Original Article

Received: 2024/02/05 Revised: 2024/04/15 Accepted: 2024/04/16

DOI: https://doi.org/10.15441/ceem.24.197

Evaluation of the Quality of ED Management for Patients with COPD

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Running Title: **Evaluation of the Quality of ED management for Patients with COPD**

Word Count: 2323

Abstract Word Count: 289

Keyword: Emergency Department, Chronic Obstructive Pulmonary Disease, Chronic Obstructive Pulmonary Disease Exacerbation, Infection, Steroids, Antibiotics

ABSTRACT

BACKGROUND:
Chronic Obstructive Pulmonary Disease (COPD) is associated with exacerbations and high risk of serious outcomes. Our goal was to determine the appropriateness of the ED management of COPD exacerbations.

METHODS:
This observational cohort study incorporated a health records review and included COPD exacerbation cases seen at two large academic EDs. We included all patients with the primary diagnosis of COPD exacerbation. From the electronic medical record, demographic and clinical data were abstracted, and the Ottawa COPD Risk Score (OCRS) was calculated for each. Short-term serious outcomes (SSO) included ICU admission, intubation, myocardial infarction, non-invasive positive pressure ventilation (NIV), and death at 30 days. Cases were judged for appropriateness of treatment according to explicit indications and standards developed a priori.

RESULTS:
We enrolled 500 cases with mean age 71.9, female 51.2%, admitted 50.2%, and death 4.4%. The calculated OCRS score was $\geq$2 for 70.8% of patients. The treatments provided were inhaled beta-agonists (82.6%), inhaled anticholinergics (76.6%), corticosteroids (75.2%), antibiotics (71.0%), oxygen (63.8%), NIV (8.8%) and intubation (0.6%). Overall, 50.0% of cases were judged to have had inadequate management due to missing treatments. Specifically, the proportion of missing treatments were inhaled beta agonist (17.0%), inhaled anticholinergic (22.6%), corticosteroids (24.4%), antibiotics (12.8%), and NIV (2.0%).

CONCLUSIONS:
Adequate treatment of COPD exacerbation was lacking in 50.0% of patients in these two large academic EDs. Concerning were the number of patients not receiving corticosteroids or antibiotics. Implementation of explicit treatment standards should lead to improved patient care of this common and serious condition.

Keyword: Emergency Department, Chronic Obstructive Pulmonary Disease, Chronic Obstructive Pulmonary Disease Exacerbation, Infection, Steroids, Antibiotics

Capsule Summary

What is already known
Chronic obstructive pulmonary disease exacerbation is a common Emergency Department (ED) presentation associated with morbidity and mortality.

What is new in the current study
We found that patients with COPD exacerbation lacked appropriate treatments 50% of the time and that the most common missed pharmacotherapies were antibiotics and systemic steroids. This study could improve patient care by raising awareness of the common pitfalls in treating this common and serious respiratory condition.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic lung disease secondary to inflammation and narrowing of the airways, parenchymal destruction, mucous hypersecretion, and hypoxic vasoconstriction.[1] COPD leads to frequent hospitalizations due to infectious and non-infectious acute exacerbations with a mix of viral and bacterial aetiologies.[2] COPD exacerbations account for 1% of all emergency department (ED) visits.[3] Those who experience frequent exacerbations of disease are at

risk of serious outcomes including death and endotracheal intubation. Evidence-based therapies currently recommended for optimization of bronchodilation and reduction of inflammation during COPD exacerbations including inhaled short acting beta agonists or short acting anticholinergics, long-acting anticholinergics, systemic corticosteroids, and antibiotics.[4]

In 2014, emergency department (ED) researchers developed the Ottawa COPD Risk Scale (OCRS) which includes ten highly predictive signs of serious adverse events in patients with COPD.[5] When validated in 2018, it was determined that a score ≥ 2 was an indication for hospitalization to reduce short-term serious outcomes at 30 days.[6] In the above mentioned study, it was estimated that a 11.6% increase in admission to hospital of patients with COPD exacerbations would be necessary to diminish the rate of secondary serious outcomes by 1.2%. Following the introduction of the OCRS, physicians at Canadian EDs described it as useful and likely to be applied.[7]

The goal of this study was to determine the appropriateness of treatment of COPD exacerbations in the ED. We also investigated the OCRS, patient disposition, and the rate of serious short-term outcomes.

METHODS

Study Design

We conducted an observational cohort study by reviewing the health records of a consecutive sample of COPD patients seen over a 36-month period from June 30th, 2017, to July 1st, 2020 at the two [BLINDED] EDs. The [BLINDED] Hospital is a large academic health care centre with 1,200 beds. The two EDs see 160,000 patients annually and are staffed by 95 certified attending physicians and 55 residents. We included all patients with the primary diagnosis of COPD exacerbation on their initial visits and return visits within 2 months to ED. We had approval of the [BLINDED] Research Ethics Board.

Data Collection Procedures

A list from the National Ambulatory Care Reporting System was obtained from the data warehouse on all included patients. The inclusion criteria were diagnosis of COPD (confirmed with a previous pulmonary function test, verified by consultant or significant cigarette smoking history), charted past medical history, charted vital signs, and completed investigations during ED visit to permit calculation of the OCRS score (urea, hemoglobin, serum CO2, ECG and chest x-ray). We excluded patients with an unclear diagnosis (ie. mixed COPD exacerbation and acute pulmonary edema), patients with incomplete charting and insufficient investigations. All potentials cases were reviewed by the first author (PK) and two medical students (LR, JW) and further reviewed by a staff Emergency Physician (IS). All pertinent information was entered into an electronic database for statistical analysis.

Measures

The demographic data collected during chart review included age, gender, data of visit, number of visits and follow up visits to the ED. The clinical presentation including the patient's presenting symptoms, past medical history, current prescribed outpatient medications, triage vital signs, blood work results, chest x-ray and electrocardiogram interpretations and walk test results were recorded. The OCRS score was calculated for each patient utilizing the required data if not already completed by the attending physician. Appendix A outlines the OCRS with a breakdown of each criterion. Information on the patient's disposition was also collected; admission to the ward, to a monitored unit (including the intensive care unit (ICU) or discharge home. We identified short-term serious outcomes (SSO) including time spent in the ICU or other monitored care settings, endotracheal intubation, myocardial infraction, use of non-invasive positive pressure ventilation (NIV), return visits to the ED within 30 days and death at 30 days. The SSO were also noted for any patients discharged home with return visits to the ED within 30 days.

Appropriateness of Treatment

Cases were judged for appropriateness of treatment according to explicit indications and standards developed by a senior respirology physician and ED physician (Figures 1 and 2). The development of the treatment standards of care was based on the most recent GOLD guidelines for acute COPD exacerbation management.[1] The recent 2023 update included no substantive changes to the management of COPD exacerbation.[8]

Figure 1 outlines the algorithm for oxygen therapy with a target saturation of 88-92% with either a venturi mask or nasal prongs. NIV is required if patients have any signs of respiratory failure. Invasive mechanical ventilation is indicated for any signs of life-threatening respiratory failure, contraindications to NIV, or failed NIV.

Figure 2 displays the algorithm for pharmacotherapy, giving the standard for administration of inhaled short acting beta 2 agonists, inhaled anticholinergics and systemic corticosteroids. Indications for antibiotics administration are signs of bacterial infection: fever, increased sputum production or purulence, opacity on chest x-ray or sepsis. The recommended antibiotic regimens differed on risk factors for pseudomonas infection (Figure 2).

Determination of appropriateness of treatments was made by the senior authors (PK, IS) according to the explicit criteria outlined in Figures 1 and 2. In all cases, consensus was reached by discussion.

Sample Size

Based on feasibility for this unfunded study, we aimed to include 500 patients seen over 36 months. We believed this number of cases would provide sufficient variety in presentations to allow us to adequately evaluate management. The same patient was not counted for two visits unless they presented more than 2 months after the initial visit.

Analysis

A simple frequency report was conducted with 95% confidence intervals.

RESULTS

Of 2696 COPD exacerbation patient visits between July 1st 2017, to June 30th 2020, 745 visits were reviewed. Of these 745 patient visits, 245 were excluded due to incorrect diagnosis, inadequate documentation of the patient's presenting symptoms and missing investigative clinical data (ECG, chest x-ray and blood work) (Figure 3).

Table 1 displays the patient characteristics for the 500 patient visits: mean age (71.9), female (51.2%), mean heart rate (97.7), mean respiratory rate (23.1), mean oxygen saturation (93%) and a mean temperature (36.7). Most patients were currently smoking tobacco or had a history of tobacco use (95.6%). Many had a listed diagnosis of COPD in their medical chart (94.8%). We confirmed the diagnosis of the remaining 4.2% with a reported pulmonary function test (FEV_1/FVC ratio <0.7) or presumed by a chronic smoking history (>40 years). Many patients had other comorbidities including hypertension (57.8%), cancer (27%), diabetes (24.8%), myocardial infarction or angina (21.0%), heart failure (19.4%), atrial fibrillation (18.0%) and chronic renal failure (10.8%). Most had prescribed outpatient medications for COPD including inhaled beta agonist (78.8%), inhaled anticholinergic (57.4%) and inhaled corticosteroids (51.4%). Home oxygen was prescribed for 12.6% of patients. Worsening cough was the most common presenting symptom (94.8%), followed by dyspnea (74.4%), increased sputum production (42.8%) and purulence (42.8%).

The calculated OCRS results of these patients varied from 1-10 on a maximum scale of 16 (Table 2). Of note, the OCRS was only calculated on 1 of the 500 patient visits (0.002%). A minority of patients had a score <2 (29.8%) which is associated with a risk of SSO <4%. Most had scores >2 (70.8%). These higher scores reflect a risk of SSO >7.2%. The OCRS scores and risk categories for SSO is displayed on Appendix A.

Table 3 outlines the frequency of treatments provided for 500 patient visits: inhaled beta agonist (82.6%), inhaled anticholinergic (76.6%), corticosteroids (IV or PO) (75.2%), antibiotics (IV or PO)

(71.0%), oxygen therapy (63.8%), NIV (8.8%) and endotracheal intubation (0.6%). Disposition of patients included: ward (42.0%, 2, monitored setting (9.6%) and discharge home (48.4%). Of those admitted to hospital, 92 patients had a serious short-term outcome: transfer to a monitored setting (12.5%), endotracheal intubation (1.6%), myocardial infarction (4.3%) and NIV (17.4%). Of the 242 patients discharged home, 58 returned to the ED within 30 days for COPD related reasons. The SSO of the discharged patients upon return included: admission to monitored setting (2.1%), endotracheal intubation (0.8%) and NIV (0.8%). Death at 30 days occurred in 22 (4.4%) patients. These deaths were most associated with acute hypoxemic respiratory failure (50.0%). Other causes listed: cancer (22.7%), gastrointestinal causes (13.6%) and infection (13.6%).

Table 4 displays the appropriateness of treatments given. The treatment was determined to be appropriate in half of the patients (50.0%). The frequency of the missing treatments are as follows: corticosteroids (24.4%), inhaled anticholinergic (22.6%), inhaled beta agonist (17.0%), antibiotics (12.8%) and NIV (2.0%).

DISCUSSION

Interpretation

This study sought to seek how appropriately patients with COPD exacerbations were being treated in the ED. Overall, 50.0% of cases were judged to have had suboptimal treatment. Notably, corticosteroids and antibiotics were often missed. This raises concern for how these patients may fair without the needed therapy in avoiding complications. Of all included patients, 2/3 were admitted. A considerable number of discharged patients returned to ED for treatment within 30 days. With appropriate treatment, we may decrease the number of returning patients to the ED. This entails the benefits of decreased ED volumes and health care expenditure. The returning patient may be having similar or unchanged symptoms, seeking more treatment that may have been missed from their first encounter.

Another surprising finding was the lack of calculation of the OCRS by ED providers. We found only 1 chart with the calculated score in the 500 reviewed. The OCRS is a clinical decision tool that may alter our disposition for patients as it permits calculation of a risk for SSO in 30 days. It appears that most patients that warranted an admission considering a calculated score ≥ 2 were admitted. This may indicate that ED providers may already be aware of the clinical findings that increase the risk of SSO. It could be that ED providers are also relying heavily on the walk test for oxygenation to determine admission versus discharge for patients. As we know, a failure walk test alone scores 2 on the OCRS, warranting admission due to increased risk of SSO.

Previous studies

There are many publications that review management[9 10] or predict outcomes of patients with COPD exacerbations.[11 12] There are only a few, however, that discuss optimal management in the ED, through use of treatment bundles in observation units.[13 14]

No previous studies have evaluated the appropriateness of ED management of COPD exacerbations and tied thisto the use of the Ottawa COPD Risk Score in the ED. The rate of admission was comparable to a previous study by Garcia-Sanz quoting a 57% admission rate.[3] In fact, a considerable number of patients admitted to hospital had short term complications with admission to ICU and use of NIV being the most common. Although complications occur in a minority of patients, these events significantly increase health care expenses.[15] Admittedly, the complications of ICU admission and NIV use were often combined as a negative pressure room was necessary due to concerns from aerosol generating procedures since the COVID 19 pandemic. Perhaps with appropriate treatment in the ED, the patients could anticipate an admission to hospital with less or no complications. Our recorded 30-day mortality of 4.4% was lower than described in previous data. In fact, Roche and al. in 2008 had a 7.4% mortality at 90 days.[16] Our rate of patients returning to ED after discharge home is comparable to previous quoted return rates of 1 in 5 patients.[17]

Limitations

This study had some limitations. Firstly, a total of 134 patients were excluded as shown in Figure 3, due to lack of blood work or investigations such as ECG and chest x-ray. This represents approximately 5.6% of the total 745 patients visits reviewed prior to exclusion. These patients were likely low risk patients who may not warrant further investigations and who were more likely to have been dispositioned home with less risk of SSO. Second, some patients may have had withheld treatments due to a pending admission. We did note that many of the missing treatments were later provided by the consulting service. However, we would argue that effective treatments should not be delayed for the admission of a consultant as these medications are readily available in the ED. Third, we did not follow patients to determine if outcomes varied by appropriateness of ED treatment.

Clinical implications

Overall, this study clarified the current management of COPD exacerbations in the ED. Certainly, our findings have the potential of improving patient care by making ED providers aware of the pitfalls of current management. Implementation of explicit treatment standards should lead to improved patient care of this common and serious respiratory condition. A method which may directly affect patient care would be the building of integrated COPD exacerbation order sets on electronic medical systems based on our predetermined treatment standards. This may lead to increased rates of indicated antibiotics and corticosteroids which were the two therapies most missed. Certainly, it appears that clinicians were utilizing adverse event predictors from the Ottawa COPD Risk Score without necessarily calculating the score. Perhaps physician gestalt is performing similarly to the explicit calculation of the score. This resulted in admission and monitoring of patients who had the highest rates of adverse events. An integrated treatment algorithm or pathway may decrease the number of missed indicated therapies.

Research implications

Further evaluation of the role of brief smoking cessation counselling in the ED as part of the management standard of COPD exacerbations may be interesting in pursuing as it the only reversible cause to this chronic pulmonary disease. An evaluation of the impact of introducing an ED COPD exacerbation treatment algorithm may also help identify if it is an appropriate quality improvement strategy. Finally, future studies could evaluate the impact of appropriateness of ED treatment on 30-days outcomes.

Conclusion

Adequate treatment of COPD exacerbation was lacking in 50.0% of patients in these two larges academic EDs. Concerning were the number of patients not receiving corticosteroids or antibiotics. Implementation of explicit treatment standards should lead to improved patient care of this common and serious respiratory condition.

Figure Legend:

Figure 1. Emergency Department COPD Exacerbation Treatment Standard (Oxygen Therapy)

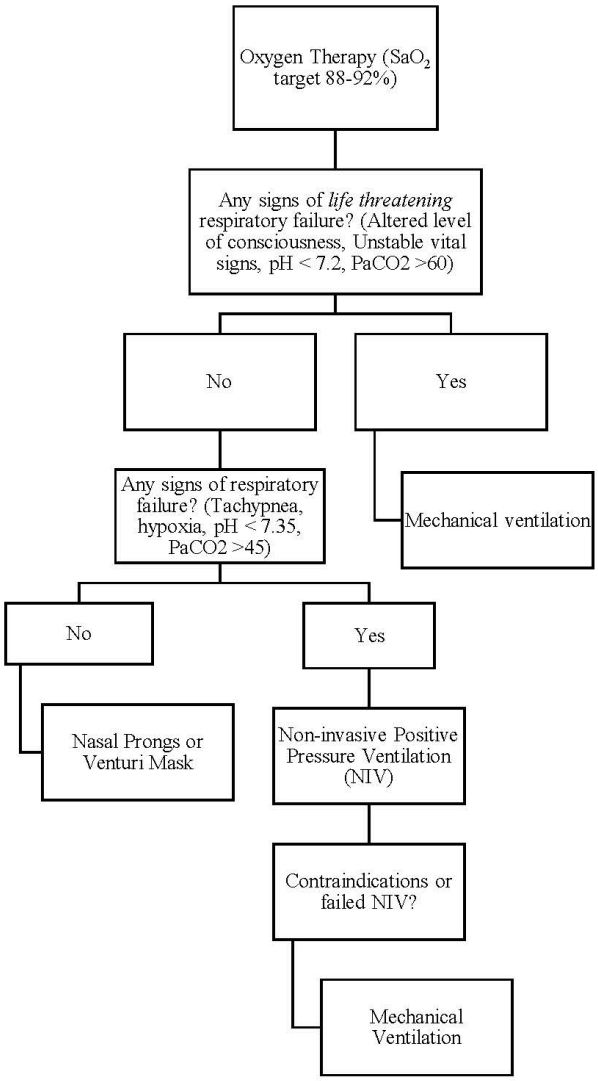

Figure 1. Emergency Department COPD Exacerbation Treatment Standard (Oxygen Therapy)

Figure 2. Emergency Department COPD Exacerbation Treatment Standard (Pharmacotherapy)

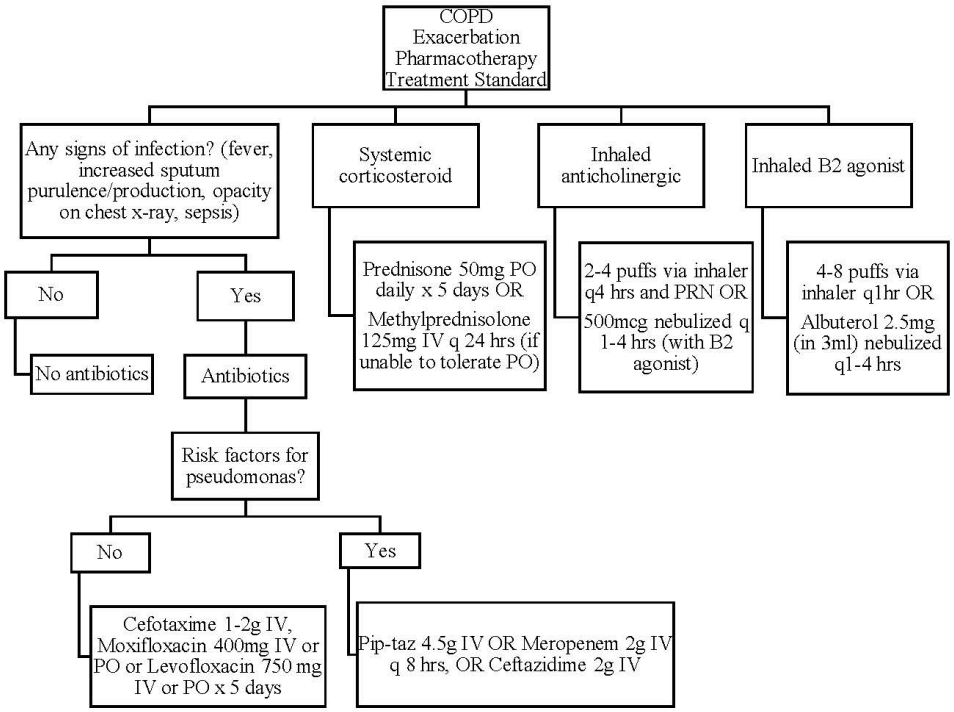

Figure 2. Emergency Department COPD Exacerbation Treatment Standard (Pharmacotherapy)

Figure 3. Inclusion and Exclusion of Patients Visits

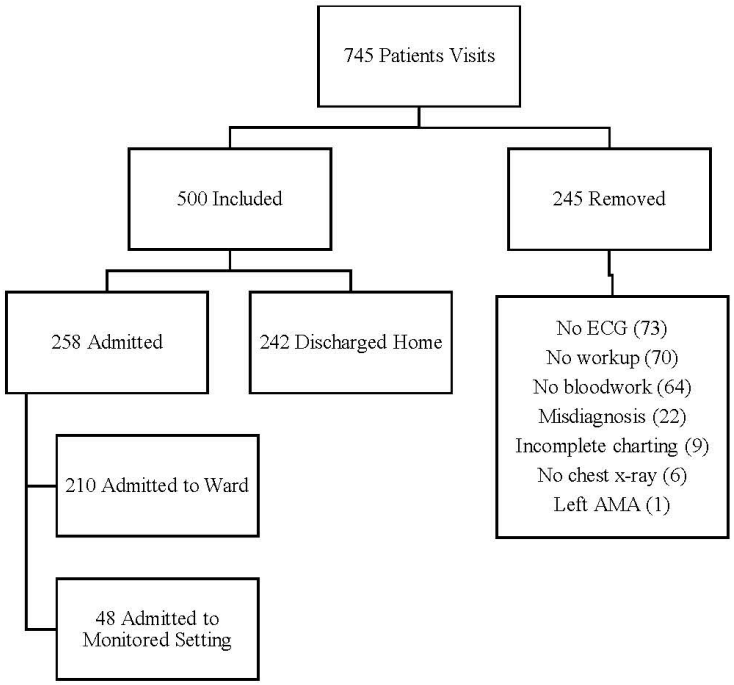

Figure 3. Inclusion and Exclusion of Patients Visits

Table 1 Characteristics of 500 Visits of Patients with COPD Exacerbations treated at The [BLINDED] Hospital Emergency Departments

Characteristics	Visits N=500
Age in years, Mean (SD)	71.9 (11.7)
Range	39 - 101
Female (%)	256 (51.2)
Male (%)	244 (48.8)
Vital signs at triage, Mean (SD)	
Heart rate, bpm	97.7 (20.9)
Systolic blood pressure, mmHg	138.5 (24.7)
Diastolic blood pressure, mmHg	77.5 (15.0)
Respiratory rate, (/min)	23.1 (6.1)
Oxygen saturation, %	93.0 (5.7)
Temperature, ºC	36.7 (0.8)
Past medical history (%)	
Current or former smoker	478 (95.6)
COPD	474 (94.8)
Hypertension	289 (57.8)
Cancer	135 (27.0)
Diabetes	124 (24.8)
Myocardial infarction or angina	105 (21.0)
Heart failure	97 (19.4)
Atrial fibrillation	90 (18.0)
Chronic renal failure	54 (10.8)
Valvular heart disease	44 (8.8)
Peripheral vascular disease	37 (7.4)
Dementia	36 (7.2)
Pacemaker	21 (4.2)
Current prescribed outpatient medications (%)	
Inhaled beta agonist	394 (78.8)
Inhaled anticholinergic	287 (57.4)
Inhaled corticosteroid	257 (51.4)
Antibiotic	78 (15.6)
Home oxygen	63 (12.6)
Oral corticosteroid	62 (12.4)
Presenting symptoms (%)	
Worsening cough	474 (94.8)
Dyspnea	372 (74.4)
Increased sputum production	280 (56.0)
Sputum purulence	214 (42.8)
Chest pain	123 (24.6)
Fever	106 (21.2)

COPD=chronic obstructive pulmonary disease; SD=Standard Deviation.

Table 2 Ottawa COPD Risk Score (OCRS) Criteria and Calculated Score of 500 Patients with COPD at The [BLINDED] Hospital Emergency Departments

OCRS criteria **Visits N=500**	**Percentage of patient (%)**	**Number of patients**
History of CABG	4.2	21
History of intervention for PVD	7.4	37
History of intubation for respiratory distress	3.0	15
Heart ratre >110bpm	26.6	130
Hemoglobin <100g/l	10.4	52
Urea >12mmol/L	10.8	54
Serum CO2 >35mEq/L	24.8	124
Pulmonary congestion on chest x-ray	20.6	103
Acute ischemic changes on ECG	9.8	49
Walk test: SaO2 <90% or HR >120bpm after 3 mins of walking	53.2	266
Calculated OCRS on chart review **Visits N=500**	**Visits N=500** **%**	
0	20.8	104
1	9.0	45
2	21.2	106
3	13.4	67
4	16.0	80
5	8.8	44
6	3.0	15
7	3.6	18
8	2.4	12
9	1.0	5
10	0.8	4
>10	0.0	0

COPD=chronic obstructive pulmonary disease; CABG=coronary artery bypass graft; ECG=electrocardiogram; PVD=peripheral vascular disease; SaO2=oxygen saturation.

Table 3 Disposition and Treatments in ED of 500 Patients with COPD at The [BLINDED] Hospital Emergency Departments

Treatments and disposition (N=500)	Percentage of patients (%)	Number of patients
Treatments provided		
Inhaled beta agonist	82.6	413
Inhaled anticholinergic	76.6	383
Corticosteroid (IV or PO)	75.2	376
Antibiotics (IV or PO)	71.0	355
Oxygen therapy	63.8	319
Non-invasive positive pressure ventilation	8.8	44
Intubation	0.6	3
Disposition		
Home	48.4	242
Admission to monitored setting (AMA/ICU)	9.6	48
Admission to ward	42.0	210
Complications during admission to hospital		
Admission to monitored setting (AMA/ICU)	12.5	32
Endotracheal intubation	1.6	4
Myocardial infarction	4.3	11
Non-invasive positive pressure ventilation	17.4	45
Return to ED visits within 30 days if discharged home	24.0	58
Complications during return ED visit		
Admission to ICU/monitored setting	2.1	2
Endotracheal intubation	0.8	1
Myocardial infarction	0.0	0
Noninvasive pressure ventilation	0.8	1
Death at 30 days	4.4	22
Cause of death at 30 days		
Acute hypoxemic respiratory failure	50.0	11
Cancer	22.7	5
Gastrointestinal complications (perforation/obstruction)	13.6	3
Infection	13.6	3

COPD=chronic obstructive pulmonary disease; IV=intravenous; PO=per oral; ICU=intensive care unit; AMA=acute medical assessment; ED= Emergency department.

Table 4 Appropriate Treatments Not Given When Indicated in 500 COPD patient visits at The [BLINDED] Hospital Emergency Departments

Treatments N=500	Percentage of patients (%)	Number of patients
Treatment appropriateness (as per predetermined goal standard - Appendix B) (%)		
Yes	50.0	250
No	50.0	250
Missing treatments (%) *		
Corticosteroids (IV or PO)	24.4	122
Inhaled anticholinergic	22.6	113
Inhaled beta agonist	17.0	85
Antibiotics (IV or PO)	12.8	64
Non-invasive positive pressure ventilation	2.0	10
Oxygen therapy	0.0	0
Endotracheal intubation	0.0	0

COPD=chronic obstructive pulmonary disease; IV=intravenous; PO=per oral.
* Patients may have had more than one missing treatments

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