

# Acute exacerbation of chronic obstructive pulmonary disease: Influence of social factors in determining length of hospital stay and readmission rates

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**BACKGROUND:** Acute exacerbation of chronic obstructive pulmonary disease (AECOPD) is the leading reason for hospitalization in Canada and a significant financial burden on hospital resources. Identifying factors that influence the time a patient spends in the hospital and readmission rates will allow for better use of scarce hospital resources.

**OBJECTIVES:** To determine the factors that influence length of stay (LOS) in the hospital and readmission for patients with AECOPD in an inner-city hospital.

**METHODS:** Using the Providence Health Records, a retrospective review of patients admitted to St Paul's Hospital (Vancouver, British Columbia) during the winter of 2006 to 2007 (six months) with a diagnosis of AECOPD, was conducted. Exacerbations were classified according to Anthonisen criteria to determine the severity of exacerbation on admission. Severity of COPD was scored using the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. For comparative analysis, severity of disease (GOLD criteria), age, sex and smoking history were matched.

**RESULTS:** Of 109 admissions reviewed, 66 were single admissions (61%) and 43 were readmissions (39%). The number of readmissions ranged from two to nine (mean of 3.3 readmissions). More than 85% of admissions had the severity of COPD equal to or greater than GOLD stage 3. The significant indicators for readmission were GOLD status ( $P < 0.001$ ), number of related comorbidities (OR 1.47, 95% CI 1.10 to 1.97;  $P < 0.009$ ) and marital status (single) (OR 4.18, 95% CI 1.03 to 17.02;  $P < 0.046$ ). The requirement for social work involvement during hospital admission was associated with a prolonged LOS ( $P < 0.05$ ).

**CONCLUSIONS:** The results of the present study show that disease severity (GOLD status) and number of comorbidities are associated with readmission rates of patients with AECOPD. Interestingly, social factors such as marital status and the need for social work intervention are also linked to readmission rates and LOS, respectively, in patients with AECOPD.

**Key Words:** Acute exacerbation of COPD; Length of stay; Readmission rate, Social factors

## Exacerbation aiguë de la bronchopneumopathie obstructive chronique : Influence des facteurs sociaux sur la durée de l'hospitalisation et les taux de réadmission

**HISTORIQUE :** L'exacerbation aiguë de la bronchopneumopathie obstructive chronique (EABPOC) est la principale cause d'hospitalisation au Canada et constitue un fardeau financier important pour le système hospitalier. L'identification des facteurs qui influent sur la durée du séjour hospitalier et les taux de réadmission permettra d'utiliser à meilleur escient les maigres ressources hospitalières.

**OBJECTIF :** Déterminer quels facteurs influent sur la durée du séjour (DS) et la réadmission des patients souffrant d'une EABPOC dans un hôpital urbain.

**MÉTHODES :** À partir des dossiers de Providence Health, les auteurs ont procédé à une analyse rétrospective des patients admis à l'Hôpital St. Paul (Vancouver, Colombie-Britannique) durant l'hiver 2006-2007 (six mois) avec un diagnostic d'EABPOC. Ils ont classifié les exacerbations selon les critères d'Anthonisen afin d'en mesurer la gravité au moment de l'admission. La gravité de la BPOC a été établie selon les critères GOLD (pour *Global Initiative for Chronic Obstructive Lung Disease*). À des fins d'analyse comparative, la gravité de la maladie (critères GOLD), l'âge, le sexe et les antécédents à l'égard du tabagisme ont été assortis.

**RÉSULTATS :** Parmi les 109 admissions analysées, 66 étaient des admissions simples (61 %) et 43, des réadmissions (39 %). Le nombre de réadmissions allait de deux à neuf (moyenne de 3,3 réadmissions). Plus de 85 % des admissions étaient justifiées par une BPOC de gravité égale ou supérieure au stade GOLD 3. Les principaux indicateurs de réadmission étaient le statut à l'égard des critères GOLD ( $p < 0,001$ ), le nombre de comorbidités connexes (RR 1,47, IC à 95 %, 1,10 à 1,97,  $p < 0,009$ ) et l'état civil (célibataire) (RR 4,18, IC à 95 %, 1,03 à 17,02,  $p < 0,046$ ). Le recours aux services d'un travailleur social durant l'hospitalisation a été associé à une prolongation de l'hospitalisation ( $p < 0,05$ ).

**CONCLUSIONS :** Les résultats de la présente étude montrent que la gravité de la maladie (critères GOLD) et le nombre de comorbidités sont associés aux taux de réadmissions chez les patients présentant une EABPOC. À noter, les facteurs sociaux tels que l'état civil et le recours à une intervention en travail social sont aussi liés aux taux de réadmissions et à la durée de l'hospitalisation, respectivement, chez les patients présentant une EABPOC.

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Chronic obstructive pulmonary disease (COPD) is currently the fourth leading cause of death in Canada and will be the third leading cause by 2020 (1). In 1998, the direct cost of COPD in Canada was \$1.67 billion, driven mostly by emergency visits and hospitalizations related to acute exacerbations (2). Acute exacerbation of COPD (AECOPD) is defined as a change in a patient's baseline cough, dyspnea and sputum production, and it accounts for over 1.5 million physician visits annually in Canada (3,4). AECOPD is a major predictor for morbidity and mortality (4), and is the most common reason for hospitalization in British Columbia (5). Numerous factors that predict AECOPD and influence eventual length of stay (LOS) in hospital (including three or more admissions in the previous year, reduced lung function, poor health status and hypoxemia) have been identified (6). Whether social factors such as marital status, housing, etc, also modify the risk and length of COPD hospitalization and rehospitalization is largely unknown due to a scarcity of reported data. In the present study, the characteristics of patients at St Paul's Hospital (a hospital that predominantly serves the inner city of Vancouver, British Columbia) with a primary diagnosis of AECOPD were investigated. The social factors associated with hospital LOS and the likelihood of future readmissions were also investigated.

## METHODS

Through Decision Support (Quality Improvement and Information Management) at Providence Health Care, a list of patients admitted to St Paul's Hospital with a 'most responsible diagnosis of AECOPD' during the winter of 2006 (October 1, 2006, to March 31, 2007, inclusive) was generated. Patients included in the dataset were required to meet the Anthonisen criteria for AECOPD (4). The severity of COPD was quantified using Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria. Using a hospital electronic database (Sunrise Clinical Manager), the patients' charts were reviewed to collect data, including demographics, past medical history, pulmonary function tests, length of hospital stay, treatment received while in the hospital and discharge recommendations. All patients were managed in the hospital using Canadian Thoracic Society guidelines for the treatment of AECOPD (3).

### Statistical methods

Data for each patient were coded with a unique identifier using the iCAPTURE Centre database system. To examine the factors that were associated with readmission to hospital, a logistic regression analysis was conducted using readmission (positive or negative) as the dependent variable and relevant factors as the independent variables. Because age and sex may be related to readmission, multiple logistic regression analysis was conducted using age and sex as covariates. A stepwise logistic regression analysis was conducted, including factors such as age, sex, body mass index, current smoking status, forced expiratory volume in 1 s ( $FEV_1$ ), white blood cell count, partial pressure of  $CO_2$ , partial pressure of  $O_2$ , the severity of COPD, number of comorbidities, previous steroid therapy, marital status and social work service. In the model,  $P \leq 0.3$  is required for a variable to enter the model and  $P \leq 0.05$  is required to stay in the model. All analyses were conducted using SAS version 9.1 (SAS Institute Inc, USA). The tests were two-tailed in nature. Continuous variables are shown as mean  $\pm$  SD, unless otherwise indicated.

**TABLE 1**  
Characteristics of the patients with acute exacerbation of chronic obstructive pulmonary disease (COPD)

n	109
Age, years, mean $\pm$ SD	63.0 $\pm$ 14.5
Male sex, %	61.5
Body mass index, kg/m <sup>2</sup> , mean $\pm$ SD	23.3 $\pm$ 5.2
Length of stay in hospital, days, median (interquartile range)	6.0 (3.0–9.0)
Severity of COPD, %	
GOLD stage 1	1.2
GOLD stage 2	13.4
GOLD stage 3	20.7
GOLD stage 4	64.6
Type of exacerbation, %	
Level 1	25.9
Level 2	50.9
Level 3	23.2
Number of comorbidities, %	
0	2.8
1–3	30.8
4–6	42.1
$\geq 7$	24.3

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## RESULTS

There were 109 admissions (mean age of 63.0 $\pm$ 14.5 years) included in the present study, of which 43 were readmissions (number of readmissions ranged from two to nine, with a mean of 3.3 readmissions). The majority of patients (61.5%) were men. The median LOS in hospital was six days (interquartile range, three to nine days). More than 85% of patients demonstrated GOLD stage 3 or 4 disease. The severity of AECOPD was evenly distributed with 50% of the admissions being of intermediate severity (4). Strikingly, the majority of patients admitted had at least one comorbidity; approximately 66% of patients had four or more comorbidities (Table 1).

The number of comorbidities was associated with readmissions (OR 1.47, 95% CI 1.10 to 1.97;  $P=0.009$ ). With every one unit increase in comorbidities, the risk of readmissions increased by 47% (Table 2). Being single was also associated with readmissions, with these individuals having an 18% higher readmission rate than patients with a supporting spouse, after adjustments for age and sex (95% CI 1.03 to 17.02;  $P=0.046$ ) (Table 2). Previous use of steroids (either oral or inhaled) was also related to readmissions (95% CI 1.21 to 7.33;  $P=0.017$ ) (Table 2). LOS was significantly influenced by whether a patient needed social work services during their admission ( $\beta=3.95$ ;  $P=0.005$ ) (Table 3). Other factors such as smoking status at time of admission, addiction to drugs or alcohol abuse, nutritional status (body mass index), partial pressure of  $O_2$  or partial pressure of  $CO_2$ , preadmission treatment, management during hospitalization (including whether chest x-rays or computed tomography scans were performed), or postdischarge follow-up with either a family doctor or a respirologist were not significantly associated with LOS or the risk of readmission.

Stepwise logistic regression analysis showed that both  $FEV_1$  (% predicted) (OR 0.87, 95% CI 0.80 to 0.95;  $P<0.002$ ) and admission white blood cell count (OR 1.25, 95% CI 1.02 to

TABLE 2

Relationship between the readmission of patients with an acute exacerbation of chronic obstructive pulmonary disease and relevant factors, after adjustment for age and sex

Factor	Simple logistic regression model			Multiple logistic regression model		
	$\beta$	P	OR (95% CI)	$\beta$	P	OR (95% CI)
Severity (GOLD stage 1–4)	1.85	<0.001	6.38 (2.51–16.19)	1.83	<0.001	6.23 (2.47–15.72)
Number of comorbidities (0–7 comorbidities)	0.28	0.030	1.33 (1.03–1.72)	0.39	0.009	1.47 (1.10–1.97)
Previous steroid therapy (yes=1, no=0)	1.17	0.007	3.23 (1.37–7.60)	1.09	0.017	2.98 (1.21–7.33)
Marital status (single=1, other=0)	1.27	0.061	3.56 (0.94–13.45)	1.43	0.046	4.18 (1.03–17.02)

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1.54;  $P < 0.035$ ) were significantly associated with the risk of readmission.

## DISCUSSION

Lung function status (as measured by  $FEV_1$ ), GOLD classification, number of comorbidities, previous steroid exposure and social factors (such as marital status [single]) were significantly related to the risk of readmissions in patients who were discharged from hospital following an AECOPD. The patients who needed social work assistance during their admission had significantly longer hospital stays than those who did not require such assistance.

The findings that GOLD status and number of comorbidities are related to increased risk of rehospitalization are consistent with those reported in other studies, which have shown that lower health status (which usually results in a higher number of comorbidities) is an important risk factor for readmission for COPD (7–10). Garcia-Aymerich et al (6) (Estudi dels Factors de Risc d'Agudització de la MPOC [EFRAM] study) found that in addition to disease severity, patients who were more physically active (equivalent to walking 60 min or more per day) also had a reduction in readmission to hospital, regardless of COPD severity. We did not explore the influence of physical activity in the present study, but factors such as health status (comorbidities), GOLD status, availability of pulmonary rehabilitation programs and socioeconomic status could influence subject ability and motivation for physical activity.

To date, the majority of research in this area has focused on patient's health status, medications, physical activity and blood gases (6,11). We showed a relationship between previous steroid exposure, either inhaled steroids or oral steroids, and readmission rate (Table 2). Steroids are used predominantly in subjects with severe COPD (GOLD status 3 and 4) or to prevent frequent exacerbations; therefore, steroids are predominantly used in subjects with severe COPD (3,12,13). We suspect that 'previous steroid use' is a surrogate marker for severity of COPD (GOLD status).

The potential influence of social factors on hospitalizations, LOS and readmissions for AECOPD have been largely ignored. Our findings thus extend the reports of previous studies by demonstrating the relevance of social status, such as the need for social assistance and marital status, in influencing LOS and readmission rates in COPD patients. A patient with a single marital status most likely lives alone and may not have the support offered by a companion to help manage their disease, making them more susceptible to exacerbations. For example, a patient with a single marital status is less likely to have another person ensuring that he or she is compliant with

TABLE 3

Relationship between the length of stay in hospital (one to 38 days) and relevant factors (n=109)

	$\beta^*$	$P^*$	$\beta^\dagger$	$P^\dagger$
Social work follow-up (yes=1, no=0)	3.95	0.005	3.90	0.005

\* $\beta$  and  $P$  values are from single linear regression model. The dependent variable is the length of stay in hospital;  $^\dagger\beta$  and  $P$  values are from a multiple linear regression model after adjustment for age and sex. The dependent variable is the length of stay in hospital

medications, achieves some physical activity and maintains a healthy diet. Furthermore, spouses do not just help at home; they are partners in the planning of one's life and in the confrontation of adversity (14).

Several studies have shown that socioeconomic status affects all-cause morbidity and mortality in chronic diseases, including COPD (15,16). Therefore, COPD hospitalizations have to be viewed as more than a medical issue. Social issues play a critical role in determining the outcomes of AECOPD in hospitals. To optimize health outcomes and reduce LOS, social as well as medical needs of patients must be addressed in the hospital during severe AECOPD episodes. Recently, Ansari et al (17) showed that socioeconomic status of the patient significantly affects admission to hospital for AECOPD. In our study, we found that LOS in hospital was significantly determined by the need for social work assistance during patient hospital admission. Our study also suggests that patients' LOS may be reduced by addressing issues, such as housing arrangements, home care and other social services, earlier on in their hospital stay. This sentiment was echoed in a recent study (18) which found that longer LOS was associated with people living alone. Taken together, this finding suggests that patients need to be flagged for early social work assessment and discharge planning. This practice could influence not just LOS but also reduce readmission rates in patients with AECOPD.

The benefits of rehabilitation programs have been cited in numerous studies (6,11,19). Subjects enrolled in pulmonary rehabilitation programs receive education necessary to manage and make decisions regarding their disease. They also meet with fellow COPD patients and educators on an ongoing basis, providing a social support network that could play an important role in decreasing the number of exacerbations and hospitalizations (6,12,19). These studies strengthen our finding that a social support network (whether in the form of a spouse or fellow COPD patients in a rehabilitation program) is important in preventing readmission to hospital. Pulmonary rehabilitation programs also help patients develop self-management

plans, which have been shown to reduce frequency of hospitalizations for COPD patients in Canada (20). This finding leads to the suggestion that all patients admitted for AECOPD should be considered for enrolment in a pulmonary rehabilitation program.

The present study was a single-centre retrospective study, and was not designed and powered to address specific treatment modalities that prevent AECOPD (such as the long-term use of tiotropium or a combination of long-acting beta-agonist and inhaled corticosteroid) or treatments in the hospital (such as noninvasive ventilation or intensive care treatment) that could influence LOS. However, we suspect that our patient population reflects a unique social circumstance representative of most inner-city hospitals, highlighting the importance of social factors (as determinants of LOS) and hospital readmission rates for patients with an exacerbation of a chronic disease such as COPD. Prospective studies that factor in social factors and socioeconomic status of patients with optimal therapy (eg, use of inhaled tiotropium and/or inhaled corticosteroid plus long-acting beta-agonist, vaccination and pulmonary rehabilitation) are required to better understand the importance of these variables in predicting readmission for AECOPD. Our findings add to the growing emphasis that social factors may play an equally important role in predicting the frequency of COPD exacerbations, and should be considered in future research that focuses on evaluation and prevention of AECOPD-related hospitalizations. It also highlights opportunities for policymakers to develop targeted public health and health service interventions.

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