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ORIGINAL RESEARCH

What is the Cost to Employers of Direct Medical Care for Chronic Obstructive Pulmonary Disease?

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ABSTRACT

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality in the United States. In 2000, an estimated 10.5 million people had COPD, of which more than 7.2 million were from the under-age 65 employed population. The prevalence of COPD in the workforce population was substantial with 46.5% of current employment among adults having the disease. However, the cost burden in the employed population is unknown. We examined COPD prevalence and costs in a large employment-based population. Using claims data from 1999 to 2003, we estimated the cost associated with COPD-related hospitalizations, emergency department visits, outpatient services, and prescription drug use. Per patient use of hospital care for COPD decreased during 1999 through 2003, including a decrease in the number of hospital admissions (from 0.10 in 1999 to 0.04 in 2003) and in the length of stay in hospitals (from 0.53 in 1999 to 0.17 in 2003). The number of outpatient visits, however, increased from 3.45 in 1999 to 3.80 in 2003. COPD-related per patient total medical costs decreased from \$1460 in 1999 to \$1138 in 2003 largely because of a decrease in the cost of hospitalizations for COPD. In contrast, mean per patient expenditures for outpatient services increased over the same period from \$243 in 1999 to \$295 in 2003. The cost of COPD to employers is high, but the cost could be reduced by programs aimed at preventing new cases of COPD, reducing hospitalizations, and providing more outpatient services to COPD patients.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality in the United States. It affects

approximately 10.5 million people, of which 7.2 million people are under the age of 65. In 2000, approximately 120,000 deaths were attributable to COPD, which is now the fourth leading cause of death in the United States (1). At the current rate of increase, COPD is poised to become the third leading cause of death by 2020 (2).

COPD is a progressive and irreversible disease of the respiratory system, with disabling symptoms that include chronic cough and dyspnea (3). The major risk factor in the development and progression of the disease is tobacco use (1); however, other factors such as respiratory infections, genetic predisposition, and exposure to indoor and outdoor air pollution can significantly contribute to an increased risk of developing or of worsening the severity of the disease (4, 5). Clinical diagnosis of COPD is often difficult, particularly in the early stages of the disease. Pulmonary function tests, such as spirometry, are required to

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correctly diagnose the disease and categorize its severity level; however, these tests are not routinely done, even in high-risk populations (1, 2, 6).

The economic burden of COPD is enormous around the world (7–12). In 1993, the estimated direct medical costs of COPD in the United States were \$14.7 billion (13), and the estimated indirect costs related to the disease were \$9.2 billion, for a total cost of more than \$23.9 billion. COPD had the highest direct medical costs among lung diseases in the United States. In 1993, direct medical costs for asthma were \$9.8 billion, \$5.1 billion for lung cancer, \$1.7 billion for pneumonia, \$1.4 billion for influenza, and \$0.7 billion for tuberculosis (14). In 2000, the estimated direct costs for COPD medical care increased to \$18 billion, with \$14.1 billion in lost productivity, bringing the estimated total cost of the disease to \$32.1 billion (16). As a result, the United States experienced an estimated \$8.2 billion increase in the total economic burden of COPD for the period 1993 through 2000.

For employers, in addition to the substantial direct costs associated with COPD care, there are also significant indirect costs such as missed days of work, disability payments, and productivity losses for those employees with advanced levels of the disease (3). COPD is a disabling respiratory disease and can have a much greater impact than other respiratory diseases such as asthma on worker disability, absence from work, perceived inability to work, and perceived limitations in the type or amount of work the person is able to do (17). Approximately, 46.5% of adults with COPD are actively employed (18), although employees with COPD may be absent from work three times than those without the disease, and the absences are longer compared with asthma and other respiratory diseases (19).

Increasing concerns over the costs of COPD worldwide has led to a growing interest in estimating the economic burden of the disease from a societal prospective (2,3,7,13,20). With the

rising health care costs of COPD, employers need to know the costs of this disease in their workforce. In contrast to the number of studies on the costs of asthma, limited information on COPD (2, 3, 20–23) costs has been available, and no studies have been done that specifically address the problem of COPD costs from the perspective of employers.

The purpose of this study is to determine the trends in prevalence, the use of health care services, and the medical costs associated with COPD in the employment-based insured population. We examined proportions of medical costs attributable to inpatient, outpatient, emergency departments (EDs), and prescription drugs over a 5-year period (1999 through 2003) in the employer risk pool. We then analyzed the prevalence and the cost of COPD to employers for different age groups, genders, types of health plans, and relationship to an employee.

MATERIALS AND METHODS

Our data were drawn from the Medstat Marketscan database. This database contains claims from approximately 200 large employers and includes health care utilization and expenditures for inpatient, outpatient, and prescriptions drug services. The database includes private sector health data from approximately 100 payers and represents the medical experience of insured employees and their dependents. The data was collected annually, with unique individual identifiers linking data from different years.

We used data from the years 1999 through 2003 with sample sizes ranging from approximately 1.9 million person years in 1999 to 3.66 million person years in 2003 (Table 1). Our target sample included individuals who were between the ages of 35 and 65 who had at least one hospitalization, emergency room visit, or outpatient visit during 1999 through 2003, and

Table 1. Population of COPD patients aged 36 through 64 in employer-insured risk pool (Medstat Marketscan 1999–2003; total number of patients 387,714)

	1999	2000	2001	2002	2003
Number of covered lives	1,881,778	1,906,512	1,982,756	2,784,379	3,664,091
Number of COPD patients (age 36–64)	62,665	58,761	62,414	88,723	115,151
Prevalence of COPD (age 36–64)	3.33	3.08	3.15	3.19	3.14
Prevalence by gender					
Male	3.06	2.84	2.88	3.00	2.95
Female	3.57	3.30	3.38	3.34	3.31
Prevalence by age groups					
35–44	2.25	2.02	2.02	1.88	1.90
45–54	3.06	2.81	2.87	2.78	2.76
55–64	5.07	4.80	4.85	4.87	4.81
Prevalence by plan types					
Fee-for-Service (FFS)	3.51	3.40	4.01	4.15	4.16
Health Maintenance Organizations (HMO)	3.62	3.46	2.94	1.71	2.06
Point of Service (POS)	3.19	2.80	2.90	3.22	2.80
Preferred Provider Organizations (PPO)	3.46	3.18	3.38	3.79	3.50
Point of Service with Capitation (POSC)	2.97	2.69	2.69	2.29	2.35
Prevalence by relation to main beneficiary					
Main Beneficiary	3.41	3.14	3.17	3.23	3.18
Spouse	3.18	2.98	3.11	3.11	3.06

who had a primary diagnosis of COPD (ICD-9 codes 490-492, -496).¹

We used MarketScan software to identify claims for or encounters with (for capitated plans) COPD for inpatient and outpatient services. We then analyzed the data using Stata (StataCorp. 2001. Stata Statistical Software: Release 7.0. College Station, TX: Stata Corporation). We included in our analysis all hospital admissions, inpatient services, emergency room visits and outpatient services that have a primary diagnosis of COPD classified by ICD-9 codes. The total number of covered lives was used as a denominator for calculating prevalence for each year of the study and for each demographic group. For inpatient hospitalization data, we included the number of hospitalizations, lengths of stays in hospitals, and total expenditures for hospitalization due to COPD. For outpatient non-emergency and emergency department visits, we calculated the number of visits, quantity of services during a visit, and total expenditures.

In the MarketScan prescription drug data, there are no indicators for diagnosis. To identify individuals with COPD, we identified all individuals with a primary diagnosis of COPD in outpatient and inpatient claims records using ICD-9 codes 490-492 and 496. We then linked all COPD patients thus identified with prescription drugs data using unique personal identifiers. In addition, we restricted our data to the medications (applying National Drug Codes) that are commonly used for asthma/COPD treatment such as:

- Fast-Acting Bronchodilators: Albuterol (all generic names for medications), Levalbuterol, Pirbuterol acetate and Terbutaline sulfate;
- Long-Acting Bronchodilators: Salmeterol xinafoate, Serevent;
- Theophylline Agents; Cholinergic Blockers (Ipratium bromide);
- Combination Agents: Albuterol/ Ipratium bromide and Fluticasone propionate/Salmeterol inhalation powder;
- Anti-inflammatory medications: Fluticasone propionate, Flunisolide, Budesonide, Methylprednisolone, Prediapred, Prednisolone and Prednisone.

We applied the Chi-Square test to analyze differences in COPD prevalence between different groups and *t*-tests to compare differences in health care utilization and costs. For statistically significant differences, we provided *p*-values.

Annual expenditures are what the insurer pays to health care providers for all health services provided to a patient caused by primary diagnosis of COPD, as defined by ICD-9 codes. We also adjusted for inflation, using the Medical part of Consumer Price Index data, with 1999 as the base year.

Our administrative database contained information on the individual's age, gender and whether the individual was the pri-

mary insured individual or had a dependent status. We also had information on the types of health care plans selected, including Health Maintenance Organizations (HMO), Points of Service with Capitation (POSC), Points of Service (POS), Preferred Provider Organizations (PPO), and Fee-For-Service (FFS). The first three types of plans (PCP plans) require enrollees to designate a primary care physician (PCP). HMO and POSC plans are capitated plans.

RESULTS

The analysis of the data demonstrated that the overall prevalence of COPD for the period of 1999 through 2003 ranged from 3.08% to 3.33% (Table 1). Although the number of COPD patients increased slightly over this period, the increase occurred concomitantly with an overall increase in the population of covered lives. Prevalence of COPD among women was higher than among men for each of the years from 1999 (3.57% for women and 3.06% for men; $p < 0.01$) through 2003 (3.31% for women and 2.95% for men; $p < 0.01$) (Table 1).

Although COPD affected every age group, the prevalence was considerably higher in older populations. In 2003, there were 481 COPD patients per 10,000 covered lives among individuals between 55 and 64 years of age and 190 per 10,000 covered lives among individuals who were between 35 and 44 years of age ($p < 0.01$).

The prevalence of COPD also varied depending upon the type of health care plans in which the patients were enrolled (Table 1). In 2003, the lowest COPD prevalence was among capitated plans: 2.06 % for HMOs (All the differences in prevalence rates between the health plans were statistically significant at the 1% level.) and 2.35% for POSC; the highest prevalence was among enrollees in PPO (3.50%) and FFS health plans (4.16%) ($p < 0.01$). POS plans had COPD prevalence between 2.80% and 3.22% ($p < 0.01$). A spouse was more likely to be diagnosed with COPD than was the main beneficiary (Table 1). In 2003, the prevalence of COPD for spouses was 3.06% and 3.18% for main beneficiaries ($p < 0.01$).

In our analysis, every inpatient admission, service provided during each admission, emergency room service and outpatient service has a primary diagnosis of COPD, as defined by ICD-9 codes. The average number of annual hospital admissions per COPD patient declined from 0.10 times per year in 1999 to 0.04 times per year in 2003 ($p < 0.05$). Similarly, the average length of hospital stays declined from 0.53 days in 1999 to 0.17 days in 2003 ($p < 0.01$) (Table 2), indicating an overall reduction in the use of hospital resources for COPD care. In contrast, the average number of annual outpatient non-emergency visits per COPD patient increased from 3.45 times a year in 1999 to 3.8 times a year in 2003 ($p < 0.01$). From 2000 the number of prescriptions filled for COPD medications declined ($p < 0.01$), as did the number of ED visits for COPD care ($p < 0.05$).

Overall, total medical expenditure for COPD care declined from \$1460 per COPD patient in 1999 to \$1138 (\$960 in 1999 U.S. dollars) per patient in 2003 (Table 3) ($p < 0.05$). Over 93% of the decline is due to the decrease in hospital expenditures for COPD care from \$713 per patient in 1999 to \$320 (\$270 in 1999

¹The ICD-9 code 490 includes bronchitis not specified as acute or chronic, which some researchers argue is not COPD. Approximately 16% of our sample has code 490. The conclusions of the paper are robust to exclusion of these individuals. Similarly, the proportion of patients with ICD-9 codes 491.0, 491.1, and 492.0 is under 2% and also does not affect the paper's conclusions.

Table 2. Mean annual inpatient, outpatient, and emergency department use by persons aged 36 through 64 years with COPD. (Medstat Marketscan 1999–2003; Total number of patients 387,714)¹

Average annual per patient medical utilizations by service type	1999	2000	2001	2002	2003
Hospital admissions	0.10	0.08	0.07	0.06	0.04
Days in hospital for all COPD patients	0.53	0.44	0.33	0.29	0.17
Days in hospital among hospitalized COPD patients	7.78	7.05	6.54	6.07	4.85
Non-emergency outpatient visits	3.45	3.46	3.47	3.72	3.80
COPD prescriptions filled	3.7	4.1	3.75	3.59	3.3
Emergency department visits	0.16	0.21	0.19	0.14	0.13

¹Every inpatient, emergency room or nonemergency room service is due to a primary diagnosis of COPD.

U.S. dollars) per patient in 2003 ($p < 0.05$), while about 7% is due to decreased medication usage. In contrast, outpatient visit costs, increased for the same period, from \$243 per patient in 1999 to \$295 (\$249 in 1999 US dollars) per patient in 2003 (all changes are significant at 5% except the increase from 1999 to 2000). Admission or outpatient costs also include the costs due to diagnostic assessment of COPD if the diagnostic evaluation was performed during that encounter. The level of diagnostic assessment can vary from patients to patients; for example it may or may not include a spirometry test. Similarly, costs for ED visits due to COPD increased from \$256 per patient in 1999 to \$304 (\$256 in 1999 US dollars) per patient in 2003.

Although, the proportion of total medical costs associated with hospital services declined for all ages from 1999 through 2003, the size of the decline varied by age group. The proportion of total medical costs declined by 80% for COPD patients aged 35 through 44, by 77% for those aged 45 through 54, and by 46% for those aged 55 through 64 (Table 4). The use of health care and the costs associated with COPD were also different for main beneficiaries of employer-based health insurance and their spouses. Spouses had more COPD-related hospital admissions (0.09 vs. 0.06) ($p < 0.01$) and outpatient visits (3.85 vs. 3.47) ($p < 0.01$) compared with main beneficiaries (Table 4). As a result, spouses had higher hospitalization costs (\$697 vs. \$495) ($p < 0.01$) and outpatient service costs (\$288 vs. \$237) ($p < 0.01$) than did main beneficiaries.

DISCUSSION

COPD is a prevalent and expensive chronic condition in the employment-based insured population, although the estimated prevalence rates are lower than in the overall U.S. population. For example, in 2000, for our employment-based insured population, we found an overall prevalence rate of COPD of 3.08% compared with the national prevalence rate of 6.0% reported in the literature (1). Even though the prevalence rate was lower, COPD affected a large part of the employed population and their families. We found variability in estimated prevalence depending on gender, age groups, types of health care plans, and between main beneficiaries and their spouses. Higher prevalence of COPD among women likely reflects higher smoking rates among women in the United States since the 1940s (1). As patients becomes older, the chances of being diagnosed with COPD increases. The result of this tendency is that the highest prevalence rates are among the working population aged 55 through 64 years, an age span that is one of the most productive stages of life.

Prevalence of COPD in capitated types of health plans, such as HMOs or POSCs, was lower than in non-capitated plans. The disease was also less prevalent in PCP plans than in plans not requiring PCPs. These findings may suggest that COPD patients tend to enroll more in less restricted managed plans such as PPO or FFS plans.

Table 3. Mean annual cost of COPD by service type for patients 36 through 64 years of age. (Medstat Marketscan 1999–2003; total number of patients 387,714)¹

Average annual per patient expenditures ²	1999	2000	2001	2002	2003
Hospital admissions	\$713	\$636	\$522	\$487	\$320
(In 1999 U.S. dollars)	(\$713)	(\$611)	(\$480)	(\$427)	(\$270)
Outpatient visits per capita	\$243	\$251	\$265	\$284	\$295
(In 1999 U.S. dollars)	(\$243)	(\$241)	(\$243)	(\$249)	(\$249)
Emergency department visits per capita	\$256	\$294	\$303	\$302	\$304
(In 1999 U.S. dollars)	(\$256)	(\$283)	(\$278)	(\$265)	(\$256)
Prescription drug expenditures per capita	\$248	\$248	\$249	\$265	\$219
(In 1999 U.S. dollars)	(\$248)	(\$238)	(\$229)	(\$233)	(\$185)
Totals	\$1460	\$1429	\$1339	\$1338	\$1138
(In 1999 U.S. dollars)	(\$1460)	(\$1373)	(\$1230)	(\$1174)	(\$960)

¹Annual average costs to a patient for all his/her hospital admissions, outpatient visits, emergency room visits due to a primary diagnosis of COPD.

²This is what insurer pays for all services provided to a patient during each year from 1999 through 2003.

Table 4. Proportion of hospitalization costs with respect to the total medical costs¹ among different age groups for COPD patients 36 through 64 years of age (Medstat Marketscan 1999–2003; total number of patients 387,714)²

Age groups	1999	2000	2001	2002	2003
35–44	27%	15%	19%	16%	15%
45–54	53%	52%	46%	38%	30%
55–64	64%	61%	54%	52%	44%

¹Total annual medical costs include hospitalizations, outpatient services, emergency department use and prescription medicine refills.

²Annual average costs due to a primary diagnosis of COPD.

Hospitalization expenditures are the largest portion of the total medical costs of COPD care. These costs decreased, however, from 1999 through 2003 and by 2003 had approached the level of outpatient costs. This leveling of costs is a result of both the decrease in hospital admissions and the decline in the average length of hospital stays per patient. In addition, the use of outpatient services (all the medical services associated with a primary diagnosis of COPD) increased, as did the average per patient costs for outpatient visits associated with COPD care. These results are consistent with the overall trend within the healthcare system during the last decade toward the reduced use of hospital service (1).

The overall decline in use of hospital services for COPD care affected the proportion of hospitalization costs with respect to the total medical costs. Increasing rates of non-emergency outpatient visits, however, indicated that patients voluntarily avoided hospitalizations or were denied hospitalizations by health plans' gatekeepers who may have been seeking opportunities to control patients' symptoms and avoid expensive hospitalizations. Another explanation could be that the decline is an indication of a shift in the treatment of patients with less severe COPD from inpatient to outpatient services.

Spouses had higher prevalence of COPD than did primary beneficiaries and had higher use of both inpatient and outpatient services. As a result, they had higher direct medical costs. A main beneficiary is typically a full-time employee and for that reason may have less time to spend on medical care compared with a spouse.

Unlike asthma, COPD disproportionately affects older persons. In addition to the increase in prevalence associated with age, there is also the increase in the proportion of the total

medical expenditure attributable to hospitalizations. For example, in 2003, the proportion of hospitalization costs for the group aged 55 through 64 years was 50% higher than that for the group aged 45 through 54 years, which in turn was 100% higher than for the group aged 35 through 44 years (Table 4). The increase in the proportion of hospitalization costs as patients become older indicated that the condition of these older patients may have become more severe and required more frequent and more intensive care. Risk factors such as smoking or exposure to environmental pollutants may contribute to the worsening of COPD or to the development of symptoms leading to the diagnosis of COPD by the age of 45 years.

There are several limitations to our study. First, we defined COPD patients as those who were diagnosed in the hospital, ED, or outpatient clinic with one of the respiratory conditions classified as COPD on the basis of ICD-9-CM codes: 490-492 and -496. This case definition of COPD may miss some patients with COPD because the person with COPD may not have sought care from physicians. Similarly, we may have included some individuals who received care for illnesses other than COPD, but who received a primary diagnosis from their provider of COPD. However, our data accurately reflect the proportion of the population who sought medical care and had employer-based health insurance coverage. Also, our analysis is limited to patients covered by privately insured employment-based health plans and, therefore, cannot be generalized to the non-employed population.

Employers currently face one of the most severe health care financing crises in the history of employer-sponsored health insurance. Although the highest reported prevalence and the most severe disease occurs in the population of people

Table 5. Health care use and cost¹ comparisons of main beneficiaries and spouse for COPD patients aged 36 through 64 years. (Medstat Marketscan 1999–2003; total number of patients 387,714)²

Health care utilization and costs	Main beneficiary	Spouse
Number of hospitalizations	0.06	0.09
Number of days in hospital	0.33	0.46
Number of outpatient non-emergency visits	3.47	3.85
Hospitalization costs	\$495.00	\$697.00
Outpatient costs	\$237.00	\$288.00

¹This is what insurer pays for all services provided to a COPD patient from 1999 through 2003.

²These are utilizations and costs due to a primary diagnosis of COPD average over period 1999–2003.

Figure 1. Mean annual costs of COPD by service type for patients 36 through 64 years of age. (Medstat Marketscan 1999–2003; total number of patients 387,714). Annual average costs to a patient for all his/her hospital admissions, outpatient visits, emergency room visits due to a primary diagnosis of COPD.

aged 65 years and older, the prevalence of COPD among employed individuals and their dependents younger than 65 is significant, and the associated costs to employers are also substantial (18).

Improving the long-term management of the disease could potentially reduce the cost of COPD to employers. One of the recommendations in *Healthy People 2010* is to increase the proportion of primary care providers who are trained to provide the appropriate lung function tests to recognize the early signs of COPD before the disease become serious and disabling. The recommendation also states that any decline in the prevalence of COPD is unlikely without substantial changes in risk factors, mainly reductions in cigarette smoking.

Using the ambulatory setting of primary care physicians trained to prevent exacerbations and to reduce the risk of COPD-related hospitalizations would be a less expensive option than hospitalization. Programs of smoking cessation can help prevent new cases of COPD and reduce the severity of the condition for those who have the disease. These programs will eventually lead to cost savings for employers. More extensive use of objective pulmonary tests will help diagnose COPD earlier and may prevent many patients from having severe cases of the disease.

COPD affects individuals in the later stages of their lives when patients may also have several other chronic comorbidities such as cardiovascular diseases, cancer, and diabetes. Future research should examine the costs attributable to each of these comorbidities as well as to different combinations of these diseases from the employers' and from society's perspective. Also, future research should examine the effect of COPD severity on COPD costs so that interventions can be more effectively targeted.

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