

The Profile of COPD Patients with Prolonged Hospitalizations: A Retrospective Analysis of 200 Hospital Admissions

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ABSTRACT **Background:** Patients with severe chronic obstructive pulmonary disease (COPD) experience frequent exacerbations and need to be hospitalized, resulting in an economic and social burden. Although data exist regarding reasons of frequent hospitalizations, there is no data available about the impact on the length of stay (LOS).

Objectives: To characterize the causes of prolonged hospitalizations in COPD patients.

Methods: A retrospective study was conducted of patients who were diagnosed and treated in the pulmonary department for severe COPD exacerbations. All patient demographic data and medical history were collected. Data regarding the disease severity were also collected (including Global Initiative for Obstructive Lung Disease [GOLD] criteria, pulmonologist follow-up, prior hospitalizations, and LOS).

Results: The study comprised 200 patients, average age 69.5 ± 10.8 years, 61% males. Of these patients, 89 (45%) were hospitalized for up to 4 days, 111 (55%) for 5 days or more, and 34 (17%) for more than 7 days. Single patients had longer LOS compared with married patients (48% vs. 34%, $P = 0.044$). Multivariate analysis showed that the number of prior hospital admissions in the last year was a predictor of LOS ($P = 0.038$, odds ratio [OR] = 0.807, 95% confidence interval [95%CI] = 0.659–0.988), as well as the use of non-invasive respiratory support by bilevel positive airway pressure (BiPAP) during the hospitalization ($P = 0.024$, OR = 4.662, 95%CI = 1.229–17.681).

Conclusions: Fewer previous hospitalizations due to COPD exacerbations and the need for non-invasive respiratory support by BiPAP were found as predictors of longer LOS.

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KEY WORDS: bilevel positive airway pressure (BiPAP), chronic obstructive pulmonary disease (COPD), hospitalization, risk factors

Chronic obstructive pulmonary disease (COPD) is a progressive lung disease, which is characterized by non-reversible airflow obstruction and chronic respiratory symptoms [1]. In the United States, COPD is the third leading cause of death [2], and is responsible for 700,000 hospitalizations per year, which results in a substantial economic and social burden. COPD exacerbations are major acute events resulting in hospitalization. Moreover, it has been estimated that these hospitalizations account for approximately 70% of the total COPD treatment costs, with the costs of hospitalization significantly influenced by the length of stay (LOS).

Since one out of five patients is re-hospitalized within a month of discharge [3,4], there is a need for an evaluation method that will enable to predict future COPD exacerbation episodes that require a hospitalization.

Various factors to predict acute exacerbation of COPD and the influence hospital LOS have been suggested [5]. These included three or more admissions in the last year, reduced lung function, poor health status and hypoxemia. In addition, a few social factors have also been identified, such as marital status and housing [6,7]. However, more data is needed concerning the profile of the COPD patients with prolonged LOS.

Therefore, in the current study we assessed the risk factors for long-term hospitalizations of patients admitted to the emergency department (ED) with a COPD exacerbation.

PATIENTS AND METHODS

This retrospective study was based on the medical records of patients diagnosed and treated with COPD exacerbations in our pulmonary department between January 2016 and December 2018. Inclusion criteria included age above 40 years and admissions from the ED due to COPD with acute exacerbation.

Exclusion criteria included mechanically ventilated patients, lung cancer, severe heart failure (NYHA 4), severe non-pulmonary co-morbid illnesses, and patients who were transferred to the pulmonary department from the internal departments.

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All patient demographic data were collected, including gender, age, marital status, place of residence, employment, smoking status as well as all medical history including co-morbidities (e.g., ischemic heart disease, heart failure, pulmonary embolism, bronchiectasis, and sleep apnea syndrome). Data regarding the patient's obstructive disease were collected including the severity of the disease according to the Global Initiative for Obstructive Lung Disease (GOLD) criteria [8], follow-up by a pulmonologist, recurrence of hospitalizations due to COPD exacerbation during the year prior to the hospitalization, and the LOS. In addition, data regarding standard COPD treatment (i.e., inhaler use, inhalations, oral steroids, oxygen treatment, and home non-invasive respiratory support by bilevel positive airway pressure [BiPAP]) and the treatment given during the hospitalization (i.e., inhalations, oral or intravenous steroids, antibiotics, and the need for BiPAP) were collected.

STATISTICAL ANALYSIS

The data is described as numbers and percentages in nominal variables. Continuous data is described as averages and standard deviation.

Univariate analysis

Differences of qualitative variables by duration of hospitalization were performed using a Chi-square test. Such differences of sequential parameters were examined using T-test. Parameters found to be statistically significant during the hospitalization period were introduced into a multivariate logistic regression equation.

ETHICS APPROVAL

The study was approved by the IRB ethics committee, approval No 0314-15.

RESULTS

STUDY POPULATION CHARACTERISTICS

The study screened 227 patients hospitalized at the pulmonary department between January 2016 and December 2018. Twenty-seven patients were excluded from the study. Therefore, the study population comprised 200 patients, with an average age of 69.5 ± 10.8 years, 61% males. Of these patients, 89 (45%) were hospitalized for up to 4 days, 111 (55%) were hospitalized for 5 days or more, 34 (17%) were hospitalized for more than 7 days.

First, we compared the demographic characteristics of the patients with a short LOS (i.e., 4 days or fewer) versus long LOS (i.e., 5 days or more). This comparison is presented in Table 1. No statistical difference was observed regarding the gender of the patients, their age, the need for social workers' assistance, place of residence, smoking, and employment. However, a significant difference was observed in the marital status between the groups, where single patients had longer

Table 1. Demographic data of patients with long vs. short hospitalization

Parameter	4 days or fewer (n=89)	5 days or more (n=111)	P value
Gender, male (%)	56 (63 %)	66 (59 %)	0.62
Age, years	68.3 ± 10.8	70.5 ± 10.7	0.158
Marital status (%)	43 (48%)	38 (34%)	0.044
Residence at home (%)	22 (24%)	31 (27%)	0.609
Social worker assistance	8 (9%)	16 (15%)	0.189
Unemployed (%)	30 (78%)	35 (81%)	0.349
Smoker	44 (51%)	56 (52%)	0.884

admissions compared with married patients (48% vs. 34%, $P = 0.044$).

PROLONGED HOSPITALIZATIONS ARE NOT CORRELATED TO DISEASE SEVERITY

Disease severity was evaluated by the average GOLD score, the need for a pulmonologist follow-up, and the number of hospital admissions in the past year, the co-morbidities, and the treatment these patients received. The parameters are shown in Table 2. Between the groups, there was no significant difference in the use of inhalers or oxygen. Moreover, the group that required an extended hospitalization was shown to need slightly less steroid treatment on a daily basis ($P = 0.047$). This parameter was found to be not significant as a predicting value in the multivariate analysis ($P = 0.78$, odds ratio [OR] = 1.252, 95% confidence interval [95%CI] = 0.264–5.934).

Interestingly, the only predictive value was the number of previous hospital admissions during the last year ($P = 0.022$). This parameter was also confirmed in a multivariate analysis as a predictive factor for long-term hospitalization ($P = 0.038$, OR = 0.807, 95%CI = 0.659–0.988). From these results, we concluded that fewer admissions in the past year were actually a predicting factor for a prolonged LOS.

RECURRENT HOSPITALIZATIONS CORRELATE WITH DISEASE SEVERITY

We reported that prolonged hospital stay inversely correlated to the number of previous hospitalizations. This finding was of interest and we wanted to find other factors that could affect the number of recurrent hospitalizations in our study population. Thus, we conducted another analysis based on the number of hospitalizations (i.e., no prior hospitalizations, 1–2 hospitalizations, and 3 or more hospitalizations in the last year). This comparison is shown in Table 3. We found that the group of patients who experienced no previous hospital-

Table 2. Comparison of disease severity parameters according to the LOS

Parameter	4 days or less	5 days or more	P value*
N	89	111	
GOLD stage (%)	2.93 ± 0.78	3.01 ± 0.77	0.551
Pulmonologist follow-up (%)	63 (73%)	66 (61%)	0.075
Number of hospital admissions in the last year (%)	1.19 ± 1.8	0.69 ± 1.3	0.022
Co-morbid diseases			
Ischemic heart disease (%)	22 (24%)	23 (20%)	0.501
Congestive heart failure (%)	6 (6%)	4 (3%)	0.312
Bronchiectasis (%)	2 (2%)	2 (1%)	1
Pulmonary embolisms (%)	1 (1%)	0	0.202
Obstructive sleep apnea (%)	4 (4%)	3 (3%)	1
Psychiatric diseases	19 (21%)	27 (24%)	0.65
Chronic treatment			
Inhalers (%)	63 (75%)	78 (70%)	0.439
Inhalation (%)	33 (39%)	41 (40%)	0.92
Steroid (%)	17 (20%)	11 (18%)	0.047
Oxygen (%)	27 (31%)	40 (36%)	0.467
BiPAP (%)	6 (7%)	5 (5%)	0.644

*Bold signifies significance (Correct?)

BiPAP = bilevel positive airway pressure, GOLD = Global Initiative for Obstructive Lung Disease, LOS = length of stay.

izations was older, included fewer smokers, and had a higher rate of ischemic heart disease diagnosis. However, the group that experienced three or more hospitalizations had higher average GOLD score, with more patients requiring a pulmonologist follow-up ($P = 0.0036$). They also used more inhalers and inhalation treatments, as well as more steroids and oxygen treatment, all indicative of increased disease severity [Table 3].

Another interesting finding was that the group that experienced three or more hospitalizations received significantly less antibiotic treatment during the hospitalization period (61.5% vs. 92.4% and 83.6%, $P = 0.0002$).

NON-INVASIVE VENTILATION MAY LEAD TO PROLONGED HOSPITALIZATION

We analyzed whether the treatment given during the hospitalization period affected the LOS. The majority of patients received

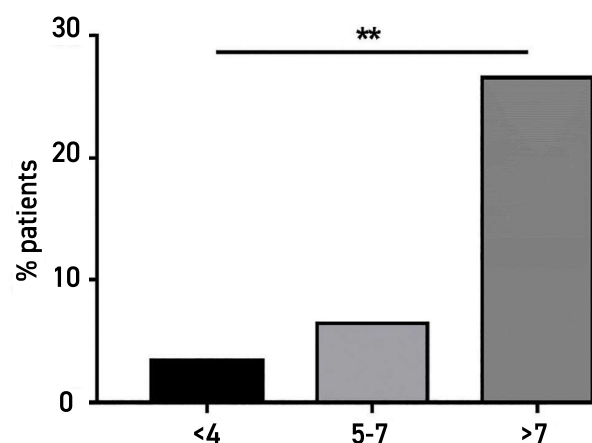
antibiotics (94%), as well as steroids (85%) during the hospitalization, with no difference between the groups.

We found that the group that received non-invasive respiratory support during the hospitalization, was at a greater risk for longer LOS ($P = 0.022$). In fact, when extending the analysis and dividing the patients into three groups according to their LOS (4 or fewer days, 5–7 days, and more than 7 days) the difference was even more significant [Figure 1] ($P < 0.0001$). This finding was also confirmed by the multivariate analysis ($P = 0.024$, OR = 4.662, 95%CI = 1.229–17.681).

As disease severity was found to be correlated to the number of prior hospitalizations, we tested whether the noninvasive ventilation was also a risk factor for recurrent hospitalizations. We found that non-invasive ventilation was not different among

Figure 1. Non-invasive ventilation may lead to prolonged hospitalization. Percent of patients that were administered BiPAP during hospitalization were divided according to their LOS: less than 4 days (< 4), 5–7 days, or more than 7 days (> 7)

** $P < 0.0001$ by Chi-square analysis



the groups ($P = 0.59$).

DISCUSSION

This study examined the reasons for prolonged hospitalizations in 200 patients hospitalized as a result of a COPD exacerbation. After analyzing multiple demographic and clinical factors, only two multivariate predictors were detected: fewer previous hospitalizations due to COPD exacerbation and the need for non-invasive respiratory support by BiPAP.

In a literature review, prolonged hospitalization in patients with COPD was found to be secondary to both medical and social reasons [9,10]. Diamantea and colleagues [11] prospectively examined 164 patients hospitalized for COPD flare-ups in two tertiary hospitals. They found that seven parameters could predict a prolonged hospitalization. The parameters were classified according to Antonisen criteria (i.e., co-morbid morbidity

according to the Charlson Comorbidity Index, oxidation, carbon dioxide in arterial gases, shortness of breath according to the Borg Scale of Perceived Exertion, number of admissions in the past year, history of chronic respiratory insufficiency). The parameters were inserted into a score called AECOPD-F a score that can accurately predict the duration of hospitalization in COPD patients (the score is equal to or greater than 3). However, this score is not in common practice use.

Wang et al. [12] studied 599 patients hospitalized for COPD exacerbation. In their multivariate analysis, hospitalizations on weekends (Thursday to Saturday), heart failure, stroke, diabetes, high arterial carbon dioxide, and low serum albumin were all associated with prolonged hospitalization for more than 11 days. Wong et al. [6] retrospectively assessed 109 patients who were hospitalized due to COPD flare-ups, 43 with recurrent hospitalizations and the remainder hospitalized for the first time (60%). They found that lonely (not married) patients and patients requiring social care involvement and treatment are

related to repeated hospitalizations and longer hospitalizations, in addition to disease severity according to GOLD criteria and co-morbid diseases related to recurrent hospitalization. As previously suggested, hospitalization burden may be reduced by applying home hospitalizations [13]. In our study, marital status was also found to be related; however, it was not significant in our multivariate analysis.

Our study found interesting findings regarding to those described above. To the best of our knowledge, our study was the first to measure the inverse correlation between the number of COPD exacerbations and the LOS. A partial explanation could be that in patients with a well-known disease, the next hospitalization may be shorter, only to treat the current cause of the exacerbation, without the need for complete assessment and differential diagnosis. In addition, Tal and co-authors [14] found that although exacerbation frequency increases as disease worsens, no clear connection had yet been found between exacerbation frequency and the disease severity.

Table 3. Patients' clinical parameters according to the number of previous hospitalizations

Previous hospitalizations over the last year	0	1-2	+3	P value
N	119	55	26	
GOLD stage (%)	2.84	3.08	3.1	0.08
Pulmonologist follow-up (%)	66 (55.5%)	41 (74.5%)	22 (84.6%)	0.0036
Age	71 ± 10.5	66.2 ± 9.4	69.4 ± 13.3	0.02
Smoker	54 (45.4%)	30 (54.5%)	16 (61.5%)	0.23
Past smoker	58 (48.7%)	24 (43.6%)	9 (34.6%)	0.4
Co-morbid diseases				
Ischemic heart disease (%)	32 (26.9%)	7 (12.7%)	6 (23.1%)	< 0.0001
Congestive heart failure (%)	8 (6.7%)	0	2 (7.7%)	0.133
Bronchiectasis (%)	1 (0.8%)	3 (5.5%)	0	0.095
Pulmonary embolisms (%)	1 (0.8%)	0	0	0.71
Obstructive sleep apnea (%)	3 (2.5%)	3 (5.5%)	2 (7.7%)	0.39
Psychiatric diseases	26 (21.8%)	13 (23.6%)	7 (26.9%)	0.85
Chronic treatment				
Inhalers (%)	74 (62.2%)	43 (78.2%)	24 (92.3%)	0.003
Inhalation (%)	33 (27.7%)	29 (52.7%)	15 (57.7%)	0.0007
Steroid (%)	10 (8.4%)	12 (21.8%)	6 (23.1%)	0.02
Oxygen (%)	28 (23.5%)	27(49.1%)	12 (46.2%)	0.0014
BiPAP (%)	3 (2.5%)	7 (12.7%)	2 (17.7%)	0.029

BiPAP = bilevel positive airway pressure, GOLD = Global Initiative for Obstructive Lung Disease

Another important finding is the use of BiPAP as predicting value for long-term hospitalizations. In most cases, the use of non-invasive ventilation may suggest on disease severity, which is possibly worse and therefore requiring a longer LOS.

A recent review [15] identified several randomized trials who evaluated interventions to reduce recurrent hospitalizations for patients with COPD [16-21]. These trials examined a variety of interventions, including a post-discharge care program, guidance and explanation about the disease, guidance on inhaler use, action plan and intervention, smoking cessation counseling, accompanying morbidity assessment, referral to pulmonary rehabilitation, and home surveillance after discharge. All interventions showed an important impact on the number of previous hospitalizations. In our study, we also found differences in the patients' clinical characteristics between those who were never hospitalized due to a COPD flare-up, and those who already were.

LIMITATIONS

Our study has several limitations, mainly because it is a retrospective study. However, our study has many advantages because it is a work based on a computerized database, which increases the reliability of the data and incorporates all the examined parameters. Although important [22], pulmonary rehabilitation was not included in the current analysis.

CONCLUSIONS

Prolonged hospitalization in COPD patients involves morbidity, mortality, and high resource consumption. Repeated hospitalizations and the need for non-invasive respiratory support with BiPAP predict long-term hospitalization in patients hospitalized for COPD. Prospective studies are needed to confirm these results.

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References

- Meeraus W, Wood R, Jakubanis R, et al. COPD treatment pathways in France: a retrospective analysis of electronic medical record data from general practitioners. *Int J Chron Obstruct Pulmon Dis* 2019; 14: 51-63.
- Kochanek KD, Xu J, Murphy SL, Minino AM, Kung HC. Deaths: final data for 2009. *Natl Vital Stat Rep* 2011; 60: 1-116.
- Jencks SF, Williams MV, Coleman EA. Rehospitalizations among patients in the Medicare fee-for-service program. *N Engl J Med* 2009; 360: 1418-28.
- Stein BD, Charbeneau JT, Lee TA, et al. Hospitalizations for acute exacerbations of chronic obstructive pulmonary disease: how you count matters. *COPD* 2010; 7: 164-71.
- Lin WC CC, Lu CL, Lai WW, Huang MH, Tsai LM, Li CY, Lai CH. The association between recent hospitalized COPD exacerbations and adverse outcomes after percutaneous coronary intervention: a nationwide cohort study. *Int J Chron Obstruct Pulmon Dis* 2019; 14: 169-79.
- Wong AW, Gan WQ, Burns J, Sin DD, van Eeden SF. Acute exacerbation of chronic obstructive pulmonary disease: influence of social factors in determining length of hospital stay and readmission rates. *Can Respir J* 2008; 15: 361-4.
- Crisafulli E, Ielpo A, Barbetta E, et al. Clinical variables predicting the risk of a hospital stay for longer than 7 days in patients with severe acute exacerbations of chronic obstructive pulmonary disease: a prospective study. *Respir Res* 2018; 19: 261.
- Montes de Oca M, Perez-Padilla R. Global Initiative for Chronic Obstructive Lung Disease (GOLD)-2017: The alat perspective. *Arch Bronconeumol* 2017; 53: 87-8.
- Inabnit LS, Blanchette C, Ruban C. Comorbidities and length of stay in chronic obstructive pulmonary disease patients. *COPD* 2018; 15: 355-60.
- Alshabanat A, Otterstatter MC, Sin DD, et al. Impact of a COPD comprehensive case management program on hospital length of stay and readmission rates. *Int J Chron Obstruct Pulmon Dis* 2017; 12: 961-71.
- Diamantea F, Kostikas K, Bartzioakas K, et al. Prediction of hospitalization stay in COPD exacerbations: the AECOPD-F score. *Respir Care* 2014; 59: 1679-86.
- Wang Y, Stavem K, Dahl FA, Humerfelt S, Haugen T. Factors associated with a prolonged length of stay after acute exacerbation of chronic obstructive pulmonary disease (AECOPD). *Int J Chron Obstruct Pulmon Dis* 2014; 9: 99-105.
- Levi B, Borow M, Wapner L, Feldman Z. Home hospitalization worldwide and in Israel. *IMAJ* 2019; 21: 565-7.
- Tal S, Adir Y, Stein N, et al. COPD exacerbator phenotype is inversely associated with current smoking but not with haptoglobin phenotype. *IMAJ* 2019; 21: 19-23.
- Prieto-Centurion V, Markos MA, Ramey NI, et al. Interventions to reduce rehospitalizations after chronic obstructive pulmonary disease exacerbations. A systematic review. *Ann Am Thorac Soc* 2014; 11: 417-24.
- Fan VS, Gaziano JM, Lew R, et al. A comprehensive care management program to prevent chronic obstructive pulmonary disease hospitalizations: a randomized, controlled trial. *Ann Intern Med* 2012; 156: 673-83.
- Casas A, Troosters T, Garcia-Aymerich J, et al. Integrated care prevents hospitalisations for exacerbations in COPD patients. *Eur Respir J* 2006; 28: 123-30.
- Kwok T, Lum CM, Chan HS, Ma HM, Lee D, Woo J. A randomized, controlled trial of an intensive community nurse-supported discharge program in preventing hospital readmissions of older patients with chronic lung disease. *J Am Geriatr Soc* 2004; 52: 1240-6.
- Bourbeau J, Julien M, Maltais F, et al. Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: a disease-specific self-management intervention. *Arch Intern Med* 2003; 163: 585-91.
- Bucknall CE, Miller G, Lloyd SM, et al. Glasgow supported self-management trial (GSuST) for patients with moderate to severe COPD: randomised controlled trial. *BMJ* 2012; 344: e1060.
- Garcia-Sanz MT, Gonzalez-Barcala FJ, Canive-Gomez JC, Garcia-Couceiro N, Alonso-Acuna S, Carreira JM. Prolonged stay predictors in patients admitted with chronic obstructive pulmonary disease acute exacerbation. *Lung India* 2018; 35: 316-20.
- Rokach A, Romem A, Arish N, et al. The effect of pulmonary rehabilitation on non-chronic obstructive pulmonary disease patients. *IMAJ* 2019; 5: 326-9.

An ounce of action is worth a ton of theory.

Ralph Waldo Emerson (1803-1882), American essayist, lecturer and poet, and champion of individualism