzicha JA, Seemungal TA. COPD exacerbations: defining their cause and prevention. Lancet. 2007;370:786–96.
[4] Shah T, Churpek MM, Coca Perraillon M, Konetzka RT. Understanding why patients with COPD get readmitted: a large national study to delineate the Medicare population for the readmissions penalty expansion. Chest. 2015;147:1219–26.
[5] Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. N Engl J Med. 2009;360:1418–28.
[6] Hersh AM, Maselli DJ, Cabana MD, et al. Predictors of hospital admission and repeat emergency department visits for adults with asthma. Ann Am Thorac Soc. 2014;11:685–92.
[7] Goto T, Camargo CA, Jr, Faridi MK, Hasegawa K. Hospital readmission among elderly patients with asthma and chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2016;194:672–82.

[8] Perez X, Wisnivesky JP, Lurslurchachai L, Kleinman LC, Kronish IM. Barriers to adherence to COPD guidelines among primary care providers. Respir Med. 2012;106:374–81.
[9] Wang Q, Bourbeau J. Outcomes and health-related quality of life following hospitalization for an acute exacerbation of COPD. Respirology. 2005;10:334–40.
[10] Cai X, Yang W, Gao X, et al. Predictors of hospital readmission in patients with chronic obstructive pulmonary disease: a retrospective study. Respirology. 2018;23:189–95.
[11] Sethi S, Murphy TF. Infection in the pathogenesis and course of chronic obstructive pulmonary disease. N Engl J Med. 2008;359:2355–65.
[12] Restrepo MI, Mortensen EM, Waterer GW, Wunderink RG, Coalson JJ, Anzueto A. Impact of macrolide therapy on mortality for patients with severe sepsis due to pneumonia. Eur Respir J. 2009;33:153–9.
[13] Miravitlles M, Anzueto A. Antibiotics for acute and chronic respiratory infections in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2013;188:1052–7.
[14] Albert RK, Connett J, Bailey WC, et al. Azithromycin for prevention of exacerbations of COPD. N Engl J Med. 2011;365:689–98.
[15] Wedzicha JA, Calverley PM, Seemungal TA, et al. INSPIRE Investigators. The prevention of chronic obstructive pulmonary disease exacerbations by salmeterol/fluticasone propionate or tiotropium bromide. Am J Respir Crit Care Med. 2008;177:19–26.
[16] Calverley PM, Anderson JA, Celli B, et al. Salmeterol and fluticasone propionate and survival in chronic obstructive pulmonary disease. N Engl J Med. 2007;356:775–89.
[17] Suissa S, Dell'Aniello S, Ernst P. Long-term natural history of chronic obstructive pulmonary disease: severe exacerbations and mortality. Thorax. 2012;67:957–63.
[18] DIMECO.
[19] Kut A, Salgür F. Socio-economic status evaluation in medicine: are we doing the right thing in medical research? Türk Aile Hek Derg. 2015;19:4–13.
[20] Antony GM, Rao KV. A composite index to explain variations in poverty, health, nutritional status and standard of living: use of multivariate statistical methods. Public Health. 2007;121:578–87.
[21] Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand. 1983;67:361–70.
[22] Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the hospital anxiety and depression scale. An updated literature review. J Psychosom Res. 2002;52:69–77.
[23] Chung F, Yegneswaran B, Liao P, et al. STOP questionnaire: a tool to screen patients for obstructive sleep apnea. Anesthesiology. 2008;108:812–21.
[24] Chung F, Abdullah HR, Liao P. STOP-Bang questionnaire: a practical approach to screen for obstructive sleep apnea. Chest. 2016;149:631–8.
[25] Shah T, Churpek MM, Coca Perraillon M, et al. Understanding why patients with COPD get readmitted: a large national study to delineate the Medicare population for the readmissions penalty expansion. Am J Respir Crit Care Med. 2016;194:264–72.
[26] Kerkhof M, Freeman D, Jones R, et al. Predicting frequent COPD exacerbations using primary care data. Int J Chron Obstruct Pulmon Dis. 2019;14:1079–90.
[27] Alqahtani JS, Aldabayan YS, Aldhahir AM, Al Rajeh AM, Mandal S, Hurst JR. predictors of 30- and 90-day COPD exacerbation readmission: a prospective cohort study. Int J Chron Obstruct Pulmon Dis. 2021;16:2769–81.
[28] Alqahtani JS, Njoku CM, Bereznicki B, et al. Risk factors for all-cause hospital readmission following exacerbation of COPD: a systematic review and meta-analysis. Eur Respir Rev. 2020;29:190166.
[29] Fernández-García S, Represas-Represas C, Ruano-Raviña A, et al. Social and clinical predictors of short- and long-term readmission after a severe exacerbation of copd. PLoS One. 2020;15:e0229257.
[30] Lau CS, Siracuse BL, Chamberlain RS. Readmission after COPD exacerbation scale: determining 30-day readmission risk for COPD patients. Int J Chron Obstruct Pulmon Dis. 2017;12:1891–902.
[31] Cerezo Lajas A, Gutiérrez González E, Llorente Parrado C, Puente Maestu L, de Miguel-Díez J. Readmission due to exacerbation of COPD: associated factors. Lung. 2018;196:185–93.
[32] Deng D, Zhou A, Chen P, Shuang Q. CODEXS: a new multidimensional index to better predict frequent COPD exacerbators with inclusion of depression score. Int J Chron Obstruct Pulmon Dis. 2020;15:249–59.
[33] Iyer AS, Bhatt SP, Garner JJ, et al. Depression is associated with readmission for acute exacerbation of chronic obstructive pulmonary disease. Ann Am Thorac Soc. 2016;13:197–203.
[34] Coventry PA, Gemmell I, Todd CJ. Psychosocial risk factors for hospital readmission in COPD patients on early discharge services: a cohort study. BMC Pulm Med. 2011;11:49.
[35] Tsui MS, Lun FC, Cheng LS, et al. Risk factors for hospital readmission for COPD after implementation of the GOLD guidelines. Int J Tuberc Lung Dis. 2016;20:396–401.
[36] Wang RR, Wang TS, Su XL, Mao YM, Sun YX, Qu HP. [Follow-up study of patients with chronic obstructive pulmonary disease complicated with pulmonary hypertension]. Zhonghua Jie He He Hu Xi Za Zhi. 2021;44:717–22. Chinese.
[37] Dupuis-Lozeron E, Soccal PM, Janssens JP, Similowski T, Adler D. Severe dyspnea is an independent predictor of readmission or death in COPD patients surviving acute hypercapnic respiratory failure in the ICU. Front Med (Lausanne). 2018;5:163.
[38] Nakayama S, Chubachi S, Sakurai K, et al. Characteristics of chronic obstructive pulmonary disease patients with pulmonary hypertension assessed by echocardiography in a three-year observational cohort study. Int J Chron Obstruct Pulmon Dis. 2020;15:487–99.
[39] Palikhe NS, Niven M, Fuhr D, et al. Low immunoglobulin levels affect the course of COPD in hospitalized patients. Allergy Asthma Clin Immunol. 2023;19:10.
[40] Cowan J, Gaudet L, Mulpuru S, et al. A retrospective longitudinal within-subject risk interval analysis of immunoglobulin treatment for recurrent acute exacerbation of chronic obstructive pulmonary disease. PLoS One. 2015;10:e0142205.
[41] Ruan H, Zhang H, Wang J, Zhao H, Han W, Li J. Readmission rate for acute exacerbation of chronic obstructive pulmonary disease: a systematic review and meta-analysis. Respir Med. 2023;206:107090.
[42] Crisafulli E, Torres A, Huerta A, et al. C-reactive protein at discharge, diabetes mellitus and ≥1 hospitalization during previous year predict early readmission in patients with acute exacerbation of chronic obstructive pulmonary disease. COPD. 2015;12:311–20.
[43] Gavish R, Levy A, Dekel OK, Karp E, Maimon N. The association between hospital readmission and pulmonologist follow-up visits in patients with COPD. Chest. 2015;148:375–81.
[44] Hurst JR, Donaldson GC, Quint JK, Goldring JJP, Baghai-Ravary R, Wedzicha JA. Temporal clustering of exacerbations in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2009;179:369–74.
[45] Sin DD, Tu JV. Inhaled corticosteroids and the risk of mortality and readmission in elderly patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2001;164:580–4.
[46] Ruby D. The impact of community-acquired pneumonia on acute exacerbation of chronic obstructive pulmonary disease patients as regards in-hospital complications and early readmission. Open RespirMed J. 2020;14:10–5.
[47] Shin B, Kim SH, Yong SJ, et al. Early readmission and mortality in acute exacerbation of chronic obstructive pulmonary disease with community-acquired pneumonia. Chron Respir Dis. 2019;16:1479972318809480.
[48] Nantsupawat T, Limsuwat C, Nugent K. Factors affecting chronic obstructive pulmonary disease early rehospitalization. Chron Respir Dis. 2012;9:93–8.
[49] Doğan NO, Varol Y, Köktürk N, et al. 2021 Guideline for the management of COPD exacerbations: Emergency Medicine Association of Turkey (EMAT)/Turkish Thoracic Society (TTS) clinical practice guideline task force. Turkish J Emerg Med. 2021;21:137–76.