


# The impact on thirty day readmissions for patients hospitalized for acute exacerbations of chronic obstructive pulmonary disease admitted to an observation unit versus an inpatient medical unit: A retrospective observational study

Chronic Respiratory Disease  
Volume 21: 1–10  
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DOI: 10.1177/14799731241242490  
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Jacob Bell<sup>1,2</sup>, Steven Lim<sup>1,2</sup>, Takahisa Mikami<sup>1</sup>, Jeeyune Bahk<sup>3</sup> , Stephen Argiro<sup>1</sup> and David Steiger<sup>1,2</sup> 

## Abstract

**Objectives:** We aimed to evaluate the utility of an Observation Unit (OU) in management of acute exacerbations of chronic obstructive pulmonary disease (AECOPD) and to identify the clinical characteristics of patients readmitted within 30-days for AECOPD following index admission to the OU or inpatient floor from the OU.

**Methods:** This is a retrospective observational study of patients admitted from January to December 2017 for AECOPD to an OU in an urban-based tertiary care hospital. Primary outcome was rate of 30-day readmission after admission for AECOPD for patients discharged from the OU versus inpatient service after failing OU management. Regression analyses were used to define risk factors.

**Results:** 163 OU encounters from 92 unique patients were included. There was a lower readmission rate (33%) for patients converted from OU to inpatient care versus patients readmitted after direct discharge from the OU (44%). Patients with 30-day readmissions were more likely to be undomiciled, with history of congestive heart failure (CHF), pulmonary embolism (PE), or had previous admissions for AECOPD. Patients with >6 annual OU visits for AECOPD had higher rates of substance abuse, psychiatric diagnosis, and prior PE; when these patients were excluded, the 30-day readmission rate decreased to 13.5%.

**Conclusion:** Patients admitted for AECOPD with a history of PE, CHF, prior AECOPD admissions, and socio-economic deprivation are at higher risk of readmission and should be prioritized for direct inpatient admission. Further prospective studies should be conducted to determine the clinical impact of this approach on readmission rates.

<sup>1</sup>Department of Pulmonary and Critical Care Medicine, Mount Sinai Beth Israel Hospital, New York, NY, USA

<sup>2</sup>Department of Pulmonary and Critical Care Medicine, Mount Sinai West Hospital, New York, NY, USA

<sup>3</sup>Department of Internal Medicine, Mount Sinai West Hospital, New York, NY, USA

## Corresponding author:

David Steiger, Division of Pulmonary and Critical Care Medicine, Icahn School of Medicine at Mount Sinai, Mount Sinai Beth Israel Hospital, New York, NY 10019, USA.

Email: [david.steiger@mountsinai.org](mailto:david.steiger@mountsinai.org)



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## Keywords

30-day readmissions, acute exacerbations of chronic obstructive pulmonary disease, chronic obstructive pulmonary disease, observation units, readmission risk factors

Date received: 15 May 2023; revised: 1 October 2023; accepted: 19 February 2024

## Introduction

Chronic obstructive pulmonary disease (COPD) is associated with significant morbidity and mortality in the United States (US), where 4.6% of the population carries the diagnosis.<sup>1</sup> It is the 4th leading cause of American deaths and the 3rd leading global cause of death.<sup>1,2</sup> Globally, it is the seventh leading cause of poor health (measured by disability-adjusted life years) with nearly 90% of COPD deaths in those under 70 years of age occurring in low- and middle-income countries.<sup>2</sup> In the US, there are 1.5 million annual emergency department (ED) visits and 715,000 hospitalizations for acute exacerbations of COPD (AECOPD), responsible for 70% of annual costs of COPD-related healthcare expenditure.<sup>1,3,4</sup> The Centers for Medicare and Medicaid Services (CMS) report a 19.6% 30-day readmission rate, making it the third leading cause of readmission in the US.<sup>5</sup> In 2014, COPD was added to the Affordable Care Act's Hospital Readmissions Reduction Program (HRRP), imposing a maximum penalty of up to 3% reduction for all Medicare fee-for-service based operating diagnosis related group payments from 2015–2018.<sup>6</sup>

COPD readmissions result in acute and permanent declines in forced expiratory volume (FEV1).<sup>7</sup> Identifying those at risk of AECOPD and preventing readmissions can be challenging.<sup>8,9</sup> A recent systematic review identified hospitalization in the past year, comorbid asthma, obstructive sleep apnea (OSA), inadequate health insurance, and a lower socioeconomic class as risk factors for readmission.<sup>10</sup> Other factors included psychiatric illness, substance abuse, lower BMI, greater impairment in physiology (lower FEV1, elevated partial pressure of carbon dioxide (pCO<sub>2</sub>), increased Modified Medical Research Council score), and Medicare/Medicaid dual eligibility, often a marker of a patient cohort that is poorer, less educated, with lower health literacy.<sup>11–13</sup>

Multiple interventions have been instituted to attempt to lower rates of AECOPD and subsequent readmissions. The transition from inpatient to outpatient care has been targeted by various evidence-based, multidisciplinary COPD discharge care bundles that aim at addressing medication adherence and technique, appropriateness of therapy, patient education, early outpatient follow-up, and any potential supplementary oxygen needs.<sup>14,15</sup> Another popular intervention is the utilization of observation units (OUs) or extended ED stays, with a maximum admission duration of 24–48 h.<sup>16</sup> OUs are established to provide rapid evaluation

and efficient care to patients of lower-acuity with the aim to minimize formal inpatient admissions. The use of OU's can reduce expenses incurred from managing AECOPD, as much as \$3.1 billion nationally, compared to short-stay inpatient admissions.<sup>16,17</sup> OUs vary with respect to location in hospitals and how they are supervised. They are located in EDs or Internal Medicine (IM) units, and the primary providers may be ED versus IM doctors versus Advanced Practice Providers (APPs).<sup>14,18–20</sup>

There is currently a paucity of data describing the utility of OUs in AECOPD management and outcomes, specifically regarding the effect on reducing readmission rates and preventing inpatient admissions. One study described 22% of ED patients with AECOPD admitted to an OU, with 45% of those requiring an inpatient conversion. Of the 55% discharged from the OU, 49% were readmitted within 30 days.<sup>15,21</sup>

The aims of this study were three-fold. Firstly, we wanted to determine the 30-day readmission rate for AECOPD following admission to an IM-operated OU using an established COPD discharge care bundle. Secondly, we aimed to identify specific patient characteristics that were associated with a risk of readmission. Finally, we aimed to compare the outcomes of patients with AECOPD who were discharged directly from an OU versus an inpatient floor after the OU patient stay was converted to an inpatient admission. We hypothesized that the 30-day readmission rate from the OU would be less following discharge directly from the OU compared to patients who were discharged following admission to a medical floor from the OU.

## Methods

### Study design

We conducted a retrospective observational study of a Quality Improvement (QI) database of consecutive adult patients (>18 years) admitted to an urban-based tertiary care hospital that is part of the Mount Sinai Health System OU for AECOPD between January to December 2017. Patients were initially identified based on admission diagnosis International Classification of Diseases (ICD)-10 coding for AECOPD, which was then manually confirmed by chart review of electronic medical records. Clinical diagnosis of AECOPD was based on worsening respiratory symptoms in those with a prior diagnosis of COPD or with prior admissions defined by ICD-10 coding for COPD.

The Observation Unit in this 200~300 bed teaching hospital in Manhattan is a 20-30 bed unit that is physically separated from the ED and is staffed by IM Attendings and APPs. When patients are deemed to be of lower acuity with expected short hospital stay for a common complaint, an admission to an OU is considered by the ED and IM team. In the OU, rapid evaluation and full comprehensive services are offered including administration of intravenous (IV) antibiotics, nebulizer treatments, chest physical therapy, supplemental oxygen, and non-invasive ventilation.

Patients that received the protocolized COPD management bundle and those who did not were both included in the analysis. The COPD bundle is provided by a multi-disciplinary team that includes provision of patient education regarding COPD, and inhaler technique, smoking cessation counseling, tailored care plans, and early outpatient follow-up. The COPD bundle is applied to patients with prior or recent hospitalizations, active tobacco smokers, and upon request of the OU providers. The bundle recipients were analyzed and compared to non-bundle recipients to be able to evaluate the clinical implication of the bundle use. We reviewed patient demographics, clinical histories, comorbidities, and subsequent hospital encounters, where each encounter represented each admission. As a single patient could have multiple admissions/encounters, we considered the number of each encounter for analyses. All data was collected in a secure electronic REDcap database.

The primary outcome was 30-day readmission rate following an index OU hospitalization for AECOPD. Patient outcomes were further analyzed if patients with AECOPD had a greater or fewer than 6 annual OU admissions in 2017 and whether they were discharged home from the OU or required conversion to full inpatient admission. We assessed various characteristics of patients, including their health insurance, housing status, home COPD medications, smoking history, and prior AECOPD admissions in the preceding year. The pulmonary history included the use of supplemental oxygen, comorbid pulmonary conditions including pulmonary embolism (PE), asthma, OSA, obesity hypoventilation syndrome (OHS), and use of continuous positive airway pressure. Medical comorbidities documented within the past year were also recorded, including psychiatric diagnoses (depression, bipolarism, schizophrenia, personality disorders, anxiety) and prior or active substance abuse. Active smoking was not considered substance abuse in this analysis. Pulmonary function tests (PFTs) and/or spirometry were not uniformly available for all patients and were therefore not included in this analysis. This study was approved by the Mount Sinai Beth Israel Internal Review Board (IRB), ID number 21-00781. As no direct patient contact or intervention from the study group was needed, informed consent was waived. Researchers exclusively utilized de-identified data.

## Statistical analysis

Normally distributed continuous variables were reported as means with standard deviation and compared with t-test. Categorical variables were expressed as proportions and compared with the chi-square test. For variables significantly different between those who had readmission within 30-day post-discharge and those who did not, we calculated odds ratio (OR) based on univariate logistic regression analysis. For predictive modeling of outcome of 30-day readmission for COPD, variables of specific clinical interest were developed into a model in a stepwise fashion with a stopping rule based on minimal Bayesian Information Criterion, a significant threshold of 0.05 was used. Data processing and statistical analysis was performed in R (versions 3.6.3) and JMP 16 Pro.

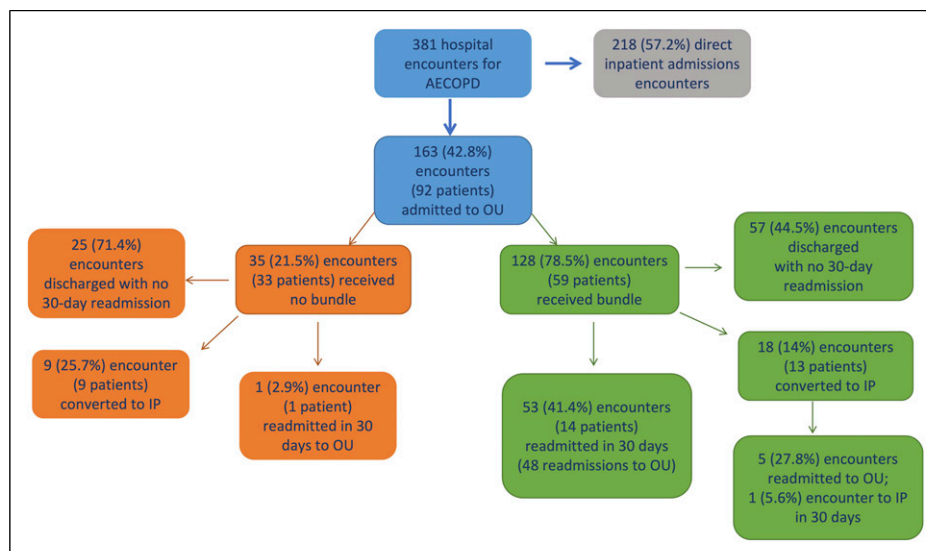
## Results

Of a total 381 encounters for AECOPD, 218 were direct inpatient admissions encounters (57.2%), leaving 163 OU admission encounters (92 unique patients) (42.8%) (Figure 1). There was a varying frequency of annual admissions per patient: 70 patients had one visit, 12 had 2 visits, 5 had 3 visits, 2 had 5 visits, and 3 had >6 annual admissions, each having 11, 14, and 19 annual visits.

Of 163 OU admission encounters, 54 encounters (15 of 92 unique patients) were readmitted for AECOPD within 30 days, giving a total readmission rate of 33.1%. The COPD bundle was recommended to all patients but was only applied to 128 encounters (59 unique patients), which was 78.5% of OU admissions for AECOPD. The average OU length of stay (LOS) was 1.6 days [IQR 1.0-2.0 ± 0.71] in patients that received the COPD bundle and was 1.3 days in those that did not receive the COPD bundle.

### 30-day readmission versus no 30-day readmission in bundle recipients

Of 128 AECOPD encounters admitted to the OU who received the bundle, 57 encounters were discharged without readmission within 30 days, whereas 53 encounters (14 patients) were readmitted within 30 days, giving a readmission rate of 41.4% (Figure 1). Patients who were undomiciled, with history of congestive heart failure (CHF), prior PE, or a prior admission for COPD were significantly associated with readmission in 30 days (Table 1). On univariate logistic regression analysis, homelessness (OR 7.78, 95% CI 1.62-44), CHF (OR 4.62, 95% CI 1.27-17.56), and prior admission (OR 4.62, 95% CI 1.27-17.56) put patients at higher risk of readmission in 30 days. Of the 35 encounters (33 patients) (21.5%) that did not receive the bundle, one encounter/patient was readmitted within 30 days to the OU, giving a rate of 2.9%.



**Figure 1.** Flow diagram of patients admitted with acute exacerbation of COPD in 2017.

### Greater than 6 annual versus less than 6 annual OU COPD admissions

In the group of 128 OU encounters that received the bundle, a total of 44 encounters (3 patients) had >6 annual OU admissions, 37 of which were 30-day readmissions. These accounted for 34% of encounters that received the bundle and 27% of total annual OU admissions for AECOPD. Of note, when these 3 patients were excluded from analysis, the total 30-day readmission rate fell from 33.1% to 13.5%, and among the bundle recipients, the rate decreased from 41.4% to 14.2%. When comparing the 3 patients with >6 annual admissions to the bundle recipients with fewer admissions, there was a statistically significantly higher rate of substance abuse, psychiatric diagnosis, and prior PE. Though not statistically significant, it is noteworthy that all 3 patients with >6 annual admissions were active tobacco smokers (Table 2).

### Patient requiring an inpatient conversion versus patients discharged directly from the OU

From OU, patients were either discharged home or converted to a full inpatient admission for further treatment. Among the bundle recipients, 110 bundle recipient encounters were discharged directly home from OU (46 unique patients, 86% of encounters). 18 encounters (13 unique patients, 14% of encounters) were converted to inpatient status, requiring an average of 5.3 additional days in the hospital. Of those, five were readmitted within 30 days to the OU and one was readmitted within 30 days to the inpatient unit. These re-admissions occurred in 4 unique patients, with a 30-day readmission in 33.3% (Figure 1). Of the encounters without inpatient conversions, there were

48 30-day readmissions to OU, giving a readmission rate of 43.6%. The 6 inpatient conversion encounters were readmitted a mean of 14.7 days [IQR 10.5–20.3 ± 9.5] after discharge, while those who were discharged home from OU but had subsequent readmission were readmitted a mean of 15.2 days [IQR 8.3–21.8 ± 8.7] after discharge. Comparing the two groups, there was a statistically significant higher rate of prior COPD admissions in the inpatient conversion group (92.3% v. 45.7%,  $p = .0028$ ). There were higher rates of current smokers, homelessness, comorbid asthma, home oxygen use, and substance abuse in those requiring inpatient conversion, but these were not statistically significant. There were similar rates of prior smoking and comorbid psychiatric diagnosis between the two groups (Table 2).

### Predictors of 30-day COPD readmission risk

To explore independent predictors of patients at risk of 30-day readmission rates, we performed a logistic regression including variables of clinical interest on outcomes in 30-day readmission (prior COPD admissions, history of CHF, domiciled status, psychiatric diagnosis, and substance abuse). In the model, history of CHF (OR 8.46, 95% CI 1.5–87,  $p = .0142$ ) and being undomiciled (OR 16.1, 95% CI 2.0–133,  $p = .0098$ ) were associated with increased risk 30-day readmission. After multivariate regression, prior histories of COPD admission ( $p = .65$ ), psychiatric diagnosis ( $p = .44$ ), or substance abuse ( $p = .23$ ) were no longer independent predictors of 30-day readmission.

### Discussion

The deleterious effects of AECOPD and readmissions have prompted the inclusion of COPD readmission reduction in

**Table 1.** Demographics and clinical characteristics of patients.

Variables	No 30-day Re-admissions(N = 45)	30 day Re-admissions (N = 14)	p
Age (mean (SD))	65.7 (13.1)	66.9 (12.3)	0.77
Male	20 (44.4)	7 (50)	0.95
Female	25 (55.6)	7 (50)	
BMI (mean (SD))	27.0 (9.60)	27.2 (8.8)	0.28
Insurance			0.13
Government	18 (40)	7 (50)	
Private	27 (60)	6 (42.9)	
Uninsured	0	1 (7.1)	
Domiciled			
Domiciled	42 (93.3)	9 (64.3)	0.02
Undomiciled	3 (6.7)	5 (35.7)	
Pulmonary comorbidities			
Asthma	16 (35.6)	7 (50)	0.51
OSH/OSA	2 (4.44)	1 (7.1)	1
Home oxygen	8 (17.8)	3 (21.4)	1
Home CPAP	1 (2.2)	0	1
Lung cancer	1 (2.2)	0	1
Pulm HTN	3 (6.7)	3 (21.4)	0.28
ILD	1 (2.2)	0	1
PE	0	4 (28.6)	<0.01
COPD	41 (91.1)	13 (92.9)	1
Other Comorbidities			
CHF	8 (17.8)	7 (50.0)	0.04
CKD	3 (6.7)	2 (14.3)	0.73
GERD	4 (8.9)	0	0.58
Vascular disease	12 (26.7)	4 (28.6)	1
Substance abuse	12 (26.7)	7 (50.0)	0.19
Psychiatric history	12 (26.7)	5 (35.7)	0.75
Prior COPD admits	21 (46.7)	12 (85.7)	0.02
No prior COPD admits	24 (53.3)	2 (14.3)	
Smoking			0.14
Current smoker	19 (42.2)	10 (71.4)	
Previous smoker	23 (51.1)	4 (28.6)	
Never smoker	3 (6.7)	0	
Index Meds			
LABA	1 (2.2)	1 (7.1)	0.97
LAMA	12 (26.7)	4 (28.6)	1
LABA/ICS	24 (53.3)	8 (57.1)	1
LAMA/LABA	1 (2.2)	2 (14.3)	0.27
ICS	4 (8.9)	0	0.58
Albuterol as needed	36 (80.0)	12 (85.7)	0.93
Anticoagulation	6 (13.3)	3 (21.4)	0.76
Chronic steroids	3 (6.7)	2 (14.3)	0.73
No meds	4 (8.9)	1 (7.1)	1

Note – except where indicated, data are number of patients, with percentages in parentheses. Normally distributed continuous variables were reported as means with standard deviation and compared with t-test. Categorical variables were expressed as proportions and compared with the chi-square test. BMI: body mass index, OHS: obesity hyperventilation syndrome, OSA: obstructive sleep apnea, CPAP: continuous positive airway pressure, HTN: hypertension, ILD: interstitial lung disease, PE: pulmonary embolism, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, CKD: chronic kidney disease, GERD: gastrointestinal reflux disease, LABA: long-acting beta agonist, LAMA: long-acting muscarinic agonist, ICS: inhaled corticosteroids.

**Table 2.** Comparison of greater or fewer than 6 admissions and inpatient conversion.

Variables	>6 annual admission v. <6 annual admissions			In-patient conversion v. No in-patient conversion		
	<6 annual admissions % (N = 56)	>6 annual admissions % (N = 3)	p	IP conversions % (N = 13)	No IP conversions % (N = 46)	p
Age (mean (SD))	66.0 (13.0)	65 (11.36)	0.89	67.3 (9.3)	65.6 (13.7)	0.68
Male	24 (42.9)	3 (100)	0.18	6 (46.2)	21 (45.7)	1
Female	32 (57.1)	0		7 (53.9)	25 (54.4)	
BMI (mean (SD))	28.7 (9.5)	26.0 (5.6)	0.7	28.7 (13)	28.5 (8.3)	0.36
Insurance			0.68			0.84
Government	23 (41.1)	2 (66.7)		6 (46.2)	19 (41.3)	
Private	32 (57.1)	1 (33.3)		7 (53.8)	26 (56.5)	
Uninsured	1 (1.8)	0		0	1 (2.2)	
Domiciled			0.06			0.5
Domiciled	50 (89.3)	2 (66.7)		10 (76.9)	41 (89.1)	
Undomiciled	6 (10.7)	1 (33.3)		3 (23.1)	5 (10.9)	
Pulmonary comorbidities						
Asthma	23 (41.1)	0	0.42	8 (61.5)	15 (32.6)	0.12
OSH/OSA	3 (5.4)	0	1	0	3 (6.5)	0.82
Home oxygen	11 (19.6)	0	0.93	4 (30.8)	7 (15.2)	0.39
Home CPAP	1 (1.8)	0	1	0	1 (2.2)	1
Lung cancer	1 (1.8)	0	1	0	1 (2.2)	1
Pulm HTN	5 (8.9)	1 (33.3)	0.7	3 (23.1)	3 (6.5)	0.22
ILD	1 (1.8)	0	1	0	1 (2.2)	1
PE	2 (3.6)	2 (66.7)	<0.01	1 (7.7)	3 (6.5)	1
COPD	51 (91.1)	3 (100)	1	13 (100)	41 (89.1)	0.5
Other comorbidities						
CHF	13 (23.2)	2 (66.7)	0.32	5 (38.5)	10 (21.7)	0.39
CKD	5 (8.9)	0	1	2 (15.4)	3 (6.5)	0.65
GERD	4 (7.1)	0	1	2 (15.4)	2 (4.3)	0.44
Vascular disease	15 (26.8)	1 (33.3)	1	4 (30.8)	12 (26.1)	1
Substance abuse	16 (28.6)	3 (100)	0.05	6 (46.2)	13 (28.3)	0.38
Psychiatric history	14 (25.0)	3 (100)	0.03	4 (30.8)	13 (28.3)	1
Prior COPD admits	30 (53.6)	3 (100)	0.33	12 (92.3)	21 (45.7)	0.01
No prior COPD admits	26 (46.4)	0		1 (7.7)	25 (54.4)	
Smoking			0.19			0.63
Current smoker	26 (46.4)	3 (100)		7 (53.8)	22 (47.8)	
Previous smoker	27 (48.2)	0		6 (46.2)	21 (45.7)	
Never smoker	3 (5.4)	0		0	3 (6.5)	
Index Meds						
LABA	2 (3.6)	0	1	0	2 (4.3)	1
LAMA	14 (25.0)	2 (66.7)	0.36	2 (15.4)	14 (30.4)	0.47
LABA/ICS	31 (55.4)	1 (33.3)	0.88	15 (38.5)	27 (58.7)	0.33
LAMA/LABA	2 (3.6)	1 (33.3)	0.35	1 (7.7)	2 (4.3)	1
ICS	4 (7.1)	0	1	0	4 (8.7)	0.63
Albuterol as needed	45 (80.4)	3 (100)	0.93	12 (92.3)	36 (78.3)	0.46
Anticoagulation	8 (14.3)	1 (33.3)	0.94	1 (7.7)	8 (17.4)	0.67
Chronic steroids	4 (7.1)	1 (33.3)	0.6	2 (15.4)	3 (6.5)	0.65
No meds	5 (8.9)	0	1	1 (7.7)	4 (8.7)	1

Note – except where indicated, data are number of patients, with percentages in parentheses. Normally distributed continuous variables were reported as means with standard deviation and compared with t-test. Categorical variables were expressed as proportions and compared with the chi-square test. BMI: body mass index, OHS: obesity hyperventilation syndrome, OSA: obstructive sleep apnea, CPAP: continuous positive airway pressure, HTN: hypertension, ILD: interstitial lung disease, PE: pulmonary embolism, COPD: chronic obstructive pulmonary disease, CHF: congestive heart failure, CKD: chronic kidney disease, GERD: gastrointestinal reflux disease, LABA: long-acting beta agonist, LAMA: long-acting muscarinic agonist, ICS: inhaled corticosteroids.



the HRRP, and the creation of OUs with unclear benefits.<sup>18,20,22</sup> Our paper demonstrated a high readmission rate in patients admitted to the OU with AECOPD. The 30-day readmission rate of 41.4% among the bundle recipients is comparable to previously reported OU data.<sup>15,22</sup> Eighteen patients (14%) of the bundle-recipient OU encounters were later converted to an inpatient admission, which is lower than previously reported OU data.<sup>15,22</sup> Of those 18 encounters, the 30-day readmission rate was 33%, which was lower than the readmission rate for those discharged directly from the OU (44%). The increased risk of 30-day readmission following discharge from the OU suggests possible suboptimal management by OU versus inappropriate triage to the OU from the ER.<sup>23,24</sup>

On univariate analysis, history of PE, CHF, and prior admission for COPD were associated with increased risk of 30-day readmission, as previously reported.<sup>10,25,26</sup> Of note, the 30-day readmission rate decreased to 14.2% with the exclusion of patients with >6 annual OU visits, resulting in a readmission rate comparable to published COPD 30-day readmission rates.<sup>18,27,28</sup> Patients with increased OU utilization (>6 annual OU visits) were found to have a statistically significant increase in substance abuse, psychiatric diagnosis and prior PE, and were active smokers. These individuals and each admission were included in analysis to illustrate the real-world challenges of managing patients admitted for AECOPD, and frequent utilizers have been demonstrated to represent a significant number of patients requiring inpatient management of AECOPD.<sup>29</sup> Based on the results from our study, we would recommend that OU patients with a history of PE, CHF, prior admission for COPD, substance abuse, and psychiatric diagnosis should be considered for a direct admission to the general medical service rather than the OU.<sup>10,30</sup> In particular, substance abuse is associated with an increase in health care utilization and readmission for AECOPD, persisting after adjusting for tobacco misuse and substance abuse associated comorbidities.<sup>31</sup>

Previous studies have demonstrated that pulmonologists under recognize the contribution of psychological illness to COPD morbidity.<sup>32</sup> The prevalence of depression and anxiety in patients with COPD is estimated at 40% and 36%, respectively.<sup>33,34</sup> Psychiatric illness in patients with COPD is associated with a reduction in ability to manage COPD, thus an increase in hospital admissions with increased length of stay, decreased medication and non-pharmacological compliance.<sup>35</sup> In a study from the COPD Gene cohort, anxiolytic and hypnotic use was demonstrated to be the highest in severe and very severe COPD.<sup>36</sup> There are well described barriers to providing psychiatric support for patients with COPD and psychiatric illness when navigating the health care system. Challenges often include limitations in availability of mental health services, and long waiting times to see psychiatrists.<sup>37</sup> There

is clearly a need for the integration of mental health providers in the global management of patients admitted with COPD and comorbid psychiatric illness.<sup>35</sup>

Notably 39% of study patients had a co-diagnosis of asthma. Prior studies have demonstrated that patients with asthma-COPD overlap syndrome have increased number of respiratory symptoms, exacerbations, hospital utilization, and worsening general health status.<sup>38</sup> Of interest, the three patients that were high utilizers in this cohort did not have a co-diagnosis of asthma.

A prior history of a pulmonary embolism was a risk factor for COPD readmission, particularly in frequent utilizers with >6 admissions a year. It has been well established that acute PE may be a cause of admission for AECOPD.<sup>39,40</sup> However, COPD is also an independent risk factor for PE due to the reduced mobility, systemic inflammation, and polycythemia, that has been associated with COPD.<sup>41</sup> COPD is also commonly associated with CHF. Both conditions frequently coexist and share common risk factors that include advanced age, cigarette smoking, and systemic inflammation.<sup>42,43</sup> HF should be treated as per heart failure (HF) management guidelines that describes the use of statins, angiotensin converting enzymes inhibitors and angiotensin receptor blockers, which can reduce morbidity and mortality of COPD patients.<sup>44,45</sup> Patients admitted with AECOPD and a history of HF would benefit from a multidisciplinary management to help reduce morbidity and mortality.

We believe that the data presented is the first to describe the experience of COPD management in an OU managed by an Internal Medicine department.<sup>10,15,22</sup> Our findings should be contextualized based on the characteristics of our patient population. Mount Sinai Beth Israel is an urban safety net hospital that provides care for a significant number of patients who are undomiciled, of low socioeconomic status, with psychiatric illness, and substance abuse. Additionally, our OU is more frequently utilized for AECOPD than other OUs, with 42% of ED admissions being routed to the OU.<sup>14,15</sup>

We demonstrated that patients with an inpatient conversion had a lower readmission rate (33%) compared to those discharged home from OU (44%), raising the question whether the initial disposition to the OU from ED was appropriate. The three patients with >6 annual admissions, which accounted for 34% of bundle-recipient OU admissions, illustrate the significant, real-world barriers to preventions of readmissions for AECOPD in patients with multiple risk factors, as all three patients were active smokers, had psychiatric diagnoses, and substance abuse history, and two were undomiciled.<sup>10,46</sup>

This study's limitations include its retrospective and observational design. However, it represents a real-world description of our experience in managing AECOPD in an IM-managed OU. Patients were identified by the index

admission coding, which has historically been fraught with inconsistencies in accurately defining COPD.<sup>46</sup> Since we did not include spirometry data to support the diagnosis of COPD in the study cohort it is possible that we have over diagnosed the incidence of COPD admissions and the subsequent readmission rate.<sup>47</sup> The disposition of patients from the ED was a provider-dependent process, and not protocolized based on predefined clinical criteria. Therefore, the decision to refer patients for discharge from the ED or admission to the OU or the IM inpatient service may not have been consistent. Similarly, there were no criteria recommended to exclude admission to the OU. It is therefore possible that the OU admitted cohort was potentially not uniform in the severity of the AECOPD or comorbid conditions, potentially complicating the study's generalizability. There was no explicit protocol that provided guidance on the decision to discharge a patient from OU versus admission to an inpatient floor. This study also lacked imaging-based information on patients, including Chest CT data that may have helped to better characterize the COPD patient and further define baseline patient risk factors. Additionally, information on eosinophil levels was not collected in these patients.

## Conclusion

Admissions to an OU for AECOPD was associated with a high 30-day readmission rate (41.4%) that was greater than the readmission rate of patients admitted to a medical bed after an OU admission. A prior history of COPD admission, PE, and CHF should prompt consideration of a direct general medical admission bypassing the OU. Additionally, high utilizers of OUs should be admitted directly to IP status to maximize patient exposure to multidisciplinary care, including where appropriate, provision of psychiatric counselling and drug rehabilitation services, and management by cardiology to decrease the risk of readmissions. The use of explicit management protocols that recommend general admission rather than OU admission for patients with AECOPD who have advanced COPD and risk factors for readmission may help reduce 30-day readmissions. Further prospective studies should be conducted to determine the clinical impact of this approach on readmission rates.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

## ORCID iDs

Jeeyune Bahk  <https://orcid.org/0000-0001-7034-5707>

David Steiger  <https://orcid.org/0000-0003-0152-4167>

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