

Utilization and Medical Care Expenditures in Patients with Chronic Obstructive Pulmonary Disease

A Managed Care Claims Data Analysis

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Abstract

Objective: To estimate annual healthcare utilization and expenditures for patients with chronic obstructive pulmonary disease (COPD) versus those without COPD, and to determine the attributable costs of treating the complications of COPD.

Methods: This was a retrospective case-control study comparing 1-year (2000) utilization and expenditures for medical and pharmacy care between 18 061 COPD patients and 18 061 age-, sex-, and geographically matched control patients without COPD. Total medical expenditures were calculated using the actual amounts requested by the submitting provider. Total pharmacy expenditures were the charge for each prescription medication to the health plan.

Results: Healthcare utilization, in terms of hospitalizations, emergency room admissions, and outpatient encounters, were two to three times higher in the patients with COPD than the control patients. Per person total healthcare expenditures for patients with COPD were 25 times (respiratory-related) and 1.6 times (nonrespiratory) greater than those for the matched control patients. Total expenditures were highest for patients with COPD who were 55–64 years of age.

Conclusions: This claims analysis, utilizing data from a typical managed care population, demonstrates that COPD is a costly condition among managed care patients, as indicated by the high per person expenditures. Respiratory-related expenditures for patients with COPD were much higher, with acute hospitalizations accounting for a large proportion of the expenditures. Nonrespiratory-related expenditures were also higher among patients with COPD, reflecting expenditures associated with comorbid conditions. COPD exerts a large financial and nonfinancial burden on patients as well as the healthcare system. It is essential to educate primary care physicians about the impact of early diagnosis and treatment to improve lung function, clinical symptoms, and patient quality of life. As a result, interventions that decrease the likelihood of inpatient hospitalizations are likely to be cost effective from a managed care perspective.

Chronic obstructive pulmonary disease (COPD), as defined by the Global Initiative for Obstructive Lung Disease (GOLD),^[1] is a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases.^[1] Related symptoms of COPD include chronic cough, sputum production, exertion dyspnea, and wheezing. According to data from the National Health and Nutrition

Examination Survey (NHANES) III, the national prevalence of COPD is estimated at 23.6 million adults (13.9% of the adult population) using the GOLD definition of COPD.^[1,2] These data also indicate that a substantial portion of affected patients have mild or moderate lung disease and yet remain undiagnosed.^[2] Furthermore, according to data from the National Health Interview Survey, approximately 70% of patients with COPD are <65 years of age.^[3] COPD is the fourth leading cause of death and disability

in the US^[2] and is the high ranking cause of death that is rising in prevalence worldwide.^[4]

COPD continues to impose a substantial health and economic burden in the US. In 1998, COPD was responsible for an estimated 14.2 million ambulatory visits (82 visits per 1000 population) to either physicians' offices or hospital outpatient departments, and 1.4 million emergency department visits (8 visits per 1000 population). COPD is a leading cause of hospitalizations in American adults.^[2] In 1998, almost 662 000 hospitalizations (1.9% of total hospitalizations) were attributed to COPD and 2.53 million hospitalizations (7% of total hospitalizations) had COPD listed as a contributing cause for the hospitalization.^[2] To address the burden of COPD, the National Lung Health Education Program (NLHEP) was developed to provide an in-depth resource for clinical practitioners on topics such as prevention, early identification, differential diagnosis, and clinical management of COPD and related disorders.^[5] This initiative is aimed at preventing or forestalling premature morbidity and mortality from COPD and related disorders.

The total economic cost of COPD morbidity and mortality in the US was estimated to be \$US32.1 billion in 2002 (\$US18 billion direct medical costs plus \$US14.1 billion indirect costs related to morbidity [loss of work time and productivity] and premature mortality).^[6] Despite the high prevalence, morbidity, and mortality of COPD, little is known about its impact on medical care utilization and costs. Previous studies conducted in special populations, such as patients with severe end-stage disease or Medicare enrollees, have reported increased inpatient medical care utilization associated with COPD.^[7-10] However, details about outpatient physician or pharmacy utilization in these studies are limited. Additionally, there is a lack of information about the effects of comorbid conditions on the costs and utilization associated with COPD, especially for the non-Medicare population.

In this study, we examined the health resources used and expenditures incurred by COPD patients in a managed care organization. More specifically, we compared inpatient, outpatient, and pharmacy services between patients with and without COPD to estimate the expenditures attributable to COPD.

Methods

Study Design

This retrospective case-control study used data from a large, managed care organization. We used longitudinal claims data from California, Oklahoma, Oregon, Texas, and Washington, USA (locations of the branches of the managed care organization), which consisted of approximately 3.5 million commercial and

Medicare+Choice members. We examined electronic pharmacy, medical, and enrollment claims for the years 1999 and 2000. All claims are downloaded to a central data warehouse on a monthly basis and undergo quality assurance edits. This database has been used in previous healthcare services and economic studies.^[11-13]

Identification of Cases and Controls

Two study intervals were defined. The 1999 calendar year served as the identification period, in which patients were selected for inclusion into the study, and 2000 as the year where utilization and expenditures were reviewed. We classified patients into one of two groups. Patients were defined as having COPD if they had inpatient or outpatient claims on two different dates with a diagnosis (any diagnostic field) of COPD using the International Classification of Diseases (9th Edition) [ICD-9] during the identification period, and no diagnosis of asthma (ICD-9 493.x) on any medical claim in either the identification or review periods. COPD diagnoses were limited to ICD-9 codes 491.x (chronic bronchitis), 492.x (emphysema), and 496 (COPD, unspecified), which are the codes that most closely fit the American Thoracic Society definition of COPD.^[14] Control patients included those without a diagnosis of COPD or asthma on any medical claim in either the identification or review periods, as well as no prescription claims for respiratory medications (anticholinergics, short-, long-acting, and combination β -adrenoceptor agonists, inhaled corticosteroids, theophyllines, mast cell stabilizers, and leukotriene modifying agents) during the identification and review periods. The controls were matched (1 : 1) to the patients with COPD by age at last birthday, sex, and State of plan membership in the US (California, Oklahoma, Oregon, Texas, or Washington). The patients with COPD and control patients had to be continuously enrolled in the health plan from 1 January 1999 to 31 December 2000 and aged ≥ 18 years to be included in the study.

Study Outcomes

Healthcare utilization and expenditures for medical and pharmacy services in the calendar year 2000 were the primary outcomes of interest. Healthcare utilization included acute hospitalizations defined as an inpatient hospitalization with length of stay of ≥ 1 days, emergency room (ER) visits, and outpatient encounters during the calendar year 2000. Among those with an acute inpatient hospitalization, the length of hospital stay in days was also calculated. Utilization outcomes were classified as respiratory-related if the primary or secondary diagnosis in the medical claim was indicative of COPD, respiratory infection (ICD-9 codes 460.x to 487.x) or other lung disease (ICD-9 codes 490.x to 519.x, excluding codes for COPD).

Expenditures were classified into the following categories: (i) inpatient hospitalizations included all hospital-related expenditures, irrespective of the length of stay; (ii) ER visits; (iii) outpatient encounters; (iv) prescription fills; and (v) total healthcare expenditures, the sum of all medical and pharmacy expenditures. In a similar manner to utilization outcomes, expenditures were classified as respiratory or nonrespiratory, based on the diagnoses stated earlier in this section. In calculating respiratory-related pharmacy expenditures, oral corticosteroids and antibiotics were included in addition to anticholinergics, inhaled corticosteroids, theophyllines, mast cell stabilizers, leukotriene modifying agents and short-acting, long-acting, and combination β -adrenoceptor agonists.

Inpatient, ER, and outpatient expenditures were determined using the charges appearing on the claims, which were the amounts requested by the rendering provider. Charges were used for this analysis, rather than the amount paid to the provider, since they better reflect the market rates. Pharmacy expenditures were ingredient costs, which are the charges for the drug to the health plan before applying patient copayments, pharmacy dispensing fees, and other discounts.

Other Study Variables

Several independent variables were examined during the identification period (calendar year 1999). Demographic variables included sex and age on 1 January 2000. The Deyo-adapted Charlson Index (DCI),^[15] which is a measure of comorbidity, was calculated for each patient. The DCI contains 17 categories of comorbid conditions, defined using ICD-9 diagnosis codes. Each category has an associated weight based on adjusted risk of 1-year mortality. The overall score, with a possible range of 0–33, reflects the cumulative increased likelihood of 1-year mortality. The higher the score is, the more severe the burden of comorbidity. The DCI calculation included COPD, even though COPD was present in all cases, in order to preserve the actual contrast in DCI between the COPD and non-COPD groups. Additionally, the prevalence of select disease conditions as well as any ER admissions or acute inpatient hospitalizations (≥ 1 day length of stay) during 1999 were identified for cases and controls.

Statistical Methods

All statistical analyses were performed using SAS®, Version 8.2 (Cary, NC, USA). Descriptive statistics, including means and standard deviations, were calculated for study variables. Differences in demographic, clinical, and outcome variables between cases and controls were compared using Student's *t*-tests or analysis of variance for continuous variables, and chi-square tests for

categorical variables. Study outcomes, where applicable, were further stratified by age categories, which were <45, 45–54, 55–64, 65–74, 75–84, and >85 years, and whether they were respiratory- or nonrespiratory-related.

Results

Baseline Characteristics

In the calendar year 1999, a total of 18 061 patients with COPD who met study-eligibility criteria (table I) were identified. The mean age of the cases was 74 years (SD \pm 9.2) and 50.3% were female. The last specific COPD diagnosis during the identification period revealed that 78.3% of the patients had a diagnosis of COPD, unspecified, 14.2% had chronic bronchitis, and 7.5% had emphysema. A comparison of these two groups showed that the patients with COPD had a higher DCI score (2.3 ± 1.9 vs 0.6 ± 1.3 , respectively; $p < 0.0001$) and were more likely to have had an ER/inpatient hospitalization in 1999 (57.2% vs 22.6%, respectively; $p < 0.0001$) than the control patients.

The prevalence of select baseline comorbid conditions was also found to be 1.2–8.2 times higher in the patients with COPD compared with the controls. For example, 28.8% of the COPD cases had a lung disease other than COPD or asthma compared with 3.5% of the control patients ($p < 0.0001$). Similarly, significant differences in comorbid conditions between the COPD case and control patients were also found for septicemia (1.9% vs 0.3%, $p < 0.0001$), congestive heart failure (20.8% vs 3.9%; $p < 0.0001$), atherosclerosis (4.4% vs 1.3%; $p < 0.0001$), coronary heart disease (23.6% vs 10.4%; $p < 0.0001$), hypertension (36.0% vs 28.8%; $p < 0.0001$), stroke (9.4% vs 4.6%; $p < 0.0001$), psychiatric illness (17.0% vs 6.1%; $p < 0.0001$), and cancer (14.6% vs 10.3%; $p < 0.0001$).

Respiratory- and Nonrespiratory-Related Healthcare Utilization

There were highly significant differences in healthcare utilization between the COPD case and control groups (table II). In the year 2000, 27.2% of the patients with COPD had at least one inpatient hospitalization of ≥ 1 days compared with 10.7% of the control patients ($p < 0.0001$). Patients with COPD also had higher numbers of respiratory (0.2 vs 0.01; $p < 0.0001$) and nonrespiratory-related hospitalizations (0.2 vs 0.1; $p < 0.0001$) than the control patients. Similarly, inpatient length-of-stay for respiratory (1.2 days vs 0.05 days; $p < 0.0001$) and nonrespiratory reasons (1.2 days vs 0.7 days; $p < 0.0001$), as well as the number of respiratory (0.1 vs 0.01; $p < 0.0001$) and nonrespiratory-related (0.4 vs 0.2; $p < 0.0001$) ER visits, were higher in patients with COPD compared

Table I. Baseline characteristics of patients with Chronic Obstructive Pulmonary Disease (COPD) and matched control patients^a

Baseline characteristics	COPD (n = 18 061)	Control (n = 18 061)
Mean age, year (SD)	74.0 (9.2)	74.0 (9.2)
Age group, n (%)		
<45	193 (1.1)	193 (1.1)
45–54	439 (2.4)	439 (2.4)
55–64	1359 (7.5)	1359 (7.5)
65–74	6987 (38.7)	6987 (38.7)
75–84	7214 (39.9)	7214 (39.9)
85+	1869 (10.3)	1869 (10.3)
Female, %	50.3	50.3
Last diagnosis in 1999, %		
COPD, unspecified	78.3	NA
chronic bronchitis	14.2	NA
emphysema	7.5	NA
Mean Deyo-adapted Charlson Index (SD)	2.3 (1.9)	0.6 (1.3) ^b
Any ER/hospitalization in 1999, %	57.2	22.6 ^b
Prevalence of major comorbid conditions, %		
lung disease other than COPD	28.8	3.5 ^b
septicemia	1.9	0.3 ^b
congestive heart failure	20.8	3.9 ^b
atherosclerosis	4.4	1.3 ^b
diabetes mellitus	13.0	11.1 ^b
coronary heart disease	23.6	10.4 ^b
hypertension	36.0	28.8 ^b
stroke	9.4	4.6 ^b
psychiatric illness	17.0	6.1 ^b
cancer	14.6	10.3 ^b

a The patients with COPD and control patients were matched 1:1 on age, sex, and State of plan membership (California, Oklahoma, Oregon, Texas, or Washington, USA).

b $p < 0.0001$.

ER = emergency room; NA = not applicable.

with control patients. Additionally, the number of outpatient encounters that were respiratory-related (2.8 vs 0.2; $p < 0.0001$) and nonrespiratory-related (8.7 vs 6.9; $p < 0.0001$) were also significantly higher in patients with COPD than those in the control group.

Respiratory- and Nonrespiratory-Related Healthcare Expenditures

Respiratory- and nonrespiratory-related total healthcare expenditures for patients with COPD were, respectively, 25 and 1.6 times greater than those for controls (figure 1), with an expenditure attributable to COPD of \$US7573 and \$US4796 per case,

respectively, in 2000. Patients with COPD incurred significantly higher expenditures for all resource areas than control patients (table III). For patients with COPD, average expenditures were highest for nonrespiratory hospitalizations (\$US5946), followed by respiratory-related hospitalizations (\$US5230), nonrespiratory-related outpatient encounters (\$US3741), and nonrespiratory-related prescription medications (\$US863). For control patients, average expenditures were highest for nonrespiratory hospitalizations (\$US3631), followed by nonrespiratory-related outpatient encounters (\$US2721), nonrespiratory-related prescription medications (\$US621), and nonrespiratory-related ER admissions (\$US257).

Respiratory-related total healthcare expenditures for patients with COPD were 21–96 times greater than those for control patients for all age categories (figure 2); the differences in expenditures were significant. The greatest proportional difference in expenditures was seen in the 55–64 age group, with a marginal expenditure in patients with COPD of \$US9977 per case. Conversely, the greatest proportional difference in nonrespiratory-related expenditures was observed in the 45–54 age group, with a marginal expenditure in patients with COPD of \$US11 940 per case (figure 3).

Discussion

There were several key findings in the study. Firstly, the clinical characteristics of the COPD and control patients were very different, as can be expected when comparing patients with fundamentally different chronic conditions. The patients with COPD had greater comorbidity as evidenced by the DCI Score, as well as higher prevalences of select disease conditions relative to the control patients. The increased prevalence of certain comorbidities may be expected, as abnormal spirometry results not only characterize COPD, but also indicate increased risk of lung cancer, heart attack, and stroke.^[5] Patients with COPD have an increased risk for respiratory tract infections, contributing to the higher prevalence of septicemia observed in this population. The greater prevalence of cancer, congestive heart failure, and coronary heart disease may also be related to prior cigarette smoking among the patients with COPD, which is the major risk factor for the develop-

ment of emphysema and chronic bronchitis. We also found a greater prevalence of diabetes mellitus among patients with COPD. Any relationship between these diseases is unexplained and warrants further study. The patients with COPD were also more likely to have had prior ER admissions or hospitalizations than the control patients. As a result, healthcare utilization, in terms of hospitalizations, ER admissions, and outpatient encounters, was two to three times higher in the patients with COPD than the control patients. These findings were similar to those found in a smaller study of 1522 patients with COPD that was conducted using administrative data from a health maintenance organization.^[16] For example, the investigators of that study found that 25% of patients with COPD were admitted to the hospital at least once, compared with 10.6% of control patients, which is similar to our findings of 27.2% and 10.7%, respectively. Not surprisingly, our analysis revealed that healthcare expenditures reflected the higher health resource utilization among patients with COPD. In 2000, patients with COPD spent an average of \$US7888 and \$US12 881 on respiratory-related and nonrespiratory-related resources, respectively, most of which was driven by inpatient expenditures, compared with \$US315 and \$US8085, respectively, in the control patients. These results were much higher than those found by others.^[16,17] Mapel et al.^[16] found that total healthcare costs (respiratory- and nonrespiratory-related) in 1997 were \$US11 678 in patients with COPD who were >30 years of age, and \$US5815 in matched controls. Differences in each organization's cost methodology mean that these results may not be directly

Table II. Respiratory- and nonrespiratory-related healthcare utilization for patients with Chronic obstructive pulmonary disease (COPD) and matched control patients

Healthcare utilization	COPD (n = 18 061)	Control (n = 18 061)
One or more acute hospitalization of >1 days' duration, %	27.2	10.7 ^a
Mean number of acute hospitalizations (SD)		
respiratory	0.2 (0.7)	0.01 (0.1) ^a
nonrespiratory	0.2 (0.7)	0.1 (0.5) ^a
Mean length of stay, inpatient hospital days (SD)		
respiratory	1.2 (5.0)	0.05 (0.9) ^a
nonrespiratory	1.2 (4.9)	0.7 (5.0) ^a
Mean number of ER admissions (SD)		
respiratory	0.1 (0.5)	0.01 (0.1) ^a
nonrespiratory	0.4 (1.0)	0.2 (0.6) ^a
Mean number of outpatient encounters (SD)		
respiratory	2.8 (4.7)	0.2 (1.2) ^a
nonrespiratory	8.7 (9.4)	6.9 (7.9) ^a

a p < 0.0001.

ER = emergency room.

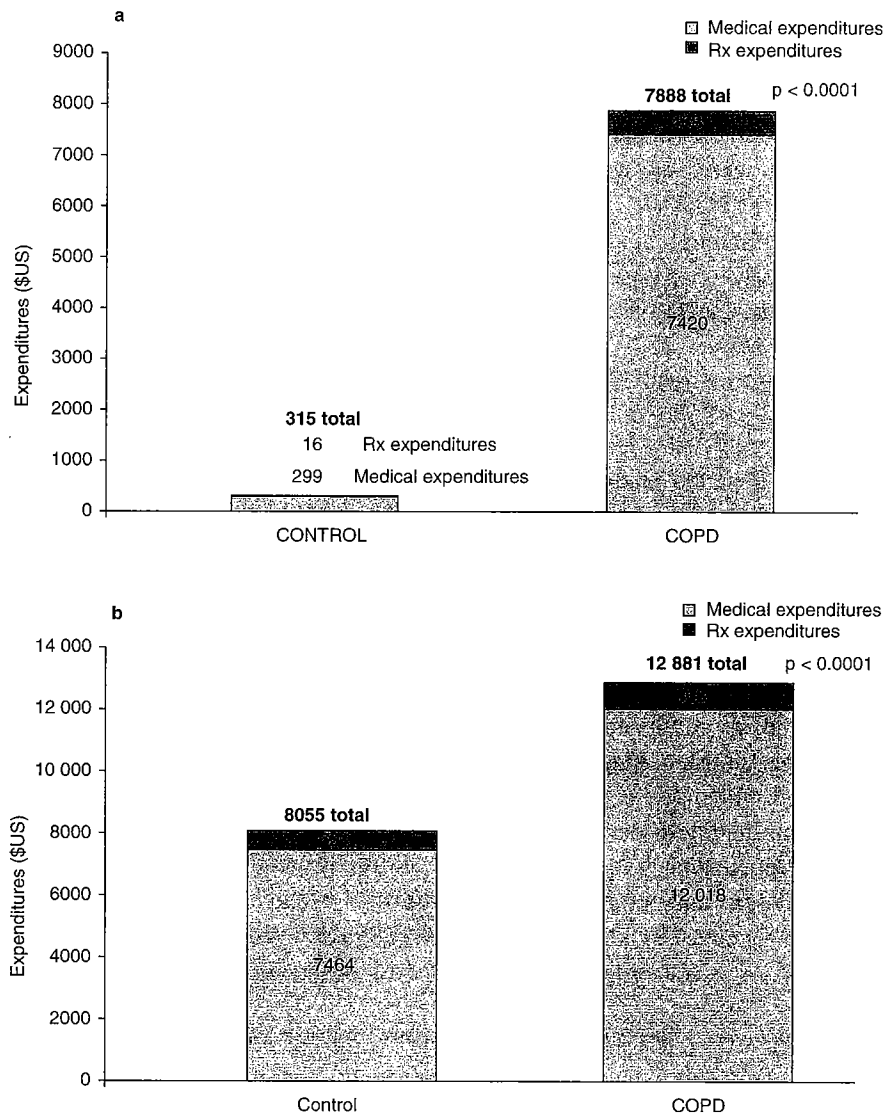


Fig. 1. (a) Respiratory and (b) nonrespiratory-related mean total healthcare expenditures in year 2000. **COPD** = chronic obstructive pulmonary disease; **Rx** = prescription.

comparable. However, our results provide evidence that patients with COPD in our managed care organization incurred substantial direct medical and pharmacy expenditures, as well as resource use, and that COPD causes a large financial and nonfinancial burden to society.

Secondly, we observed significant differences in respiratory and nonrespiratory-related healthcare expenditures according to age. COPD has traditionally been perceived as a disease of the elderly; however, COPD is a chronic condition that also affects individuals in their 30s and 40s. Data from the National Health Interview Survey revealed that approximately 70% of patients with COPD are <65 years of age.^[3] Additionally, COPD and allied conditions, including chronic lower respiratory disease, comprised

the fifth leading cause of death for individuals aged 45–64 years in 2000.^[18] Given the substantial burden of COPD on the younger working population, it is not surprising that our study findings showed that patients aged <65 years, particularly those aged 55–64 years, incurred higher respiratory-related healthcare expenditures as a result of greater resource utilization related to inpatient and outpatient care. Increased utilization and expenditures may be the result of the time and resources associated with the initial diagnosis and on-going management of COPD in the primary care setting. Other studies conducted in working age populations have demonstrated that COPD not only causes premature death, but also disables affected individuals, resulting in decreased quality of life, increased absenteeism from work, and increased healthcare expenditures.^[19-21] In order to reduce COPD-related morbidity and

Table III. Respiratory- and nonrespiratory-related healthcare expenditures for patients with Chronic obstructive pulmonary disease (COPD) and matched control patients

Expenditures (\$US)	COPD (n = 18 061)	Control (n = 18 061)
Inpatient		
respiratory	5230	217 ^a
nonrespiratory	5946	3631 ^a
ER		
respiratory	219	10 ^a
nonrespiratory	568	257 ^a
Outpatient		
respiratory	599	51 ^a
nonrespiratory	3741	2721 ^a
Outpatient pharmacy		
respiratory	468	16 ^{a,b}
nonrespiratory	863	621 ^a

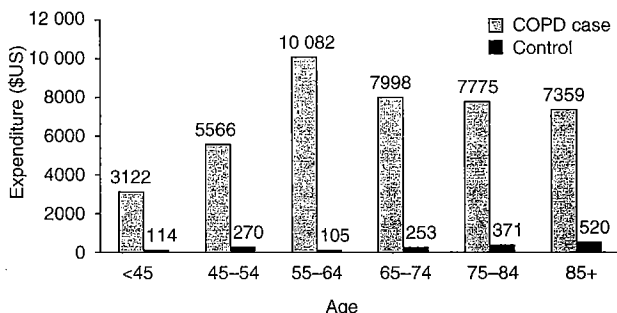
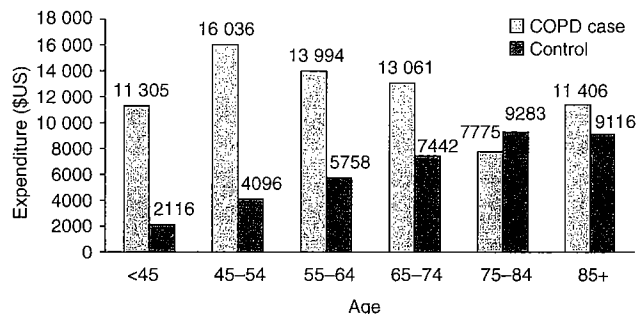
a p < 0.0001

b In calculating respiratory-related outpatient pharmacy expenditures, oral corticosteroids and antibiotics were included as additional medications.

ER = emergency room.

mortality, particularly among the working population, it is critical to increase awareness of COPD among primary care physicians so that the disease is detected early, preventative interventions (e.g. smoking cessation and exercise) are promoted, and treatment is initiated.

Finally, we evaluated the contribution of select comorbid conditions known to cause substantial morbidity and mortality. A large majority of patients with COPD had at least two of the comorbid conditions in addition to their respiratory disease. Thus, given the same admitting inpatient diagnoses, patients with COPD incurred much higher inpatient expenditures than their control counterparts. This finding is supported by the longer average length of hospital stay in patients with COPD and the higher

**Fig. 2.** Respiratory-related mean total expenditures by age categories. COPD = chronic obstructive pulmonary disease.**Fig. 3.** Nonrespiratory-related mean total healthcare expenditures by age categories. COPD = chronic obstructive pulmonary disease.

excess expenditures for COPD patients that were associated with congestive heart failure, atherosclerosis, stroke, and psychiatric illnesses (data not shown). Mapel et al.^[16] also found that most of the differences in utilization were not directly attributable to pulmonary services, but to tobacco use and smoking-related nonpulmonary diseases, especially cardiovascular diseases (by a medical records' review in a sample of cases and controls). These findings together suggest that patients with COPD experience a substantial burden because of the comorbidities associated with their respiratory disease.

There are several potential limitations to this study. First, resource utilization and healthcare spending may not reflect utilization and spending patterns in another organizational setting with different demographic and clinical patient characteristics. Second, our evaluation of the cost of COPD may be understated because charges for oxygen treatment and home medical equipment were not directly captured in the medical claims. Also, the additional cost of COPD incurred after admission to a skilled nursing facility was not included. Additionally, this study examined only patients who had survived through the follow-up period. Patients who had died may have experienced increases in utilization and expenditures in the time before their death. We were not able to examine the relationship between COPD disease severity and healthcare expenditures as diagnostic codes are not sensitive to severity levels. Finally, there are limitations with claims data that are inherent in any retrospective analysis. Precise definitions for COPD may vary and are frequently dependent on an accurate diagnosis of the condition by a physician. Other limitations include the accuracy of coding and a lack of sensitivity regarding morbidity or intensity of resource use. Thus, conclusions cannot be drawn about the appropriateness of services.

Despite these limitations, this study demonstrates that utilization of healthcare resources by patients with COPD is immense, particularly among those <65 years of age. Resource utilization and costs were not only directly related to COPD, but also to an

even greater extent resulted from comorbidities in patients with this condition.

Conclusions

In this study, we examined health resources used and expenditures incurred by patients with COPD to estimate the expenditures attributable to COPD compared with a matched control group. Among the key findings, patients with COPD had a higher prevalence of certain diseases including cancer, congestive heart failure, coronary heart disease, diabetes, and septicemia, relative to control patients. Healthcare utilization, in terms of hospitalizations, ER admissions, and outpatient encounters, were two to three times higher in patients with COPD than in control patients. In particular, patients with COPD who were aged between 55 and 64 years incurred higher respiratory-related healthcare expenditures resulting from greater resource utilization related to inpatient and outpatient care. Finally, we found that given the same inpatient diagnoses upon admission, patients with COPD incurred much higher inpatient expenditures than their control counterparts, with a longer average length of hospital stay and higher excess expenditures associated with congestive heart failure, atherosclerosis, stroke, and psychiatric illnesses.

These findings suggest that patients with COPD experience a substantial burden because of the comorbidities caused by and associated with their respiratory disease. COPD exerts a large financial and nonfinancial burden on patients as well as the health-care system. It is essential to educate primary care physicians about the impact of early diagnosis and treatment to improve lung function, clinical symptoms, and patient quality of life. As a result, interventions that decrease the likelihood of inpatient hospitalizations are likely to be cost effective from a managed care perspective.

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