

## Trends in Chronic Obstructive Pulmonary Disease Hospitalization Rates in Texas 2001-2009

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**Abstract:** Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disease associated with substantial morbidity and mortality. COPD exacerbations (worsening of symptoms) can lead to hospital admissions. One of the treatment goals in managing COPD is to reduce the exacerbation rates, since these rates affect the patient's quality of life, drive up treatment related costs, and if untreated could lead to decreased survival rate. A study of trends in COPD exacerbations is important for several reasons. First, by examining trends, we may determine whether recent treatment methods and disease relevant policies are effective. Second, by identifying disparities in exacerbation rates, health care professionals may be able to direct more efforts toward populations with the highest rates. Third, an analysis of trends will inform researchers on the progress of COPD research.

In this study we explored the change in race specific rates of COPD exacerbations according to county metropolitan status among the Texas population from 2001 to 2009

**Keywords:** *Chronic Obstructive Pulmonary Disease (COPD), time trend, disparity*

## 1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disease associated with substantial morbidity and mortality. COPD exacerbations (worsening of symptoms) can lead to hospital admissions. One of the treatment goals in managing COPD is to reduce the exacerbation rates, since these rates affect the patient's quality of life, drive up treatment related costs, and if untreated could lead to decreased survival rate (Wedzicha and Seemunga, 2007; Partridge *et al.*, 2009). COPD patients have increased healthcare utilization relative to their non-COPD counterparts, in 2008 the estimated aggregate national inpatient costs for COPD was \$6.1 billion (Mapel 2000, Wier 2011). Between 1988 and 1999 the Center for Disease Control MMWR reported that nationally there was an increasing trend in the overall rate of COPD hospitalizations (Mannino *et al.*, 2002). The highest hospitalization rates were among non-Hispanic (NH) White males.

A study of trends in COPD exacerbations is important for several reasons. First, by examining trends, we may determine whether recent treatment methods and disease relevant policies are effective. Second, by identifying disparities in exacerbation rates, health care professionals may be able to direct more efforts toward populations with the highest rates. Third, an analysis of trends will inform researchers on the progress of COPD research. Moreover, examination of hospitalization rates may offer a method for evaluating the effectiveness of various interventions. By analyzing the rates at the state and county level, locally tailored healthy policy may be implemented that could maximize health benefits and minimizing health inequality.

This study attempts to contribute to the knowledge base by exploring the change in race specific rates of COPD exacerbations according to county metropolitan status among the Texas population between the years 2001 to 2009

## 2. METHODS

### 2.1 Data Source

The data were obtained from the Texas Health Care Information Council (THCIC) discharge datasets between 2001 and 2009 (Texas Hospital Inpatient Discharge Public Use Data File. Texas Department of State Health Services, Center for Health Statistics, Austin, Texas, 2010). These were publicly available data files, which included patient demographics including age group, gender, race and ethnicity, as well as geographic data, diagnoses and procedures and payment methods. Population estimates were obtained from the Texas state demographer's website (<http://txsdc.utsa.edu/tpepp/txpopest/php> accessed 15 December, 2009) for all years 2001-2009. The estimates reported were stratified by gender, race and age across all counties in Texas and were projected based off of the 2000 census data to take into account annual deaths and growth changes. The THCIC data was combined with the demographer's data to create the analysis dataset. Urban Influence codes were used to categorize all of the 254 counties in Texas as either Metropolitan or Non-Metropolitan.

### 2.2 Variable Definitions

For the analysis, the age of subjects was restricted to individuals over the age of 18. Race/Ethnicity was categorized and restricted to: Non Hispanic (NH) White, NH Black, and Hispanic. Hospitalizations due to COPD were determined by the Agency for Healthcare Research and Quality's prevention indicator technical specifications ([http://www.qualityindicators.ahrq.gov/Modules/PQI\\_TechSpec.aspx](http://www.qualityindicators.ahrq.gov/Modules/PQI_TechSpec.aspx), Accessed 15 December, 2009) which used the admitting diagnosis ICD-9 codes 491.xx (chronic bronchitis), 492.xx (Emphysema), and 496.xx (chronic airway obstruction not elsewhere classified) and their respective subcategories. Admitting diagnosis was chosen to estimate severe COPD exacerbations which require

hospitalization; the use of ICD-9 codes for COPD classification has been verified in other studies (Kabir *et al.*, 2010; Arbex *et al.*, 2009; Mapel *et al.*, 2000)

### 2.3 Outcome Definition

Category specific hospitalization rates were calculated as the frequency of exacerbations in a category divided by the projected population at risk for that category, per 100,000 populations. The rates across gender and race of patients were calculated according to metropolitan status.

### 2.4 Statistical Analysis

Poisson regression was used to explore the change in rates of COPD hospitalization over time, as well as across categories. Based on our previous work, we checked for the interaction between metropolitan status and time, and found it to be significant. Therefore we performed stratified analyses for both rural and urban exacerbations (Jackson *et al.*, 2011). The analysis was performed using SAS version 9.2 software (SAS Institute Inc. Cary, NC, USA). All results were considered statistically significant if the p-value was less than 0.05.

## 3. RESULTS

In 2001 and 2009, females had higher hospitalization rates than males across all race categories and in both metropolitan and non-metropolitan counties (Table 1). The rates of non-metropolitan residents were higher than metropolitan residents for all gender and race combinations. Over the nine years analyzed, all county type, race, and gender combinations experienced a decrease in the percentage change from 2001. The hospitalization rates with the lowest percent change over time period analyzed were for NH males in Non-metropolitan and Metropolitan counties (8.91% and 9.29%). Metropolitan Hispanic males and females had the largest percent decrease (44.78% and 46.51%) while in Non metropolitan counties, NH Black females and males had the largest percent decrease (27.11% and 32.26%).

In the multivariable adjusted poisson regression models (Table 2), gender, race, and age category were all significant. There was significant interaction between year and metropolitan status ( $p < 0.0001$ , data not shown) therefore models 2 and 3 were run for Non-metropolitan and Metropolitan counties respectively. These stratified regressions showed that only in metropolitan counties was there a significant difference between genders. For both models the estimate for time showed a significant decrease for the effect of time (Non Metropolitan Rate Ratio=0.97,  $p < 0.0001$ ; Metropolitan Rate Ratio=0.96,  $p < 0.0001$ ). NH Whites had the highest hospitalization rate, intermediate for NH blacks, and lowest for Hispanics.

## 4. DISCUSSION

COPD hospitalization rates in both metropolitan and non-metropolitan Texas counties declined over the period 2001 to 2009, in contrast to an increase nationally from 1988 to 1999. Moreover, females had higher hospitalization rates compared to males. A number of factors may have contributed to these trends including decline in prevalence associated with decline in smoking and other risk factors, improved access to health care, and changes in medical practice patterns and medical management. Analysis of the COPD hospital discharge rates using data from the Dartmouth Atlas project revealed that the annual Texas average discharges for COPD per 1,000 Medicare enrollees was predominantly higher than the national average between 1996 and 2005 (<http://www.dartmouthatlas.org/data/table.aspx?ind=62>, Accessed 12, June, 2010). The discharge rates are much higher than the rates observed from the THCIC data; this may indicate that the decreasing trend in COPD hospitalizations could result from an increase in outpatient utilization. However, it should be noted that the Dartmouth project's results are based off of Medicare patients,

this older population has a much higher prevalence of COPD than younger age groups. The lower hospitalization rates observed from the NH black and Hispanic populations could be due to a lower prevalence of COPD or under utilization of inpatient services (Laditka, 2006). The anticipation of health care costs may prevent certain populations from seeking health services in the event of an exacerbation. However the decline in hospitalizations was observed across all racial and ethnic groups. Similarly, the gender differences observed may be attributable to different patterns of health care utilization.

The rate differences between metropolitan and non-metropolitan counties was previously observed in a cross sectional analysis of the THCIC data (Jackson *et al.* 2011), however this research shows that rates differ across time. The degree of rurality has been found to be associated with increased mortality of COPD (Abrams *et al.*, 2011) as well as increased hospitalization rate for all ambulatory care sensitive conditions (Laditka, 2009). This trend analysis provides a dynamic view of how COPD hospitalizations have changed over recent years in Texas. The overall decline in hospitalization rates in Texas is similar to the trend observed in Massachusetts (Kabir *et al.*, 2010). Moreover, the national annual estimated rate of office visits with COPD as the first listed diagnosis shows a decrease around the year 2000, for both males and females as well as for NH blacks according to the MMWR for COPD (Mannino *et al.*, 2002).

There are a few limitations of this study. First, this analysis uses publicly available administrative data files which contained limited information, and variables on smoking, spirometry, and medications were not provided. There have been numerous clinical trials on the efficacy of various medications, and the role of smoking in COPD has been well documented. Patient's use of these medications could have contributed to the decline in hospitalizations. In addition to this, there were no unique patient identifiers, and repeated visits could have introduced bias to the results. Second, the analysis included patients who were under the age of 40 who may have been misdiagnosed with COPD; however, this subgroup made up a small proportion of the sample size each year and their inclusion in the analysis likely had limited effect on the findings. Third, this study has potential for ecologic fallacy. The unit of analysis was at the county level, where varying geographic factors such as prevalence of smoking, air pollution, access to care, and occupational exposures are different across locations. Therefore the frequency of exposure and proximity to sources of pollution could have affected the exacerbation rates, as well as variations in patterns of medical treatment. Due to these limitations, further studies are needed to explain any spatiotemporal changes in the variations of COPD hospitalization rates between racial and ethnic groups.

Exacerbations of COPD can be prevented and treated. The results of this analysis show that there is an overall decreasing trend across the nine year period of COPD hospitalization rates in Texas. The findings show that NH blacks have a lower hospitalization admission rate than NH whites, and that the rates differ according to metropolitan county status. Race-wise differences suggest lower prevalence of COPD, less access to hospital services, or decreased susceptibility to COPD exacerbations. By addressing these disparities, progress can be made to decrease healthcare utilization among COPD patients and to improve their quality of life.

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**TABLES**

Table 1 COPD hospitalization rates stratified by metropolitan status, gender and race.

			2001	2009	% change
Non Metropolitan	NH White	Female	389.72	342.66	12.07%
		Male	329.96	300.56	8.91%
	NH Black	Female	255.69	186.37	27.11%
		Male	200.83	136.04	32.26%
	Hispanic	Female	137.42	100.16	27.11%
		Male	121.92	90.41	25.85%
Metropolitan	NH White	Female	326.25	289.68	11.21%
		Male	239.15	216.92	9.29%
	NH Black	Female	185.86	156.85	15.61%
		Male	173.87	137.61	20.85%
	Hispanic	Female	90.13	48.21	46.51%
		Male	86.54	47.78	44.78%
All Texas			221.94	173.48	21.83%

Rates reported per 100,000 observations; NH- Non Hispanic  
 Data came from the Texas Healthcare Information Council 2001-2009.

Table 2 Rate Ratios for the different Poisson regression models

Variables		Model 1		Model 2: Non Metro		Model 3: Metro	
		RR	p-value	RR	p-value	RR	p-value
Gender	Female vs Male	1.07	<0.0001	0.99	0.5907	1.08	<0.0001
Race	NHB vs NHW	0.88	<0.0001	0.86	<0.0001	0.87	<0.0001
	H vs NHW	0.45	<0.0001	0.57	<0.0001	0.43	<0.0001
	NHO vs NHW	1.20	<0.0001	5.31	<0.0001	1.03	0.2885
Age category	45-64 vs 18-44	18.38	<0.0001	17.08	<0.0001	18.39	<0.0001
	65+ vs 18-44	95.97	<0.0001	65.04	<0.0001	102.82	<0.0001
Metropolitan Status	Non Metro vs. Metro	1.00	0.6037				
Year		0.96	<0.0001	0.97	<0.0001	0.96	<0.0001

NHB-Non Hispanic Black, NHW-Non Hispanic White, NHO-Non Hispanic Other, H-Hispanic, RR- Rate Ratio

Model 1 adjusts for Gender, Race, Age Category, Metropolitan Status, and Year

Models 2 and 3 adjust for Gender, Race, Age Category, and Year