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Trends in asthma health care utilization at University Medical Center (UMC) of Southern Nevada in Las Vegas, 2000-2007

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TRENDS IN ASTHMA HEALTH CARE UTILIZATION AT UNIVERSITY
MEDICAL CENTER (UMC) OF SOUTHERN NEVADA
IN LAS VEGAS, 2000-2007

by

Aishia Tennille Henderson

Bachelor of Science
University of Nevada, Las Vegas
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A thesis submitted in partial fulfillment of
the requirements for the

Master of Public Health
Department of Environmental and Occupational Health
School of Community Health Sciences
Division of Health Sciences

Graduate College
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ABSTRACT

**Trends in Asthma Health Care Utilization at University
Medical Center (UMC) OF Southern Nevada
in Las Vegas, 2000-2007**

by

Aishia Tennille Henderson

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Assistant Professor of Epidemiology & Biostatistics
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Lifetime asthma prevalence is the physician diagnosis of asthma while current asthma prevalence is the existing asthma symptoms. In Nevada, the pediatric current and lifetime asthma prevalence rates were 7.1% and 11.8% in 2006. Similarly, the adult current and lifetime asthma prevalence rates were 6.9% and 13.4% in 2007.

Characterization studies examining trends of asthma health care utilization for children and adults are not well studied for Las Vegas, Nevada. This project determined if trends in asthma admissions at UMC hospital of Southern Nevada in Las Vegas have increased longitudinally across years and characterizes which demographic subgroups are disproportionately affected by asthma inpatient hospital admissions and emergency room utilization.

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CHAPTER 1

INTRODUCTION

Asthma is a reversible chronic lung disease distinguished by inflammation of the lungs. Asthma is characterized by airflow obstruction, bronchial hyperresponsiveness, underlying inflammation and recurring episodes of breathlessness, wheezing, coughing, and chest pain (NAEPP, 2007).

These episodes are also known as asthma exacerbations or asthma attacks. Asthma severity is reliant upon the strength of the interaction between these physiological characteristics and their subsequent clinical manifestation.

Prevalence rates for asthma are highest among male children, adult females and those of minority race as well as those living in inner city locations (MMWR, 2004).

While considerable scientific advancements have occurred in asthma research, the national prevalence of asthma morbidity remains high in the United States.

In Nevada, the current and lifetime asthma prevalence rates for children were 7.1% and 11.8% in 2006. Similarly,

the adult current and lifetime asthma prevalence rates were 6.9% and 13.4% in 2007.

The goal of this project was to evaluate trends in asthma inpatient hospitalizations and emergency room visits that occurred during 2000-2007 at University Medical Center (UMC) hospital of Southern Nevada in Las Vegas.

This evaluation will identify which subgroups (age, race, gender and insurance type) are disproportionately affected by asthma inpatient hospitalizations and asthma ambulatory care visits and determine if differences in trends by subgroup exist.

The investigators will develop a baseline study that will examine UMC clinical hospital data taken from the year 2006. Using a quantitative cross-sectional research approach, UMC clinical asthma data, identified by ICD-9 code, will be analyzed for longitudinal trends across years and subgroup differences.

Characterization studies that describe and examine trends of asthma hospitalizations and emergency room visits for children and adults have not been conducted in Las Vegas, Nevada.

Findings from this study will answer the following research questions; 1) Out of all cause UMC inpatient

hospitalizations, what proportion were associated with asthma inpatient hospitalizations and are there longitudinal trends? 2) Out of all cause UMC emergency hospital visits, what proportion were associated with emergency asthma hospital visits and are there longitudinal trends? 3) Are there differences in the emergency department healthcare utilization by subgroups across years?

The results from this project will provide longitudinal trends describing the proportion of children and adult asthma healthcare utilization at UMC hospital of southern Nevada.

CHAPTER 2

LITERATURE REVIEW

Asthma is a chronic inflammatory lung disease caused by continual airway inflammation and a major cause of morbidity in the United States (MMWR, 2003).

More than 22 million Americans have asthma. It is one of the most common chronic childhood diseases affecting an estimated 6 million children (NAEPP, 2007).

Asthma is classified into two categories, atopic asthma or nonatopic asthma. These asthma subtypes are delineated by a positive allergy skin test or presence of antibodies in the blood (Kelley et al. 2005).

Atopic asthma is triggered in response to exposure to environmental irritants such as mold, pollen, cockroach particles, and house dust mites (NAEPP, 2007). Nonatopic asthma is triggered in response to exposure to environmental pollutants such as smoke, exercise, fumes, and smog (NAEPP, 2007).

Inflammation has a central role in asthma. It involves an interaction of many cell types and multiple mediators with the airways that eventually results in the characteristic bronchial inflammation and airflow limitation (NAEPP, 2007).

Airway inflammation is mediated by multiple pathophysiologic changes inside the airway - bronchoconstriction, airway hyperresponsiveness or airway edema (NAEPP, 2007).

Immunoglobulin E (IgE) is the antibody that combats allergens introduced to the body and is, in part, responsible for the airway edema upon exposure.

In atopic asthma, IgE attaches to cell surfaces via specific high-affinity receptors upon interaction with the antigen and releases a wide variety of mediators and pre-inflammatory cytokines to initiate acute bronchospasm and inflammation (Boyce, 2003; Sporik et al. 1995).

Asthma symptoms are commonly identified by repeated episodes of breathlessness, wheezing, chest pain, and coughing. Although the pathophysiology of asthma is fairly well understood, the exact etiology is not (MMWR, 2007).

The concepts underlying asthma pathogenesis have evolved dramatically in the past 25 years and are still undergoing evaluation as various phenotypes of this disease are defined and greater insight links clinical features of asthma with genetic pattern (Busse & Lemanske, 2001; EPR-2 1997)

Asthma places a disproportionate burden on patients, their families and their community in terms of a poorer quality of life, and avoidable emergency department (ED) visits and hospitalizations.

A major frustration in fighting asthma is the mystery of its development. It remains unknown why some people get the disease and others do not.

Research has identified several factors associated with the development of asthma, but none have proven to be the causative agent (MMWR, 2006).

It is hypothesized that asthma severity is contingent upon exposures to relevant irritants such as tobacco smoke, weather changes indoor and outdoor mold, pollen, environmental pollutants, animal dander and exercise (NAEEP, 2007).

While research continues to study the causative agents involved in asthma, it is clear that the development of asthma is the result of complex interactions between host factors and environmental exposures.

Studies have shown that trends in national pediatric asthma prevalence rates have remained at historically high levels with ambulatory asthma healthcare use steadily rising since the year 2000 (MMWR, 2006).

Although there are ways to prevent asthma attacks among children, the majority of children with uncontrolled asthma still suffer from asthma attacks.

The burden of avoidable emergency department visits and hospitalizations for asthma is high and has remained relatively resistant to preventative treatment (MMWR, 2006).

A randomized control trial demonstrated that not only is preventive therapy underused, but inhaled steroids, the most effective therapy currently available for long-term control of asthma, are underused (Warman et al., 2001).

Asthma is a priority for the public health research community for several reasons: 1) Asthma is one of the leading chronic childhood diseases in the United States and a major cause of childhood disability 2) Asthma places a huge burden on affected children and their families: asthma may limit a child's ability to play, learn, and sleep and necessitates complex and expensive interventions (MMWR, 2006).

Asthma is a key component in the respiratory disease chapter of the *Healthy People 2010* objectives. These objectives include reducing asthma deaths (objective 24-1), reducing hospitalizations for asthma (objective 24-2),

reducing hospital emergency department visits for asthma (objective 24-3), reducing activity limitations among persons with asthma (objective 24-4), reducing the number of school or work days missed by person with asthma because of asthma (objective 24-5), increasing the proportion of persons with asthma who receive formal patient education (objective 24-6), increasing the proportion of persons with asthma who receive appropriate asthma care according to the National Asthma Education and Prevention Program (NAEPP) Guidelines (objective 24-7).

Despite significant efforts to address the disease, asthma continues to burden children and adults. The frequency and severity of asthma symptoms can be reduced by the use of anti-inflammatory medications (e.g. leukotriene modifiers, corticosteroids) and by reducing exposure to the environmental triggers of asthma attacks (BRFSS, 2006).

Treatment with anti-inflammatory drugs can, to a large extent, reverse some of these processes; however, the successful response to therapy often requires weeks to achieve and, in some situations, may be incomplete (Bateman et al. 2004; O'Byrne and Parameswaran 2006).

For some patients, the development of chronic inflammation may be associated with permanent alterations in the airway structure—referred to as airway remodeling—that are not prevented by or fully responsive to currently available treatments (Holgate and Polosa 2006). Therefore, the paradigm of asthma has been expanded over the last 10 years from bronchospasm and airway inflammation to include airway remodeling in some persons (Busse and Lemanske 2001).

The NAEPP guidelines recommend for successful long-term management of asthma, it is essential to identify and reduce exposures to relevant allergens and irritants and to control other factors that have been shown to increase asthma symptoms and/or precipitate asthma exacerbations. These factors are in five categories: inhalant allergens, occupational exposures, irritants and comorbid conditions (NAEPP, 2007).

Currently, there are no national measures of asthma incidence; instead, asthma prevalence is focused upon. Asthma prevalence is the percentage of the population that has asthma at a given point in time. Prevalence is important as it identifies the population in need of effective measures to control asthma symptoms (MMWR, 2006).

Most of the published studies addressing health care use for asthma among children and adults have been descriptive. Using data from four National Center for Health Statistics (NCHS) data systems: Akinbami et al, 2002 described trends in childhood asthma prevalence and health care utilization in children.

The authors found that asthma prevalence increased by an average of 4.3% per year from 1980 to 1996. Specifically, asthma prevalence rates among children aged 0- to 17 years old, increased from 36 per 1000 children to 75 per 1000 from 1980 to 1995.

The gap between black and white non-Hispanic children widened progressively during this period, from 15% higher asthma prevalence among black non-Hispanic children in 1980-1981 to 26% higher in 1995-1996.

Moreover, Akinbami et al., 2002 found that black children had visit rates to hospital emergency departments approximately 3 times higher than those for white children

in 1998-1999. Asthma hospitalization rates increased to a much greater extent among black children than white children. In 1998-1999, the asthma hospitalization rate among black children was 3.6 times the rate for white children.

In 2006, there were 335,000 asthma-related pediatric stays; these stays accounted for 13.5% of all pediatric hospitalizations with asthma listed as the principal reason for hospitalization (Stranges et al., 2008).

The asthma prevalence estimates cited in Akinbami et al., 2002 are consistent with the asthma prevalence estimates reported in the 2006 National Health Interview Survey (NHIS). The survey reported that the national current asthma prevalence rate was 23.8% higher in blacks than in whites. The highest prevalence rates for whites and blacks were among the 5-17 age group. Whites had the lowest asthma prevalence rates in children under 5 years of age and blacks had the lowest asthma prevalence rates of those 45-64 years of age (American Lung Association, 2007).

Similarly, in examining the racial and ethnic differences in acute asthma among children, Boudreaux et al., 2003 concluded that black and Hispanic children

utilize the emergency department more frequently and have more severe chronic asthma. This finding is in agreement with the Center for Disease Control (CDC) report on national surveillance data of prevalence among persons with asthma.

During the 2001-2003 period, the CDC found that black children had higher emergency department visit rates compared to white children and that Hispanic children had higher emergency department visits than non-Hispanics (MMWR, 2007).

Racial disparities in childhood asthma remained evident during the years 2003-2005; the data suggest that black children had asthma prevalence rates 60% higher than white children (MMWR, 2006).

When race and ethnicity are the sole asthma prevalence indicators, Puerto Rican children have the highest asthma prevalence rates of all ethnic groups, 140% higher than non-Hispanic white children (MMWR, 2006).

A study by Griswold et al., 2005 characterized the adult asthma patients according to frequency of emergency department visits. The study concludes that patients with a high number of emergency department visits were more likely to be non-white, of lower socioeconomic status, have Medicaid insurance and have higher chronic asthma severity.

Additionally, during the 2001-2003 period, the CDC reported that among persons with current asthma, whites and blacks were equally likely to report an asthma attack during the preceding twelve months.

The rate for asthma health-care encounters, regardless of place (physician office, emergency department, outpatient department or hospital), when based on the population with asthma, did not differ by race.

However, whites with current asthma had higher rates for physician offices and blacks had higher rates for hospital-based sites (e.g. outpatient clinics and emergency department visits) (MMWR, 2007).

Although reasons for these racial differences are unclear, they likely result from multiple factors such as exposure to allergens and irritants.

Inadequate access to appropriate medical care and socioeconomic status has shown to be important contributing factors in asthma morbidity among racial groups.

The Multicenter Airway Research Collaboration performed prospective cohort studies from 1996-1998 in adults with acute asthma. The study was conducted to examine the observed differences in acute adult asthma.

The findings suggest that despite significant racial and ethnic differences in chronic asthma severity, initial

peak flow expiratory flow rate and post-hospital discharge outcome, socio-economic status accounted for most of the observed acute asthma differences among adults presenting to the emergency department (Boudreaux et al 2003).

Claudio et al., 2006 examined the impact of ethnicity and income on childhood asthma in urban communities.

The study concluded that children who resided in a lower socio-economic status communities had a 70% greater risk of having current asthma independent of ethnicity and income.

Although asthma disproportionately affects race, age and gender; the literature suggests that asthma morbidity rates continue to plateau and/or decline.

Hospital discharges, defined as the length of overnight stay, for asthma have declined since 1995.

The number of hospital discharges has decreased 4.3% between 1995 and 2005 while the hospital discharge rate has declined 15% since it peaked at 19.5 per 10,000 in 1995 (American Lung Association, 2009). Available data from the last eight years show that lifetime and attack prevalence rates have fluctuated. Therefore, more years of national data are needed to successfully assess the asthma prevalence trend (American Lung Association, 2009).

One of the possible reasons for the fluctuation and case ascertainment in asthma prevalence rates is the re-design of the National Health Interview Survey questionnaire.

The NHIS is a major tracking system for asthma prevalence, it is used to produce annual health estimates based on self-reports of a nationally representative sample. Starting in 1997, asthma prevalence estimates were based on receiving an asthma diagnosis; that is, currently having the disease at the time of the interview, and experiencing an attack in the past year (MMWR, 2006).

An analysis of NHIS data before and after the 1997 redesign indicates that if the redesign had not occurred, the asthma prevalence measurements would show a plateau in the late 1990's (MMWR, 2006).

Nonetheless, prevalence rates remain at historically high levels. In 2005, 6.5 million children currently had asthma and 3.8 million children had at least one asthma attack in the previous year. Nearly two out of every three children who currently have asthma had at least one attack in the past 12 months (MMWR, 2006).

Asthma remains a public health problem. In 2007, approximately 22.9 million Americans had asthma. Asthma ranks within the top ten prevalent conditions causing

limitation of activity and costs our nation \$19.7 billion in health care costs annually (American Lung Association, 2009).

Asthma is a common chronic malfunction of the airways that is complex and characterized by variable and recurring symptoms, airflow obstruction, bronchial hyperresponsiveness, and an underlying inflammation (NHBLI, 2007).

The concepts underlying asthma pathogenesis have evolved in the past 25 years and are still undergoing evaluation as various phenotypes of this disease are defined and greater insight links clinical features of asthma with genetic patterns (NHBLI, 2007).

The Behavioral Risk Factor Surveillance Survey (BRFSS) routinely includes questions that assess asthma status. As a result, child asthma prevalence data are produced from the responses to two asthma questions from the BRFSS Childhood Asthma Module.

For Nevada, children were found to have a 7.1% and 11.8% respective current and lifetime asthma prevalence rate during the year 2006 (Yang et al. 2006). Similarly, the current and lifetime asthma prevalence rates for adults living in Nevada during 2007 were 6.9% and 13.4% respectively (BRFSS 2007).

Little is known about asthma morbidity for children and adults living in southern Nevada. What is central to the various phenotypic patterns in asthma morbidity is the presence of underlying airway inflammation, which is variable and has distinct but overlapping patterns that reflect different aspects of the disease in children and adults (NHBLI, 2007).

Research has shown that the risk factors for asthma severity include a variety of factors this includes but is not limited to: gender, race/ethnicity, age, geographic region.

The reasons for the variability in asthma are unclear, what is clear from the literature is females, African Americans, Puerto Ricans, younger children (0-4 years old) and residents of inner city, urban areas tend to exhibit higher cases of asthma morbidity.

Current research examining pediatric and adult asthma healthcare utilization trends have been described in many US states using archived hospital data or emergency department use. Yet there are no research investigations in southern Nevada that examine pediatric and adult longitudinal trends in asthma health care use.

This study will be the first investigation to describe asthma healthcare trends as well as emergency department

visits and characterize the population of asthma sufferers in Las Vegas, Nevada. The study findings can be incorporated into the larger body of asthma research as this study will be the first pediatric and adult asthma research investigation examining asthma health care use conducted in Las Vegas, Nevada.

CHAPTER 3

METHODOLOGY

Asthma inpatient hospitalizations and emergency room visits in southern Nevada were obtained from the University Medical Center (UMC) of Southern Nevada. The data were obtained with the full consent and release from UMC research board. This research project was approved by the University of Nevada, Las Vegas Biomedical Institutional Review Board.

Study Population:

A cross-sectional analysis was performed of asthma patients visiting UMC hospital for an asthma inpatient hospitalization or emergency room visit during the years 2000-2007. Patient demographics include age, race, gender, and insurance type. Exclusions were not performed in the analysis. Analyses were conducted using SPSS v.16 (SPSS Inc., Las Vegas, NV) and Microsoft Office Excel, 2003. Personal identifiers were removed prior to all analyses to retain anonymity of all study participant

Data Classification:

Patients were separated into four subgroups; namely, race, age, sex and insurance type. Race categories included Black, Hispanic, White and Other. Due to small numbers, American Indian and Asian were collapsed into the group category labeled Other.

Insurance type categories included PPO/HMO, Self-Pay, Medicaid/Medicare and Other. Due to small numbers CCSS, Commercial, EFC Fin Classes, Other government, Tracking Financial Classes, Tricare and Workers Compensation were collapsed into the group category labeled Other. All p-values are two-tailed with $p < 0.05$ statistically significant.

Statistical Analyses:

The Chi-Square test for trend compares proportions using a 2xK chi-square test and tests for linear trends across groups (Van Belle et al., 2004).

For the present analysis, the Chi-Square test for trend was used to calculate linear trends and compare the proportions for asthma inpatient hospitalizations and emergency asthma hospital visits out of the total all cause hospitalizations at UMC during the study period. The 2xK

chi-square test for trend was used to determine statistically significant increase or decrease in asthma hospitalizations and asthma emergency room visits of patients admitted to UMC of Southern Nevada.

Linear regression was used to test if year was predictive of the proportion of asthma emergency room visits at UMC of southern Nevada.

In the regression model, the independent variable (X) is year and the dependent variable (Y) is the proportion of asthma emergency hospital visits. Linearity and equal variances are assumed.

Analysis of covariance (ANCOVA) allows comparison of one variable in 2 or more groups while taking into account (or to correct for) variability of other variables, called covariates.

In the present analysis, ANCOVA was used to correct variability that existed in the covariate, year. Differences in the slopes of asthma emergency room visits were compared between the dependent variable, subgroup proportion, and the independent variable, subgroup. Post hoc analyses were conducted using planned contrasts to determine significant differences between the subgroups.

CHAPTER 4

RESULTS

Of the 243,791 patients included in the current analysis, 6,715 patients required an inpatient hospital stay for an asthma-related event at UMC of southern Nevada. The characteristics of the study population are shown in Table 1. The annual proportions for asthma-related inpatient hospitalizations were variable during 2000-2007. Given that asthma symptomology is variable with fluctuating levels of severity, it is not surprising that there is a high degree of variability within the population proportions. The CDC reported that asthma hospitalizations were irregular during the 2000-2004 period with an overall significant decreasing trend (MMWR, 2004). The American Lung Association, 2009 reported that between 2003 and 2006, there was 25% decrease in asthma inpatient hospitalizations.

Table 1. Demographic of Asthma Patients admitted to UMC of Southern Nevada during 2000-200 according Race, Gender, Insurance Type and Age.

Black	37%
Hispanic	32%
White	25%
Other	5.8%
Females	45%
Males	54%
PPO/HMO	19%
Self-Pay	38%
Medicaid/ Medicare	34%
Other	9.2%
<18	60%
>=18	40%

Overall, the χ^2 test for trend demonstrates there is a statistically significant decreasing trend in asthma inpatient hospitalizations at UMC hospital of southern Nevada (χ^2 -trend = 34.784, $p < 0.05$) (Figure 1).

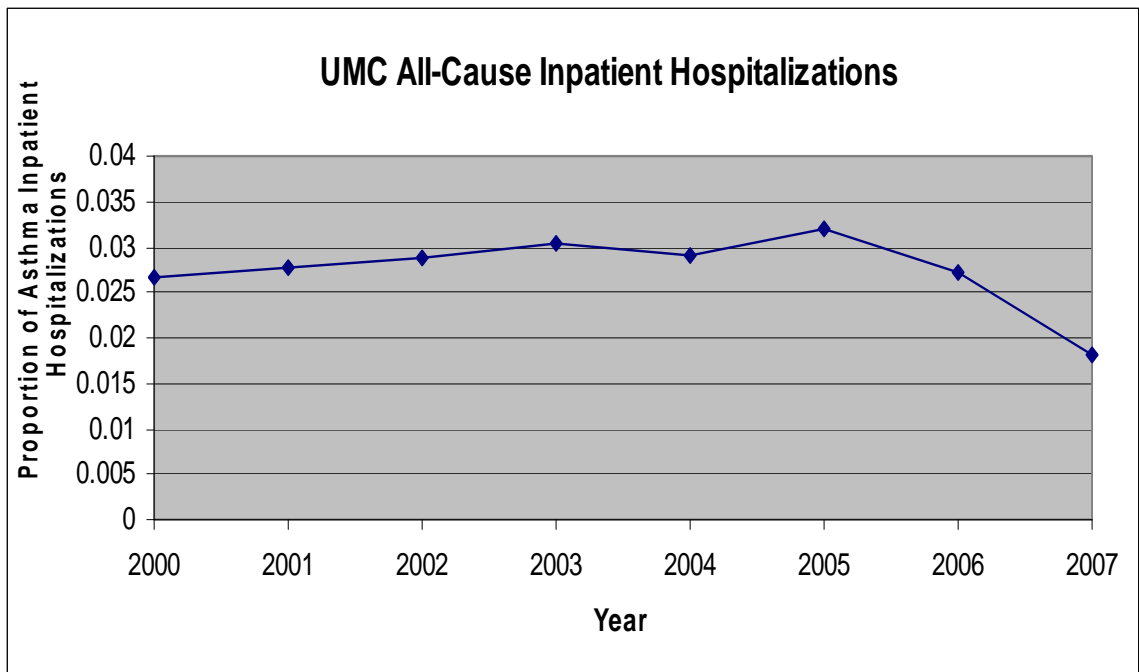


Figure 1. Annual proportions of asthma-related inpatient hospitalizations of children & adults at UMC hospital of Southern Nevada, 2000-2007.

Note. N=243,791

On the whole, our study showed a downward trend for asthma inpatient hospitalizations for the years 2000-2004 at UMC of southern Nevada. This finding is in agreement with the reported evidence for asthma hospitalizations (Table 2).

TABLE 2. Annual Proportions of Asthma Inpatient Hospitalizations of Children & Adults at UMC of Southern Nevada, 2000-2007.

Year	Asthma Inpatient Hospitalizations
2000	2.67%
2001	2.76%
2002	2.87%
2003	3.03%
2004	2.89%
2005	3.20%
2006	2.72%
2007	1.81%

Note. N=243,791

Of the 593,053 patients included in the current analysis, 16,501 patients visited the emergency room for an asthma-related event at UMC of southern Nevada.

The annual proportions for asthma-related emergency room visit exhibited a higher degree of variability during the years 2000-2007 (Table 3).

TABLE 3. Annual Proportions of Asthma Emergency Room Visits of Children & Adults at UMC of Southern Nevada, 2000-2007.

Year	Asthma Emergency Room Visits
2000	2.25%
2001	2.62%
2002	2.66%
2003	3.17%
2004	2.90%
2005	3.14%
2006	2.67%
2007	2.56%

Note. N=593,053

Factors driving this variable upward trend may be due to increasing disease severity, poor asthma control or inadequate asthma self-management.

A significant p-value, $p < 0.05$, and a positive X^2 trend value ($X^2 = 8.380$) suggest that there is a statistically significant trend towards increased use of emergency room visits for asthma in southern Nevada (Figure 2)

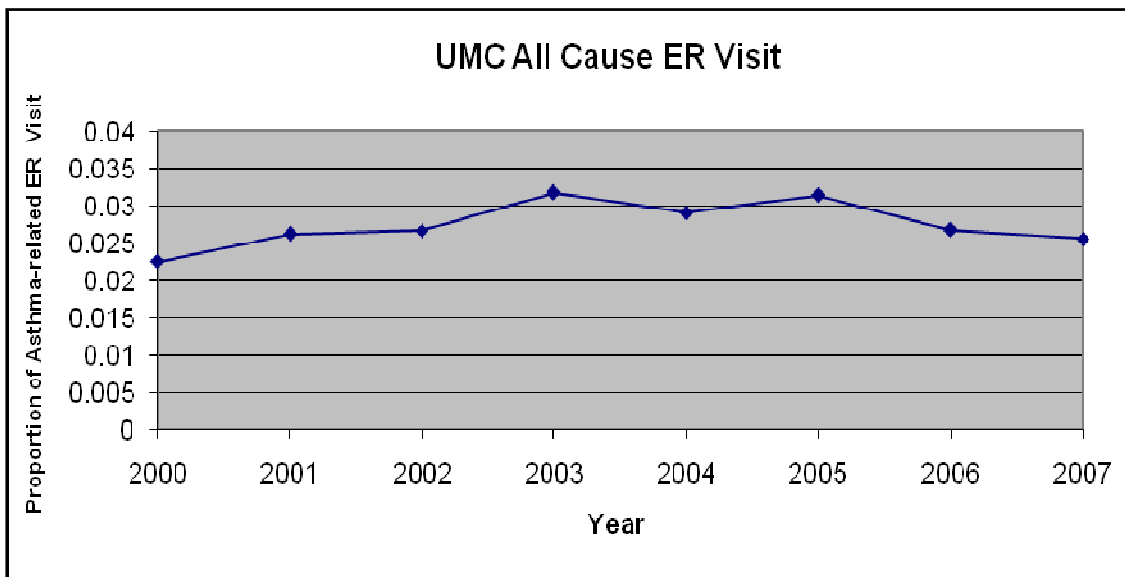


Figure 2. Annual proportions of asthma-related emergency visits of children & adults at UMC hospital of southern Nevada, 2000-2007.

Note. N=593,053

There were 16,501 asthma-related emergency room visits during the study period. The data suggest that a disparity exists in the use of ambulatory care between the demographic subgroups.

To assess the differences between the four demographic subgroups, simple linear regression was used to test whether year predicted an asthma-related event (ER visit) for the subgroup proportion.

The racial composition analyzed in this study includes, Black, White, Hispanic, and Other. Due to low enrollment, the following race/ethnicity (American Indian, Asian Pacific Islander) were aggregated, named Other and classified as the fourth insurance subgroup included in the analysis.

Simple regression analysis in Table 4 demonstrated that year was a predictor for race in asthma-related emergency room visits. Specifically, Whites, Blacks, and Hispanics had statistically significant p values, $p < 0.05$ respectively ($R^2=0.92$, $R^2=0.62$, $R^2=0.93$).

Table 4. Linear Regression Analysis for Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Race, 2000-2007.

Race	Slope	F-value	p-value	R²
White	-0.021	74.272	< 0.001	0.925
Black	0.004	10.092	0.019	0.627
Hispanic	0.016	89.090	< 0.001	0.937
Other	0.01	0.079	0.788	0.013

Note. Dependent Variable: Proportion of race per total asthma-related ER Visit.

Note. N=593,053.

Note. Independent Variable: Year.

Within the race subgroups, Hispanics and Blacks showed an increased use in asthma-related emergency room visits during the 2000-2007 years while Whites show a significant decrease during the same period. Race/ethnicity in the other category demonstrated an unchanging trend in asthma-related emergency room visits throughout the study period (Figure 3).

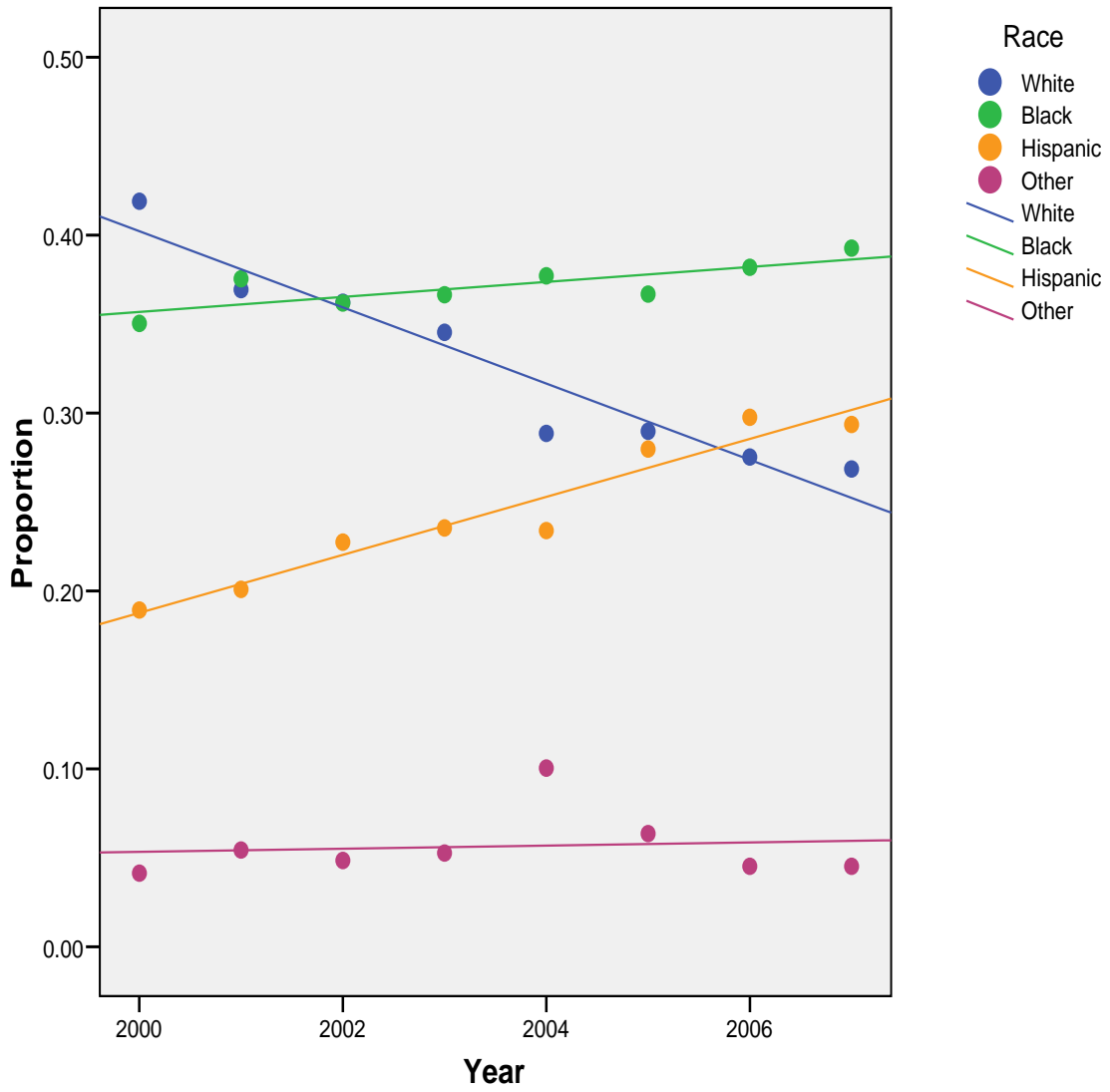


Figure 3. Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Race, 2000-2007.

It is well documented that racial differences exist in emergency room visits for asthma events (Akinbami et al., 2002, Claudio et al., 2006, Warmen et al., 2001). Table 5 lists the racial differences in emergency healthcare use. ANCOVA demonstrates that there were significant differences in asthma-related emergency healthcare utilization between Whites and Blacks ($\beta= 51.298$) with the greatest difference in asthma-related emergency healthcare use between Whites and Hispanics ($\beta= 75.635$).

This finding is consistent with Boudreaux et al., 2003 who found that Hispanics had higher asthma morbidity, life time asthma prevalence and higher emergency department use for asthma exacerbations.

Moreover, the CDC reported that Blacks had higher emergency room visits than Whites and Hispanics had higher emergency room visits than did non-Hispanics during the year period 2001-2003 (MMWR, 2004).

Although our data do not provide insight into the reasons for these differences, it is likely that the observed racial differences in the present study are associated with socioeconomic status (Claudio et al., 2006, Boudreaux et al., 2003, Griswold et al., 2005).

Table 5. ANCOVA Analysis for Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Race, 2000-2007.

Slope Comparisons	Contrast Estimate	p-value
White vs. Black	51.298	< 0.001
White vs. Hispanic	-75.635	< 0.001
White vs. Other	-44.943	< 0.001
Black vs. Hispanic	24.338	0.001
Black vs. Other	-6.354	0.336
Hispanic vs. Other	-30.692	< 0.001

Note. Slopes were not homogenous ($F_{3, 24} = 47.394$, $p < 0.001$).

Note. Dependent Variable: Proportion of race per total asthma-related ER Visit.

Note. Independent Variable: Race.

Note. N=593,053.

Note. Covariate: Year.

The relationship between gender and asthma-related emergency room visits was evaluated and demonstrated that gender and asthma-related emergency room visits had significant p values but were weakly associated. ($p < .05$; $R^2=0.22$, respectively) (Table 6). Males had an increase in emergency room use for asthma while females had decreased use of emergency room use for asthma (Figure 4).

Table 6. Linear Regression Analysis of Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Gender, 2000-2007.

Gender	Slope	F-value	p-value	R²
Male	0.003	1.768	0.232	0.228
Female	-0.003	1.86	0.230	0.229

Note. Dependent Variable: Proportion of gender per total asthma-related ER Visit.

Note. N=593,053.

Note. Independent Variable: Year.

ANCOVA demonstrated a significant upward trend for males in emergency asthma-related visits ($p=0.08$) (Table 7). The pattern for asthma changes throughout the life course with younger males experiencing higher asthma morbidity (Akinbami, et al, 2006).

The differences in asthma course by gender requires further study; however, it is plausible that some of the observed gender differences in our study are attributable to changes in disease pattern, changes in disease severity, inadequate asthma self-management education or poor medication use (MMWR, 2004).

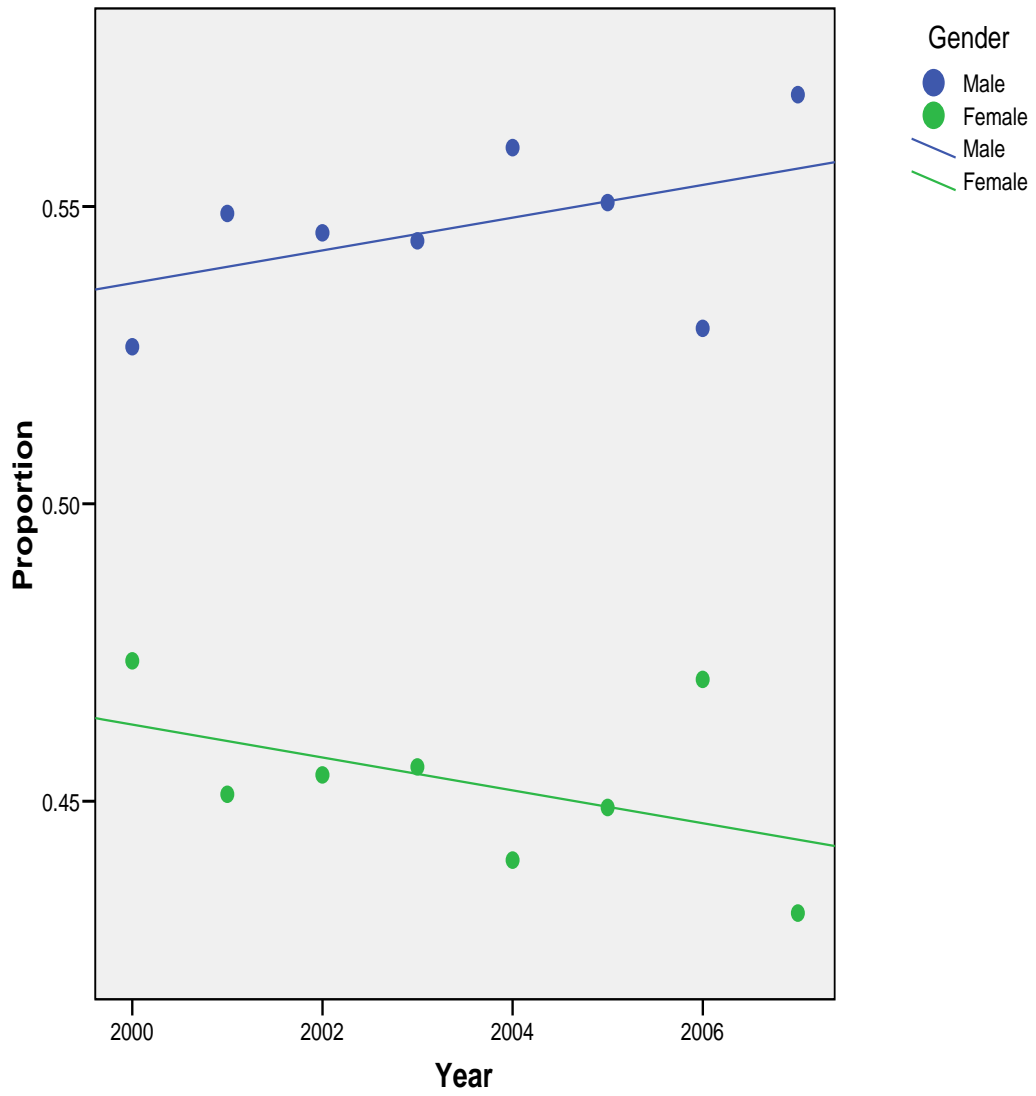


Figure 4. Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Gender, 2000-2007.

Table 7. ANCOVA Analysis of Asthma-Related Emergency Room Visit at UMC of Southern Nevada by Gender, 2000-2007.

Slope Comparisons	Contrast Estimate	p-value
Male vs. Female	10.964	0.086

Note. Slopes were homogenous ($F_{1, 12} = 3.554, p = 0.084$).
 Note. Dependent Variable: Proportion of gender per total asthma-related ER Visit.

Note. N=593,053.

Note. Independent Variable: Gender, Covariate: Year.

Within the age subgroup, age was separated into two groups: <18 years & \geq 18 years. Those who were <18 years exhibited higher use of emergency room visits for asthma and a significant increasing trend ($p=0.02$, respectively). The findings from our study are consistent with the asthma literature. Just over 2.5% of all ambulatory visits among children 0-17 years of age made in 2004 were for asthma (MMWR, 2006).

In 2005, 5.2% of children had at least one asthma attack in the previous year and nearly two out of three children who currently have asthma had at least one attack in the past 12 months (Akinbami et al., 2006). Table 8 shows that both age groups (<18 years & \geq 18 years) and emergency healthcare use were strongly associated ($R^2=0.57$, respectively).

Table 8. Linear Regression Analysis of Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Age, 2000-2007.

Age	Slope	F-value	p-value	R²
< 18	0.011	8.089	0.029	0.574
≥ 18	-0.011	8.089	0.029	0.574

Note. Dependent Variable: Proportion of age per total asthma-related ER Visit.

Note. Independent Variable: Year.

Note. N=593,053.

ANCOVA further supports the significant difference in asthma-related emergency room visits between the two age groups ($p < 0.05$) (Table 9); with the greatest difference in ambulatory care displayed in the <18 years age group (Figure 5).

Table 9. ANCOVA Analysis for Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Age, 2000-2007.

Slope Comparisons	Contrast Estimate	p-value
< 18 vs. ≥ 18	-43.387	0.002

Note. Dependent Variable: Proportion of age per total asthma-related ER Visit.

Note. Independent Variable: Age.

Note. Covariate: Year.

Note. N=593,053.

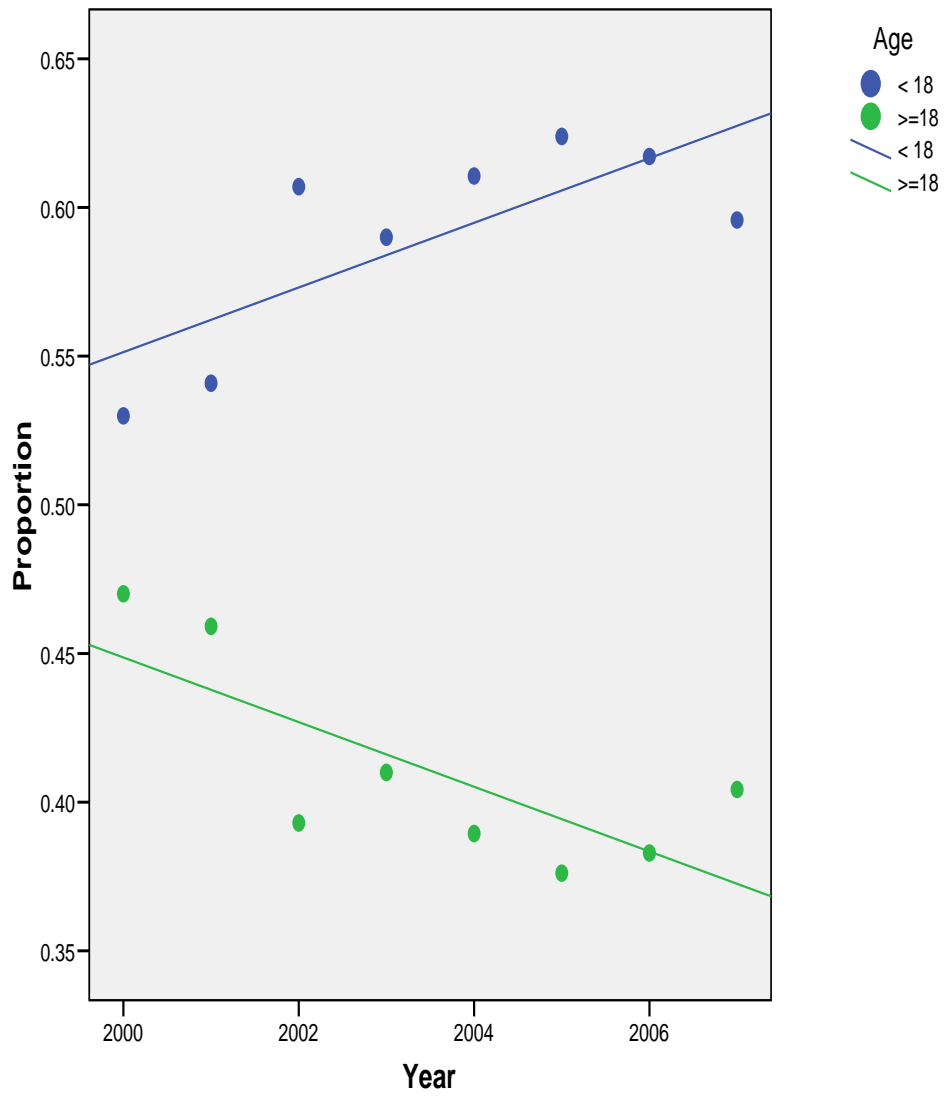


Figure 5. Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Age, 2000-2007.

Insurance type subgroups analyzed for this study include, Preferred Provider Organization and Health Maintenance Organization, abbreviated as, PPO/HMO.

Self-Pay, Medicaid/Medicare and Other. Due to low patient enrollment, the following insurance types (CCSS, Commercial, EFC Fin Classes, other government, Tracking Financial Classes, Tricare and Workers Compensation) were aggregated, named Other and classified as the fourth insurance subgroup included in the analysis.

Within the insurance type subgroup, linear regression demonstrated that year was a predictor for an asthma-related emergency room visit for patients who possessed insurance type that fell into the Other subgroup ($p=0.004$) (Table 10).

This finding may be explained by the method used to aggregate the insurance types within this subgroup. As previously mentioned, workers compensation was included within the other subgroup.

Ferris et al., 2002 showed that worker's compensation financed patients who had increased emergency asthma-related visits to the emergency room as a source of routine medical care. Therefore, year as a strong predictor for the Other subgroup may explain the significant p value ($p=0.004$) by the presence of worker's compensation.

Table 10. Linear Regression Analysis of Asthma-Related
Emergency Room Visits at UMC of Southern Nevada by
Insurance Type, 2000-2007.

Insurance Type	Slope	F-value	p-value	R²
PPO/HMO	-0.002	0.163	0.701	0.026
Self Pay	-0.012	1.862	0.221	0.237
Medicaid/Medicare	0.027	3.647	0.105	0.378
Other	-0.012	21.017	0.004	0.778

Note. Dependent Variable: Proportion of insurance type per total asthma-related ER Visits.

Note. Independent Variable: Year.

Note. N=593,053.

PPO/HMO, Self-Pay, Medicaid/Medicare insurance types demonstrated significant differences in utilization of asthma related emergency room visits. (p=0.030, p=0.004, p=0.004 respectively) (Table 11). Although our data do not provide insight into the reasons for these differences, several hypotheses are possible: 1) less available primary care 2) patient preferences or 3) patient understanding of acute care resources.

Table 11. ANCOVA Analysis for Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Insurance Type, 2000-2007.

Slope Comparisons	Contrast Estimate	p-value
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PPO/HMO vs. Self Pay	21.407	0.391
PPO/HMO vs. Medicaid/Medicare	-56.532	0.030
PPO/HMO vs. Other	-21.662	0.385
Self Pay vs. Medicaid/Medicare	77.939	0.004
Self Pay vs. Other	-0.255	0.992
Medicaid/Medicare vs. Other	-78.194	0.004

Note. Slopes were not homogenous ($F_{3, 24} = 4.546, p = 0.012$).

Note. Dependent Variable: Proportion of insurance type per total asthma-related ER Visits.

Note. Independent Variable: Insurance Type.

Note. Covariate: Year.

Note. N=593,053.

The relationship between type of health insurance and poor asthma outcomes is complex and not well studied. Lack of health insurance is associated with decreased health care utilization and impaired health (Bair et al., 2001). The uninsured in our study exhibit a decrease in emergency healthcare utilization for asthma during years 2000-2002 with a marked increase in emergency healthcare use from 2003-2007 (Figure 6). This may be explained by lack of asthma care compliance due to cost. In 2003, Stevens et al. reported that lack of compliance by the uninsured in asthma self-management was due to cost. The author's found that uninsured patients delayed and failed to fill asthma

prescriptions in order to reduce out-of-pocket cost, thus leading to increased emergency room visits for an asthma attack.

Conversely, Medicaid/Medicare insurance experienced a significant increase in asthma-related emergency room visits during 2000-2002 with a decrease in asthma emergency room utilization from 2003-2007 (Figure 6).

This increase may be explained by increased enrollment in Medicaid; Holahan et al., 2005 reported that enrollment for families increased 11.6% between 2000 and 2002 and another 7.1% between 2002 and 2003. The number of people below 200% of the federal poverty level greatly increased (Holahan et al., 2005)

Moreover, Holahan et al., 2005 reported that growth in Medicaid spending averaged a 10.2% increase during 2000-2003. During this period, Medicaid spending for prescription drug cost rose from \$16.6 billion in 2000 to \$26.6 billion in 2003.

Medicaid payments to Medicare grew from \$4.7 billion to \$6.3 billion during this period. This includes payments for Medicare premiums for all Medicaid dual-eligibles (Holahan et al., 2005). PPO/HMO insurance type demonstrated a decreasing trend in asthma emergency room visits from

2000-2002 with an increasing trend from 2003-2007 (Figure 6).

This increase in emergency healthcare use may be explained by the increased spending by managed care organizations for prescription drug costs. The Policy Journal of Health Sphere, 2005 reported that managed care organizations spending on prescription drug costs increased from \$26.5 billion in 2000 to \$41.5 billion in 2003 - an average annual increase of 16.1%.

Studies of the influence of insurance type on asthma healthcare utilization (Ferris et al., 2002) have generally found that workers compensation and managed care insurance have similar asthma healthcare outcomes (Figure 6).

As hypothesized earlier, it is conceivable that the similar trend exhibited by the PPO/HMO and Other subgroups within this study could be influenced by the presence of indemnity insurance. Overall, further study is needed to determine the independent effects of insurance status on emergency asthma-related visits.

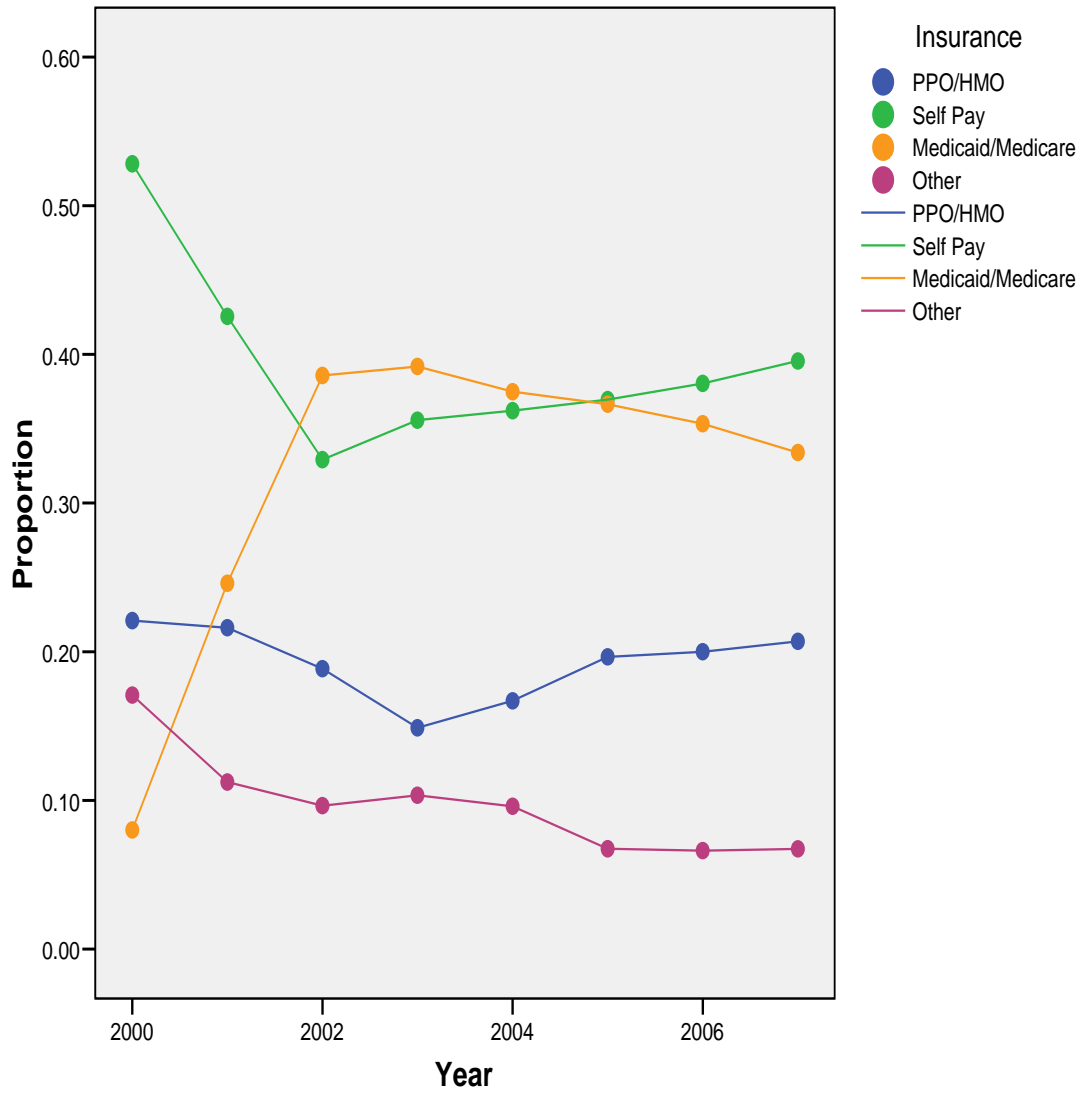


Figure 6. Asthma-Related Emergency Room Visits at UMC of Southern Nevada by Insurance Type, 2000-2007.

CHAPTER 5

DISCUSSION

To our knowledge, studies examining asthma hospitalizations and emergency room visits in southern Nevada have not been conducted. Our conclusion that increased use in asthma healthcare utilization at UMC of southern Nevada between patients of different race, gender, age and insurance type is an important and novel finding.

Previous studies involving children and adults with chronic asthma found that low SES, continuous use of oral steroids, age, insurance type, minority race, gender, and physician clinical treatment regimens were predictors for increased use of emergency room visits for asthma (Akinbami et al., 2002, Diette et al., 2002, Boudreaux et al., 2003, Wolfenden et al., 2003).

There is evidence to suggest that those of minority race, namely, Blacks and Puerto Ricans suffer from higher asthma morbidity by way of increased emergency room visits and hospitalizations for asthma with Blacks requiring more frequent hospitalization for asthma (Cohen et al., 2006).

Consistent with this finding, our study demonstrated that Blacks utilized UMC's emergency room for asthma at higher rates compared to Whites and paralleled emergency room use with Hispanics.

It has been reported that poor asthma outcomes (hospitalizations) and asthma prevalence are influenced, in part, by age. A study by the Health Care Utilization Project (HCUP), 2006 reported that asthma-related hospitalizations were highest among the youngest age groups (<1 year) and declined with increasing age.

Contrary to our findings on asthma hospitalizations, the HCUP also reported that the majority of these hospitalizations listed asthma as the secondary condition. However, our study was in agreement with the HCUP's reported findings on the decline in asthma-related hospitalization as age increases.

Evidence suggests that the profile of asthma is inconsistent in gender. Younger males exhibit higher prevalence and healthcare use compared to younger girls while adult females exhibit higher prevalence and healthcare use compared to adult males (MMWR, 2006).

Our study demonstrated that males had higher asthma-related emergency healthcare use compared to females. It is

not clear from our study if age was a contributor in the increased use of emergency room visits for asthma for this subgroup.

There are many studies on the relationship between insurance status and poor asthma outcomes (Bair et al., 2001, Ferris et al., 2002).

In a study that examined the quality of care of acute asthma patients with varying insurance status. Bair et al., 2006, found that uninsured patients and patients with public aid insurance were more likely to report using the emergency room as their usual site of asthma care or their usual source of asthma prescriptions.

Moreover, Bair et al., 2006, found that patients with managed care insurance used their physician's office for acute asthma treatment more than patients with Medicaid insurance or those that lacked health insurance.

Consistent with the author's findings, our study demonstrated that self-pay and public insurance coverage exhibited higher asthma-related emergency room visits compared to managed care insurance.

Contrary to our study, Sox et al., 1998, investigated the effects of insurance status and a having regular source of asthma care on use of emergency services. The author's

concluded that lacking a regular source of care for asthma was a stronger predictor of emergency department visits than insurance status.

In 2006, Nevada's current asthma prevalence rate for children and adults were 7.1% and 7.7% respectively. These prevalence rates indicate that Nevada fell below the national current asthma prevalence rate of 8.5%. Nevertheless, our study demonstrated that a disparity exists in our subgroup analysis of emergency asthma healthcare utilization at UMC of southern Nevada.

Our study demonstrated that asthma hospitalizations decreased during the years 2000-2007 while emergency room visits increased during the same period.

The differences in these outcomes require further study. As previously mentioned, severe, uncontrolled asthma, poor asthma self-management or poor patient compliance in prescribed asthma treatment may contribute to the increased emergency room visits rather than hospitalizations in our study.

The clinical practice guidelines from NAEPP recommend that asthma symptoms be treated early and rapidly. It is important that physicians correctly diagnose asthma and classify the level of asthma severity (intermittent,

mildly-persistent, moderately-persistent or severely-persistent) and correctly administer appropriate drug therapy. Numerous effective pharmacologic options are available for the treatment of asthma (Sarver et al., 2009).

Medications for asthma are categorized into two classes, long-term control medications and quick-relief medications. Long-term control medications include: leukotriene modifiers, inhaled corticosteroids, inhaled-long acting bronchodilators, cromolyn, theophylline and immunomodulators. These anti-inflammatory drugs reduce airway inflammation and airway secretions (NAEPP, 2007).

Quick-relief medications include: Short Acting Beta₂ Agonists, Anticholinergics. These anti-inflammatory medications are used to treat asthma exacerbations and provide fast relief of bronchoconstriction and its accompanying symptoms such as cough, chest-tightness and wheezing (NAEPP, 2007).

The NAEPP suggest that a tailored, step-wise approach for asthma control that is reliant upon disease severity is most effective in controlling exacerbations.

Asthma self-management education is essential in providing patients with the skills necessary to control and

improve asthma outcomes and should be integrated in clinical practice (NAEPP, 2007). It is recommended that clinicians provide all patients with a written asthma action plan that includes daily management and instructions on how to recognize and handle worsening asthma (NAEPP, 2007).

Yoos et al., 2006 found that suboptimal treatment for asthma in children were, in part, due to family factors such as inaccurate assessment of asthma symptoms, failure to seek care when needed and inadequate adherence to drug therapy.

Similarly, a study by Sarver et al., 2006 reported that the primary reason for lack of asthma control in adults, despite the available drug therapy, was non-adherence to asthma treatment regimens. Sarver et al., conclude that non-adherence contributes increased asthma exacerbation rates and health care resource utilization.

In assessing asthma-beliefs of people with asthma, the NAEPP, 2007 reported that African-American and other minorities who have asthma often accept suboptimal levels of asthma control because they are not aware of the effect that proper asthma management can have on their quality of life.

We recognize that this study is potentially limited by its cross-sectional design as it can only examine associations and cannot establish causation.

Additionally, the asthma estimates in this report relied on UMC hospital records. The possibility of misclassification by physician diagnosis, poor transcription of asthma diagnosis in patient records or incorrect coding of asthma-related events may lower our ability to detect true differences in the study population.

UMC hospital of southern Nevada was not randomly chosen, as such, our data were limited to patients who visited UMC hospital during the study period.

Therefore, our study findings are not generalizable to the overall population of patients with asthma in southern Nevada. Last, the data analysis did not adjust for repeat visits to UMC during the study period and the analysis was not weighted by population density.

Thus, our findings are not internally and externally valid; however, our findings suggest that significant increased use in emergency asthma-related healthcare utilization were demonstrated among minority race groups, younger aged groups, males, public insurance coverage type and the uninsured in southern Nevada. UMC hospital of

southern Nevada is a public, county hospital that treats patients who have public insurance or have no insurance, of minority race. These patients are precisely the group at greatest risk for morbidity and mortality from asthma exacerbations.

This study adds to the growing evidence indicating that increased use in asthma-related emergency room use in southern Nevada is associated with our subgroup classifications; age, race, gender and insurance type. Further study is needed to examine the sociodemographic factors associated with asthma healthcare utilization in southern Nevada.

Additionally, further study is needed to confirm the relationships between asthma self-management, quality of asthma care and emergency room visits among urban diverse populations in southern Nevada.

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