HHS Public Access

Author manuscript

COPD. Author manuscript; available in PMC 2018 February 01.

Published in final edited form as:

COPD. 2017 February ; 14(1): 72–79. doi:10.1080/15412555.2016.1199669.

Trends in outcomes, financial burden, and mortality for acute exacerbation of chronic obstructive pulmonary disease (COPD) in the United States from 2002–2010

Chetna Jinjuvadia, MD[*], **Raxitkumar Jinjuvadia, MD**[$], **Chaitanya Mandapakala, MD**[*], **Navin Durairajan, MD**[#], **Suthat Liangpunsakul, MD, MPH**[^], and **Ayman O. Soubani, MD**[*]

[#]Department of internal medicine, Detroit Medical Center/Wayne State University, Detroit, MI

[*]Division of Pulmonology and Critical Care Medicine, Department of Medicine, Wayne State University, Detroit, MI

[$]Division of Gastroenterology and Hepatology, Department of Medicine, Henry Ford Health System, Detroit, MI

[^]Division of Gastroenterology and Hepatology, Department of Medicine, and Roudebush Veterans Administration Medical Center, Indianapolis, IN

Abstract

Chronic obstructive pulmonary disease (COPD) is the cause of substantial economic and social burden. We evaluated the temporal trends of hospitalizations from acute exacerbation of COPD and determine its outcome and financial impact using the National Inpatient Sample (NIS) databases (2002 to 2010). Individuals with age ≥ 18 years were included. Subjects who were hospitalized with primary diagnosis of COPD exacerbation and those who were admitted for other causes; but had underlying acute exacerbation of COPD (secondary diagnosis) were captured by ICD-9 codes. The hospital outcomes and length of stay were determined. Multivariate logistic regression was used to identify independent predictors of inpatient mortality. Overall acute exacerbation of COPD related hospitalizations accounted for nearly 3.31% of all hospitalizations in year 2002. This did not change significantly to year 2010 (3.43%, p=0.608). However, there was an increase in hospitalization with secondary diagnosis of COPD. Elderly white patients accounted for most of the hospitalizations. Medicare was the primary payer source for most of the hospitalizations (73%–75%). There was a significant decrease in inpatient mortality from 4.8% in 2002 to 3.9% in 2010 (slope −0.096, p<.001). Similarly, there was significant decrease in average length of stay from 6.4 days in 2002 to 6.0 days in 2010 (slope −0.042, p<.001). Despite this the hospitalization cost was increased substantially from $22,187 in 2002 to $38,455 in 2010. However, financial burden has increased over the years.

Corresponding Author. Ayman O. Soubani, MD, Harper University Hospital 3 Hudson, 3990 John R Detroit, MI 48201, Phone: 313-966-0695, asoubani@med.wayne.edu.

Declaration of Interest statement

None of the authors have any conflicts with the contents and the results of this paper.

Author contribution:

Conception, design and interpretation of data (RJ and SL)
Drafted manuscript (ND, CM, SL)
Reviewed and revised manuscript for important intellectual content; the manuscript (CJ, SL, and AS)

Keywords

NIS data; COPD; Hospitalization costs; Mortality

INTRODUCTION

Chronic obstructive lung disease (COPD) is one of the most common reasons for hospital admission in the United States. It is the third most common cause of death in the USA. It is estimated that the healthcare-related cost for COPD was approximately US$50 billion in 2010(1). These costs can be expected to continue to rise with this progressive disease. Costs increase with increasing severity of disease, and hospital stays account for the majority of these costs(1).

Several efforts have been made to reduce the number of hospitalizations related to COPD, as evident by the development of therapies over the past 2 decades(2–4). Several quality improvements such as the development of guidelines to ensure the proper care for patients with COPD(5) have been implemented with the goal to control the symptoms and thus reducing hospitalization.

In order to determine if the inpatient admission for COPD was decreasing overtime, we analyzed the Nationwide Inpatient Sample (NIS). We hypothesized that with the advancements in the new treatments for COPD and the treatment guidelines, the inpatient admission as well as mortality secondary to COPD should reduce overtime. The trends in outcome, hospitalization costs, financial burden, and mortality for COPD in the United States from 2002–2010 were analyzed.

METHODS

Data source

The NIS database is part of the Healthcare Cost and Utilization Project (HCUP), sponsored by the Agency for Healthcare Research and Quality (AHRQ)(6). The Nationwide Inpatient Sample (NIS) is the largest all-payer inpatient care database in the United States, containing data on more than seven million hospital stays annually from approximately 1,000 hospitals, constituting a 20% stratified sample of all U.S. hospitals. All data were weighted using discharge level values, based on the relative proportion of the total U.S. hospital patient population accounted for by that record, to produce 100% national estimates. In this study, we included all COPD hospitalizations between 2002 and 2010 for patients ≥18 years of age. The data for missing age were excluded from the study sample. Acute exacerbation of COPD was based on the following International Classification of Diseases-Ninth Revision, Clinical Modification (ICD-9-CM) discharge diagnosis code: 491.21. If this code was listed in the first position, the admission was considered to be a primary COPD hospitalization; otherwise, the admission was considered to be a secondary COPD. Other related ICD-9-CM codes were shown in Supplementary Table 1. Patient age, race (white, black, Hispanic, others), gender, household income, geographic region of treatment (Northeast, South, Midwest, and West) were abstracted. The types of hospitals were categorized into teaching/

community and urban/rural location. The primary payer for the hospitalization was categorized as Medicare, Medicaid, private insurance, self-pay, or other. Outcome-related measures were presented separately for both primary and secondary diagnoses of COPD which included in-hospital mortality, length of stay, average total hospitalization cost and discharge disposition. Discharge disposition was categorized as routine, short term hospital, skilled nursing facility, and home health care.

Statistical analysis

All statistical analyses were performed using the sampling weights and stratified sample design of the NIS to obtain nationally representative estimates. Descriptive statistics were presented as mean ± SD for continuous variables and frequencies for categorical variables. Annual rates of primary and secondary COPD hospitalizations were calculated by dividing the number of hospitalizations with COPD by the total adult inpatient admissions in the US in a given year. We also age-adjusted this inpatient admission rate using direct standardization method for comparison over the years with year 2002 adult US census population as reference. The hospitalization rate per 10,000 US population were calculated using the number of COPD hospitalization per given year divided by estimated US population for that year obtained from the US census bureau. Changes in trends of hospitalization rates, inpatient mortality, length of stay and total hospitalization cost over the years were assessed using simple linear regression analysis. Additional increase in cost of hospitalizations for each year was calculated in reference to year 2002 after adjusting for medical care inflation rates. The annual rate of medical care inflation was obtained from website of Bureau of Labor Statistics. Inpatient mortality difference were compared separately for overall, primary and secondary diagnosis of COPD between age group less than 40 and more using chi square test. Multivariate logistic regression analysis using forward method was performed to identify independent predictors of inpatient mortality from year 2010 data. Statistical analyses were performed using SAS 9.3 (Cary, NC).

Results

National estimates of COPD-related hospitalization rates in the US from 2002–2010

Overall, the rate for COPD hospitalizations in the United States has not changed significantly from 2002 to 2010 (3.31% to 3.43%, slope 0.020, p=0.608). Similarly, the rates of primary diagnosis of COPD also did not change significantly over past few years (1.68% to 1.59%, slope -0.01, p=0.665).

Although the rate of hospitalization for secondary diagnosis increased from 1.63% to 1.84%, there was no significant increase in hospitalization rate per 10,000 US populations (table 1)

Demographics and clinical characteristics of hospitalized COPD patients in the US

The mean age of patients hospitalized with a diagnosis of COPD over this period ranged from 69.9 to 70.5 years. Hospitalizations for individuals age < 40 years accounted <1% of the sample size. The majority of hospitalized patients were female and white, and the proportion of each was stable over the studied period (53% and 81%–85.6%). The majority

of cases had the household income in the first (33.3%–36.6%) or second quartiles (27.4%–31.0%) (Table 2).

Sources of admission and types of facilities for hospitalized COPD patients

Hospitalized COPD patients were admitted primarily through local emergency department (72.0%–77.2%). There were no significant changes in the source of admission over the study period. Majority of cases were hospitalized into the hospitals which were located in the urban area (74.8%–78.5%) (Table 3).

From 2002–2005, majority of cases were admitted into non-teaching hospitals (71.8%–74.4%); however, these decreased to 66.8%–69.1% from 2006–2010. There were significant geographic variations in hospitalized cases. We found that 42.5%–45% of hospitalized cases were in the Southern states; which was significantly higher than that admitted to other regions ($p < 0.05$) (Table 3).

Healthcare costs and outcomes related to hospitalizations from COPD in the US

Inpatient mortality (overall, primary, secondary, age group comparison, predictors of mortality)—During the study period, the overall in-hospital mortality of COPD related hospitalizations significantly decreased from 4.8% to 3.9% (slope −0.096, $p < 0.001$). Similarly, a significant decrease in mortality was seen with COPD as primary diagnosis and as secondary diagnosis (Table 4). Age- group analysis done in 2002 and 2010 showed higher mortality in patients who were > 40 years old ($p < 0.001$) (Table 5).

Multivariate analysis showed that age and male gender were independent predictors of inpatient mortality.. Caucasians had higher risk of mortality than African American or Hispanic patients. Interestingly patients admitted to teaching hospitals had higher mortality than those admitted to non-teaching hospitals ($p = 0.004$). When the patients had other associated conditions such as septicemia, lung cancer, pancreatic cancer, esophageal cancer, or pulmonary fibrosis, the risk of mortality was 2.48 to 3.94 times higher ($p < 0.001$). Especially when patients also had ventilator dependent respiratory failure their risk of mortality increased by 8.28 times ($p < 0.001$) (Table 6).

Length of stay—There has been a significant decrease in length of hospital stay for overall COPD related hospitalizations from 6.4 days to 6.0 days (slope −0.042, p value < 0.001) from the year 2002 to 2010. The length of stay was apparently longer with COPD as secondary diagnosis compared to admissions with COPD as primary diagnosis. Hospital stay decreased significantly from 5.1 days to 4.4 days (slope −0.078, $p < 0.001$) for admissions with COPD as primary diagnosis and from 7.7 days to 7.3 days (slope −0.035, $p = 0.029$) for COPD as secondary diagnosis (Table 4). On in-depth analysis of data in years 2002 and 2010, we found that the hospital stay was significantly longer in patients of age >40 years, either for COPD as overall diagnosis, or as primary diagnosis or secondary diagnosis ($p < 0.001$). (Table 5).

Financial burden—Over the study period there has been a significant increase in healthcare costs from COPD related hospitalizations from $22,187 to $38,455 (slope 2102, p

< 0.001). This trend was seen for hospitalizations with COPD as a primary diagnosis ($15,218 to $24,291, slope 1206, p < 0.001) and as a secondary diagnosis ($29,378 to $50,659, slope 2727, p<0.001). After adjusting for medical care inflation, the average additional cost of hospitalization for overall COPD hospitalizations was $9323 in year 2010 in comparison to year 2002. Similarly, additional cost of hospitalization for primary and secondary diagnosis of COPD was $4,310 and $12,086 in year 2010 compared to year 2002 (figure 2). Medicare was the most common payer for hospitalizations during this period (72.6%–75.8%) (Table 4). The financial burden is significantly higher for patients of age group >40 years compared to patients aged <40 years (p < 0.001) (Table 5).

For year 2010, the non-teaching hospitals appeared to have significantly less average cost of overall COPD hospitalizations compared to teaching hospitals (mean cost; non-teaching: $36,360 vs teaching: $42,806, p <0.001). Similar findings of less financial burden were noted for primary and secondary diagnosis of COPD in non-teaching hospitals in year 2010. The rural hospitals had significantly less total charges for overall COPD hospitalizations compared to urban hospitals (mean cost; rural: $ 22,099 vs urban: $42,954, p <0.001). Similar differences in hospitalization costs for overall, primary and secondary diagnosis of COPD were noted for non-teaching vs teaching and rural vs urban for year 2002 as well.

DISCUSSION

In this nationally representative sample of hospitalizations in the United States from 2002 to 2010, we found that there were no significant changes in the inpatient admission rate for overall and primary diagnosis of COPD over the past decade. Although the hospitalization related to secondary diagnosis increased over the years, there was no significant change in hospitalization per 10,000 US populations. This may likely be related to expected increase in total population over the years. The inpatient mortality for COPD has significantly decreased. However, financial charges among hospitalized COPD subjects remained high, despite shortening of the total length of hospital stay.

Past studies have shown that elderly patients, patients admitted into intensive care units, and those with acute respiratory failure carried the high rate of mortality among cases admitted into hospital because of COPD exacerbation (7). We observed a significant decrease in in-hospital mortality, notably for cases with primary diagnosis of COPD. Our results might be secondary to effective COPD management plans that result in improvement in disease assessment and monitoring; reduction in risk factors; better management of stable COPD; and more effective management of hospitalized patients with acute exacerbations.

The association between COPD exacerbations and hospitalization is well documented (1, 8). Studies have shown that direct health care costs, accounting for nearly two-thirds of total COPD dollars, are those related to physician office visits, hospitalizations, home care, and medications (1). During the study period, we found that financial charges among hospitalized COPD subjects remained high, despite decrease in the total length of stay. This remains true even after adjusting for healthcare inflation which may point towards increased availability and utilization of diagnostic and treatment modalities leading to rising in healthcare cost in the United States over the past decade (9).

It is known that there is a direct relationship between the severity of COPD and the overall cost of care at the patient level (1, 10). As it has been shown previously, patients with stage I COPD (according to GOLD definition) experienced the lowest direct cost of $1681 per patient per year, stage II patients $5037 per patient per year, and those in stage III $10,812 per patient per year (10). Hospitalization was identified as the most important cost variable across all three stages of COPD. Unfortunately, the NIS data did not allow us to categorize COPD subjects stratified by the severity at the time of admission.

Of importance, we found that the total hospital charges for subjects with secondary COPD diagnosis were higher than those for primary diagnosis. One explanation is likely due to the longer hospital stays in these patients (by the average of 3 extra days in the hospital) compared to those with primary COPD diagnosis. However, these cases might also have other co-morbidities such as congestive heart failure or renal failure which also led to the increase in the overall hospitalization cost (11).

We also observed a shift in patient disposition from routinely discharge to home in the first half of the study period to skilled nursing facility and home healthcare in the latter half. This might reflect the changes in the pattern of healthcare and follow up of discharged patients in the United States. It is also plausible that subjects who were hospitalized in the later part of the study period were more sick, thus requiring more closed follow up care or pulmonary rehabilitation after discharge.

The major limitation of our study is the use of ICD-9 coding to identify cases with COPD. It is plausible that there might be cases with potential misclassification. Further, the NIS data do not allow us to explore whether multiple admissions occurred for particular individuals due to the lack of unique subject identifiers. This limited our ability to identify if patient was admitted with first episode of exacerbation or recurrent exacerbations. Nonetheless, our results have several implications. First, this study showed the substantial increase in hospital charges among hospitalized COPD patients despite significant decrease in the length of hospital stay. Strategies to prevent admission and/or re-admission among these patients are very crucial to prevent the in-hospital healthcare related costs. For instance, the employment of telehealth strategies that promote rehabilitation and early detection of an acute exacerbation has been shown to reduce hospital admission rates in patients with severe and very severe COPD (12).

In conclusion, COPD still accounts for >400,000 admissions in the United States. Despite the stable trends in the overall COPD hospitalization rates from acute exacerbation, there has been increasing healthcare costs and financial burdens on healthcare system. Future strategies to reduce hospitalizations and or readmission of COPD patients are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding:

This work was supported by VA Merit Award 1I01CX000361, NIH U01AA021840, US DOD W81XWH-12-1-0497 (to S.L)

Abbreviation list

AHRQ	Agency for Healthcare Research and Quality
COPD	Chronic obstructive pulmonary disease
HCUP	Healthcare Cost and Utilization Project
ICD-9	International Statistical Classification
NIS	National Inpatient Sample

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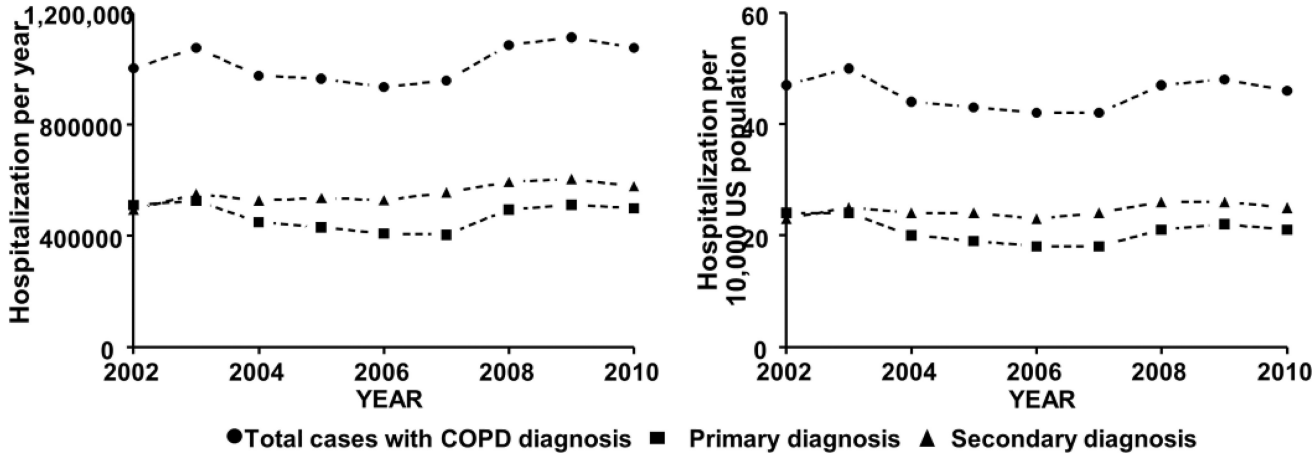

FIGURE 1.

COPD related hospitalizations over the years. (A) Number of hospitalizations per year (B) Hospitalization rate per 10,000 US population

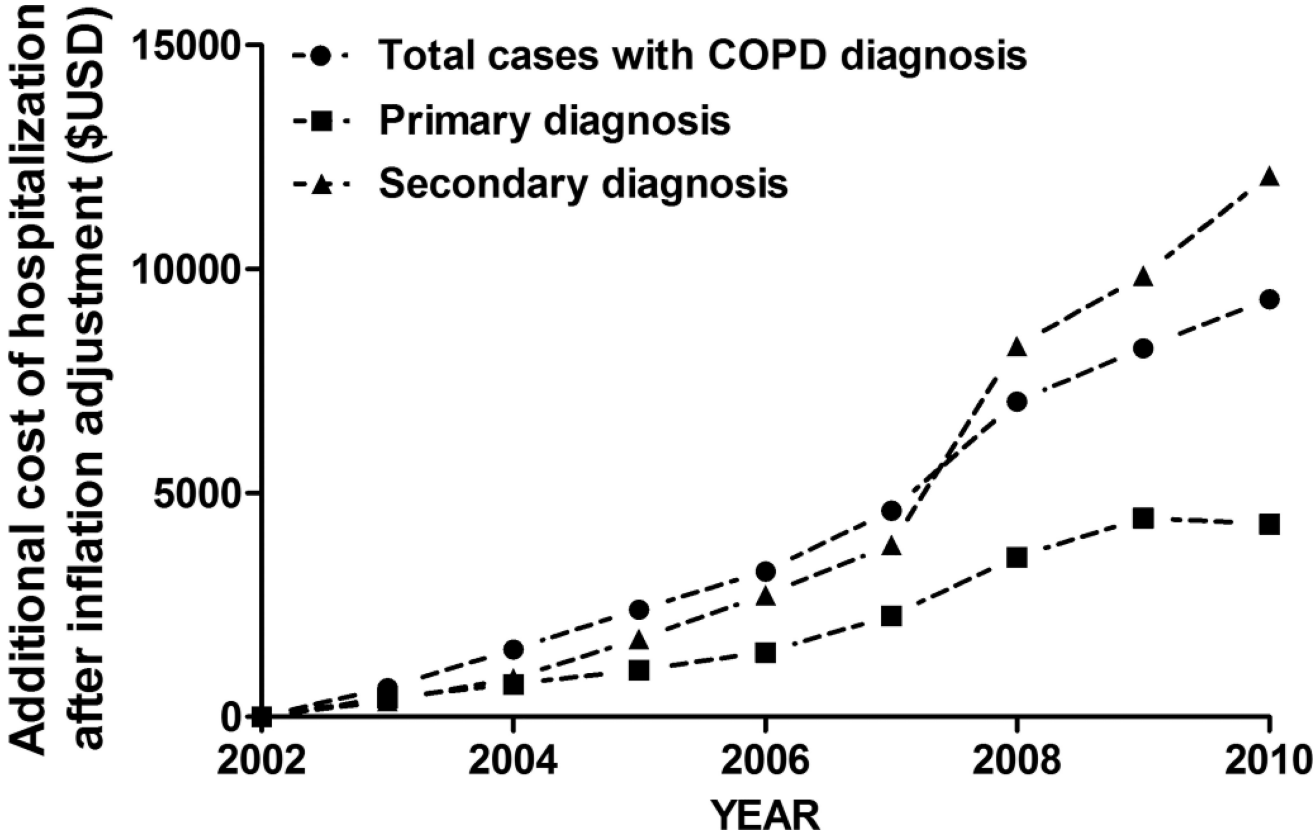

FIGURE 2.
Additional cost of hospitalization over the years with year 2002 as reference (charges adjusted for medical care inflation)

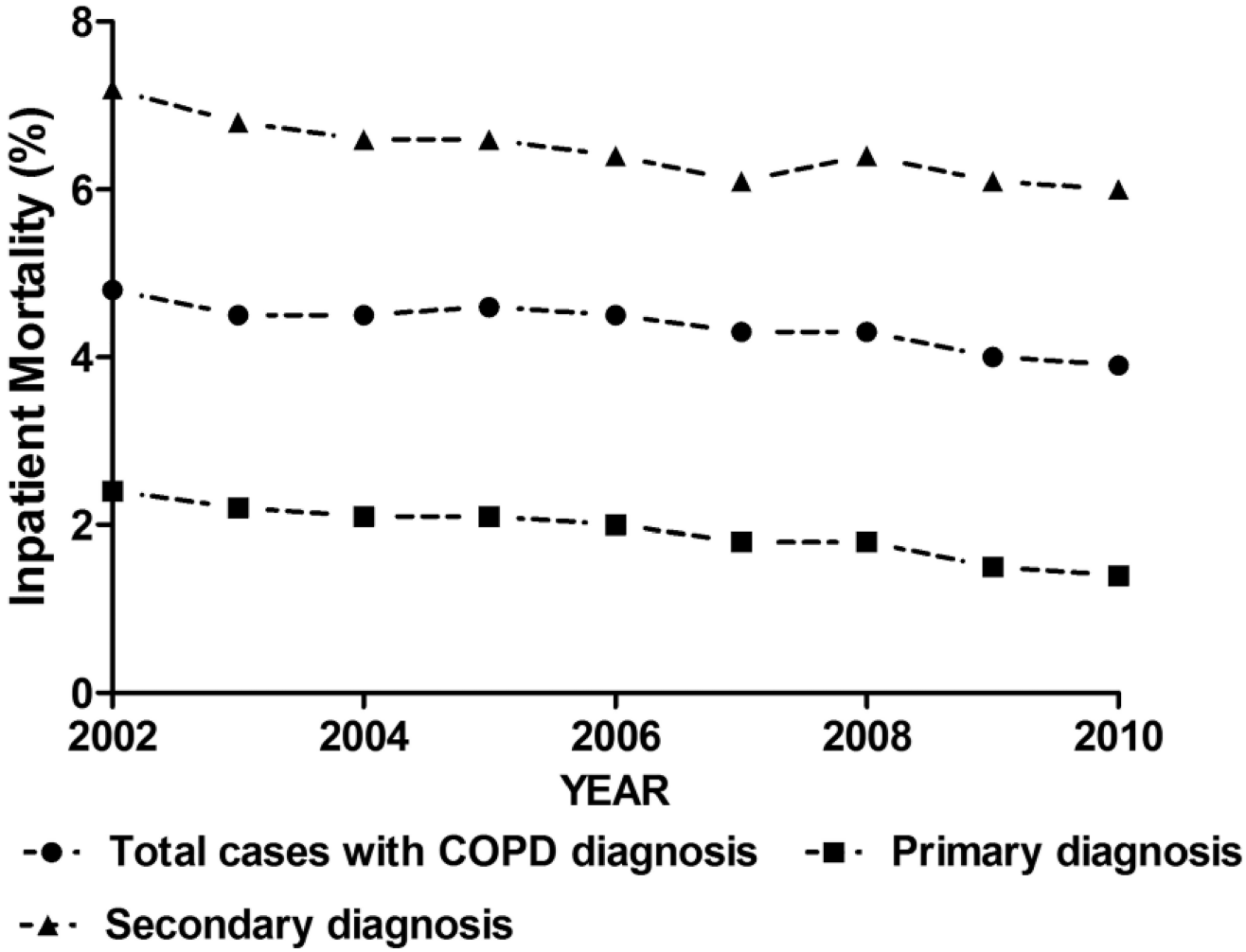

FIGURE 3.
Trends in inpatient mortality

Table 1

National Estimates of acute COPD exacerbation-related hospitalizations, Year 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010	Slope	p Value
Overall COPD-related											
Total hospitalization	1,002,902	1,075,400	974,818	964,497	934,499	957,666	1,086,123	1,113,566	1,075,575	10,349	0.257
% of overall adult hospitalization	3.31	3.51	3.15	3.11	2.95	3.04	3.39	3.52	3.43	0.020	0.608
Age-adjusted % of overall adult hospitalization *	2.13	2.24	2.00	1.95	1.86	1.94	2.10	2.22	2.15	0.003	0.854
Hospitalization rate per 10,000 population	47	50	44	43	42	42	47	48	46	−0.083	0.836
Primary diagnosis											
Total hospitalization	509,751	525,538	448,508	429,337	407,244	403,206	493,424	510,324	498,442	−453	0.947
% of overall adult hospitalization	1.68	1.71	1.45	1.39	1.29	1.28	1.54	1.61	1.59	−0.01	0.665
Age-adjusted % of overall adult hospitalization *	1.13	1.14	0.96	0.91	0.85	0.85	0.99	1.06	1.04	−0.01	0.516
Hospitalization rate per 10,000 population	24	24	20	19	18	18	21	22	21	−0.28	0.370
Secondary diagnosis											
Total hospitalization	493,151	549,862	526,310	535,160	527,255	554,460	592,699	603,242	577,133	10802	0.005
% of overall adult hospitalization	1.63	1.79	1.70	1.73	1.67	1.76	1.85	1.91	1.84	0.026	0.017
Age-adjusted % of overall adult hospitalization *	1.00	1.09	1.04	1.04	1.01	1.09	1.11	1.16	1.12	0.015	0.021
Hospitalization rate per 10,000 population	23	25	24	24	23	24	26	26	25	0.250	0.084
Overall adult hospitalization for all causes in US											
All adult hospitalization in the USA	30,268,725	30,676,256	30,966,846	30,978,228	31,628,376	31,551,163	32,060,332	31,647,642	31,318,051		

* age-adjusted rates were calculated using direct standardization with year 2002 as reference population

Table 2

Baseline Characteristics of Hospitalizations from COPD, Year 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Age in years (mean ± SD)	70.3 ± 0.2	70.3 ± 0.2	70.4 ± 0.1	70.6 ± 0.1	70.3 ± 0.2	70.2 ± 0.2	70.5 ± 0.2	69.7 ± 0.2	69.9 ± 0.2
Race (%)									
White	83.2	81.4	83.4	85.6	82.4	82.1	83.4	81.7	81
Black	9.1	8.5	8.7	6.9	9.0	9.9	8.3	9.0	11
Hispanic	4.9	6.6	4.6	4.8	5.3	4.6	4.1	4.9	5
Others	2.8	3.5	3.3	2.7	3.2	3.4	4.2	4.4	3
Gender (female, %)	53	53	53	53	53	53	53	53	53
Household income (%) *									
First quartile	36.6	33.9	34.8	33.4	34.2	35.9	33.3	34.5	35.4
Second quartile	27.4	28.5	29.2	28.2	27.7	28.1	31.0	29.5	27.9
Third quartile	28.0	22.7	20.3	22.3	22.2	21.3	20.7	21.6	21.8
Fourth quartile	8.0	14.9	15.7	15.9	15.9	14.7	15.0	14.2	14.9

* 2003–2010: Median household income (1) $1 – $38,999; (2) $39,000 – $47,999; (3) $48,000 – 62,999; and (4) $63,000 or more 2002: Median household income (1) $1–$24,999, (2) $25,000–$34,999, (3) $35,000–$44,999, (4) $45,000 or more

Table 3

Admission source, type and region of admitting hospitals of hospitalized COPD patients in the US from 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010
Admission source (%)									
Emergency department	74.0	73.3	72.9	72.0	73.2	74.6	76.5	72.5	77.2
Another hospital	2.0	2.0	2.1	2.5	2.6	2.5	2.2	3.6	4.1
Other facility including long-term care	1.6	1.5	1.7	1.6	1.6	1.6	1.7	2.8	3.1
Others	22.4	23.2	23.3	23.9	22.6	21.2	19.6	21.0	15.6
Weekend admission (%)	23.5	23.6	23.5	23.4	23.5	23.7	24.0	23.8	24.2
Hospital location (%)									
Rural	25.2	27.0	24.7	23.7	23.7	22.1	21.5	21.7	21.7
Urban	74.8	78.0	75.3	76.3	76.3	77.9	78.5	78.3	78.3
Teaching status of the hospital (%)									
Nonteaching	71.8	72.6	73.2	74.4	66.8	68.3	68.2	69.1	68.1
Teaching	28.1	27.4	26.7	25.6	33.1	31.7	31.8	30.9	31.9
Hospital bed size (%)									
Small	14.5	14.8	15.9	16.2	17.8	16.5	17.1	16.3	16.6
Medium	28.2	28.8	27.1	27.0	26.9	26.9	24.5	24.4	25.4
Large	57.3	56.4	57.0	56.8	55.3	56.6	58.4	59.3	58.0
Region of admitting hospital (%)									
Northeast	19.1	18.8	17.7	18.2	18.3	18.1	17.0	17.9	17.9
Midwest	22.9	22.7	24.1	23.8	24.1	25.4	26.1	23.4	25.3
South	43.9	44.8	45.0	44.5	43.7	43.1	42.7	44.3	42.5
West	14.1	13.7	13.2	13.5	13.9	13.4	14.2	14.4	14.3

Table 4

Length of hospital stay, clinical outcomes, payer, and hospital charges of hospitalized COPD patients in the US from 2002–2010

	2002	2003	2004	2005	2006	2007	2008	2009	2010	slope	p value
Length of stay (days, mean ± SD)											
COPD-related	6.4 ± 0.1	6.3 ± 0.1	6.3 ± 0.1	6.3 ± 0.1	6.2 ± 0.1	6.2 ± 0.1	6.2 ± 0.1	6.1 ± 0.1	6.0 ± 0.1	−0.042	<0.001
Primary diagnosis	5.1 ± 0.1	5.0 ± 0.1	4.9 ± 0.1	4.9 ± 0.1	4.8 ± 0.1	4.6 ± 0.1	4.7 ± 0.1	4.6 ± 0.1	4.4 ± 0.1	−0.078	<0.001
Secondary diagnosis	7.7 ± 0.1	7.5 ± 0.1	7.5 ± 0.1	7.5 ± 0.1	7.3 ± 0.1	7.3 ± 0.1	7.5 ± 0.1	7.4± 0.2	7.3 ± 0.1	−0.035	.029
Patient Disposition (%)											
Routine discharge to home	61.4	61.3	56.1	55.8	55.2	54.3	53.7	54.3	52.3		
Short-term hospital	2.4	2.3	2.4	2.5	2.4	2.5	2.5	2.6	2.4		
Skilled nursing facility	18.4	18.2	20.0	20.3	20.3	21.1	20.9	20.7	21.3		
Home healthcare	12.2	12.7	15.8	15.7	16.4	16.5	17.2	17.0	18.7		
Against medical advice	0.8	0.8	0.9	0.9	1.1	1.1	1.1	1.2	1.3		
Other (alive but destination unknown, died etc.)	4.8	4.7	4.6	4.7	4.6	4.3	4.4	4.1	4.0		
In-hospital mortality (%)											
COPD-related	4.8	4.5	4.5	4.6	4.5	4.3	4.3	4.0	3.9	−0.096	<0.001
Primary diagnosis	2.4	2.2	2.1	2.1	2.0	1.8	1.8	1.5	1.4	−0.117	<0.001
Secondary diagnosis	7.2	6.8	6.6	6.6	6.4	6.1	6.4	6.1	6.0	−0.130	<0.001
Primary expected payer (%)											
Medicare	74.3	75.0	75.0	75.8	75.3	74.0	73.4	72.6	73.0		
Medicaid	8.2	8.4	8.3	8.2	8.5	8.3	8.2	9.3	9.8		
Private insurance (including HMO)	13.5	12.6	12.3	11.9	11.7	12.9	13.6	12.9	12.4		
Self-pay	1.9	1.9	2.2	2.2	2.3	2.5	2.4	2.8	2.6		
Others	2.1	2.1	2.2	1.9	2.2	2.2	2.4	2.4	2.2		
Total charges ($, mean ± SD)											
COPD-related	22,187 ± 82.4	23,715 ± 83.3	25,551 ± 89.6	27,376 ± 93.7	29,122± 96.4	31,458 ± 105	34,704± 107	36,603 ± 117	38,455 ± 117	2102	<0.001

	2002	2003	2004	2005	2006	2007	2008	2009	2010	slope	p value
Primary diagnosis	15,218± 72.1	16,247± 76.9	17,219 ± 83.1	18,180 ± 89.1	19,181 ± 87.7	20,665 ± 105.3	22,540 ± 93.1	23,907± 106.7	24291 ± 98.8	1206	<0.001
Secondary diagnosis	29,378 ± 146	30,909± 142	32,703 ± 147	34,821 ± 149	36,982 ± 153	39,389 ± 162	44,907± 176	47,422 ± 191	50,659 ±194	2727	<0.001

Table 5

Differences in mortality, length of stay and total charges between age groups <40 years and 40 years or more for year 2002 and 2010

	Year 2002			Year 2010		
	Age <40 years[+]	**Age ≥ 40 years**	**p value**	**Age <40 years[@]**	**Age ≥ 40 years**	**p value**
Mortality - % (SE)						
Overall	0.9 (0.2)	4.8 (0.1)	<0.001	0.8 (0.2)	3.9 (0.1)	<0.001
Primary diagnosis	0.4 (0.1)	2.5 (0.1)	<0.001	0.2 (0.1)	1.4 (0.1)	<0.001
Secondary diagnosis	1.5 (0.4)	7.3 (0.1)	<0.001	1.4 (0.4)	6.0 (0.1)	<0.001
Length of stay - days (SE)						
Overall	4.6 (0.1)	6.4 (0.1)	<0.001	4.6 (0.2)	6.0 (0.1)	<0.001
Primary diagnosis	3.7 (0.1)	5.1 (0.1)	<0.001	3.1 (0.1)	4.5 (0.1)	<0.001
Secondary diagnosis	5.7 (0.2)	7.7 (0.1)	<0.001	5.9 (0.3)	7.3 (0.1)	<0.001
Total charges - $ (SE)						
Overall	15,237 (511.2)	22,261 (83)	<0.001	30,022(1428)	38,506 (118)	<0.001
Primary diagnosis	10,712 (401)	15,273 (73)	<0.001	17,804 (890)	24,332 (99)	<0.001
Secondary diagnosis	21,326 (1040)	29,453 (147)	<0.001	40,999 (2520)	50,716 (195)	<0.001

SE – standard error

[+] accounted for 1.06% of overall COPD hospitalizations

[@] accounted for 0.60% of overall COPD hospitalizations

Table 6

Predictors of inpatient mortality among patient with acute COPD exacerbation-related hospitalization for year 2010

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	***p* value**	**OR (95% CI)**	***p* value**
Age	1.04 (1.03–1.05)	<0.001	1.05 (1.04–1.06)	<0.001
Gender				
Female	1.0 (ref)			
Male	1.24 (1.18–1.29)	<0.001	1.14 (1.09–1.20)	<0.001
Race				
Caucasian	1.0 (ref)			
African American	0.75 (0.69–0.81)	<0.001	0.77 (0.70–0.85)	<0.001
Hispanic	0.96 (0.86–1.07)	0.503	0.85 (0.76–0.96)	0.010
Asian or pacific islander	1.78 (1.53–2.09)	<0.001	1.07 (0.90–1.28)	0.435
Native American	0.78 (0.60–1.07)	0.131	0.92 (0.66–1.28)	0.617
Other	1.19 (1.02–1.40)	0.027	1.14 (0.96–1.35)	0.142
Length of stay	1.05 (1.04–1.06)	<0.001	1.009 (1.007–1.012)	<0.001
Hospital bed size				
Small	1.0 (ref)			
Medium	1.00 (0.94–1.07)	0.948	0.91 (0.84–0.98)	0.011
Large	1.06 (1.01–1.13)	0.042	0.94 (0.88–1.00)	0.054
Hospital location				
Rural	1.0 (ref)			
Urban	1.25 (1.19–1.33)	<0.001	0.96 (0.89–1.02)	0.174
Hospital teaching status				
Nonteaching	1.0 (ref)			
Teaching	1.13 (1.08–1.18)	<0.001	1.08 (1.03–1.14)	0.004
Other clinical diagnosis *				
Septicemia	7.35 (7.00–7.72)	<0.001	3.94 (3.71–4.19)	<0.001
Ventilator dependent respiratory failure	10.53 (10.04–11.04)	<0.001	8.28 (7.80–8.79)	<0.001
Lung cancer	3.27 (3.05–3.50)	<0.001	3.72 (3.43–4.04)	<0.001
Pancreatic cancer	2.32 (1.31–4.09)	0.004	2.48 (1.32–4.66)	0.005
Esophageal cancer	3.32 (2.21–5.01)	<0.001	3.28 (2.03–5.31)	<0.001
Pulmonary fibrosis	2.41 (161–3.61)	<0.001	2.75 (1.73–4.36)	<0.001
Atrial fibrillation/flutter	2.06 (1.97–2.15)	<0.001	1.36 (1.29–1.44)	<0.001
Congestive heart failure	1.65 (1.58–1.72)	<0.001	1.24 (1.18–1.31)	<0.001
Coronary artery disease	1.20 (1.15–1.25)	<0.001	0.96 (0.92–1.02)	0.169
Gastric/duodenal ulcers	1.79 (1.48–2.16)	<0.001	1.09 (0.87–1.36)	0.442
Liver cirrhosis	1.33 (1.15–1.54)	<0.001	1.57 (1.32–1.86)	<0.001

	Univariate analysis		Multivariate analysis	
	OR (95% CI)	*p* value	OR (95% CI)	*p* value
Diabetes with neuropathy	0.71 (0.60–0.84)	<0.001	0.76 (0.62–0.92)	0.005
Anxiety	0.69 (0.64–0.75)	<0.001	0.95 (0.87–1.05)	0.321

*compared to individuals without this diagnosis

CI – confidence interval; OR – odds ratio