8-27-2012

Assessing the utilization of inhaled corticosteroids and health care services for asthma by Hispanic and non-Hispanic white patients using the medical expenditure panel survey

Akshay Kharat

Akshay Kharat

Candidate

Pharmaceutical Sciences

Department

This thesis is approved, and it is acceptable in quality and form for publication:

Approved by the Thesis Committee:

Matthew Borrego, PhD, MS, RPh; Chairperson

Dennis Raisch, PhD, MS, RPh

Melissa Roberts, MS, BS

Christopher Blanchette, PhD, MS, MA

Hans Petersen, MS, BS

ASSESSING THE UTILIZATION OF INHALED CORTICOSTEROIDS AND HEALTH CARE SERVICES FOR ASTHMA BY HISPANIC AND NON-HISPANIC WHITE PATIENTS USING THE MEDICAL EXPENDITURE PANEL SURVEY

by

AKSHAY KHARAT

B.PHARM., 2009
UNIVERSITY OF MUMBAI

THESIS

Submitted in Partial Fulfillment of the
Requirements for the Degree of

Master of Science
Pharmaceutical Sciences

The University of New Mexico
Albuquerque, New Mexico

July, 2012

DEDICATION

I dedicate this thesis to my beloved parents, Dr. Ajinath Kharat and Dr. Ratnamala Kharat, for their unconditional love and support.

ACKNOWLEDGEMENT

This thesis would not have been possible without the guidance and the help of several individuals who in one way or another contributed and extended their valuable assistance in preparation and completion of this study.

First and foremost, I would like to express my sincere gratitude to my advisor and thesis committee chair, Dr. Matthew Borrego for his steadfast guidance and help. Dr. Borrego has been a constant source of encouragement and support not only during the course of the thesis project but through all the years of graduate school. He has always made time to answer all my questions and help me overcome difficulties. He has been my inspiration as I hurdle all the obstacles in the completion of this research work. The plethora of experience I received under the guidance of Dr. Borrego is, in my belief, unparalleled to any form of classroom teaching. Dr. Borrego has been a very instrumental figure towards the development of my academic and professional goals.

I would also like to express my deepest thanks to my committee members, Dr. Dennis Raisch, Melissa Roberts, Dr. Christopher Blanchette, and Hans Petersen for their constant guidance and encouragement throughout my thesis and at various stages of graduate school. I was fortunate enough to work with these highly experienced researchers, and would like to thank them for their insightful comments and keen interest in this project.

Last but not the least, I would like to thank my parents for their unconditional love and support, and for letting me spread my wings and achieve my dreams. Their love has always been my strength. I will forever be grateful to my sister, Aditi for always being there for me, and putting a smile on my face. I would like to thank my girlfriend, Bijal for being so patient and listening to my complaints and frustrations and always cheering me up whenever I was down. I owe all my achievements to you all!

ASSESSING THE UTILIZATION OF INHALED CORTICOSTEROIDS AND HEALTH CARE SERVICES FOR ASTHMA BY HISPANIC AND NON-HISPANIC WHITE PATIENTS USING THE MEDICAL EXPENDITURE PANEL SURVEY

By

Akshay Kharat

B.Pharm., University of Mumbai, 2009

M.S., Pharmaceutical Sciences, 2012

ABSTRACT

Objectives: Inhaled corticosteroids (ICS) are widely used in the management of asthma. Prior research suggests that asthmatic patients' access to ICS may vary by ethnicity. The objectives of the study were to determine if there is a difference in the proportion of Hispanic and non-Hispanic White patients in the receipt of ICS prescription for asthma and to determine the independent predictors of receiving an ICS prescription in asthmatic patients. The study further examined the utilization of asthma-related healthcare services (office visits, prescription fills, inpatient visits, and emergency room visits) in Hispanic and non-Hispanic White asthmatic patients.

Methods: The U.S. Medical Expenditure Panel Survey (MEPS) 2009 dataset was utilized to compare the receipt of ICS prescription and use of healthcare

services among patients with asthma. The sample size was restricted to Hispanic and non-Hispanic White patients, above 4 years of age with ICD-9CM codes for asthma between January 1 and December 31, 2009. The proportion of patients receiving an ICS prescription within the defined timeframe was compared by ethnicity in chi-square analysis. Multivariate logistic regression was used to determine significant predictors of receiving an ICS prescription and utilization of asthma-related healthcare services.

Results: A total of 1,469 patients which is representative of 14,476,600 US Hispanic and non-Hispanic White asthmatic patients satisfied the study inclusion criteria. Of the total study population, 16.1% were Hispanics, 59.5% were females, and the mean age of the study population was 39.9±0.03 years. About 40% of non-Hispanic White asthmatics (35% children and 41.6% adults) had a receipt of ICS prescription compared to 22% of Hispanics (23.9% children and 21.2% adults), (p<.0001). Adult Hispanic asthmatic patients (≥18 years old) had 0.43 (95%CI: 0.28–0.67) times lower odds of receiving an ICS prescription compared to non-Hispanic White asthmatic patients, independent of other factors. However, there was no significant difference between Hispanic and non-Hispanic White asthmatic children (4 to 17 years old) in the receipt of ICS prescription. Among adults, being 65 years and older (vs. 18 to 40 years old OR: 2.23; 95%CI: 1.30–3.84), being a non-smoker (vs. smoker OR: 1.86; 95%CI: 1.13 - 3.07), being uninsured (vs. private insurance OR: 0.34; 95%CI: 0.17–0.7), belonging to high income group (vs. poor/negative income group OR: 3.07; 95%CI: 1.74–5.41), residing in the west (vs. northeast OR: 0.50; 95%CI: 0.31–

0.82), having a SABA prescription (vs. no SABA prescription OR: 0.33; 95%CI: 0.23–0.46), and having better overall health (OR: 1.32; 95%CI: 1.06–1.64) were predictive of receipt of ICS prescription, independent of other factors. Among children, patients who received a SABA prescription had 0.23 (95%CI: 0.12–0.43) lower odds of having a receipt of ICS medication as compared to patients who did not receive a SABA prescription. We also found that Hispanic patients had higher odds of having an asthma-related office visit (OR: 1.46; 95%CI: 1.10–1.93), emergency room visit (OR: 3.38; 95%CI: 1.64–6.95), and inpatient visit (OR: 6.94; 95%CI: 1.33–36.24) as compared to non-Hispanic Whites. Also, patients who did not receive an ICS prescription had 0.47 (95%CI: 0.35–0.63) times lower odds of having an asthma-related office visits as compared to patients who received an ICS prescription.

Conclusion: The disparity in ICS prescription patterns between Hispanic and non-Hispanic White asthmatic patients may translate into suboptimal asthma management, a higher rate of exacerbations, and higher healthcare costs in this growing minority population. The differences and potential disparities in ICS use between Hispanic and non-Hispanic White asthmatic patients warrant further investigation.

TABLE OF CONTENTS

CHAPTER 3: METHODS

CHAPTER 4: RESULTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

Background and problem statement

Asthma is a chronic inflammatory disorder of the airways which is characterized by episodic and reversible airflow obstruction and airway hyper-responsiveness.[1] People with symptoms of asthma are limited by their ability to participate in activities of daily life. The factors that influence the risks of asthma are genetic and allergens such as mites, furred animals, pollen, viral infections and tobacco smoking.[1] Asthma severity stages range from mild (with occasional symptoms) to severe (with persistent symptoms).[1]

Asthma produces a major health care burden to patients and health care systems. Approximately 34.1 million Americans have been diagnosed with asthma by a health professional during their lifetime and in 2007, an estimated 300 million people worldwide suffered from this condition.[2, 3] Despite improvements in understanding the pathophysiology of asthma and the availability of effective pharmacological agents, the incidence and mortality rates due to asthma have increased in the last several years.[3] Asthma contributes to about 250,000 deaths annually worldwide.[3] In the United States 3,384 deaths were attributed to asthma in 2005.[2] Asthma accounts for nearly 500,000 hospitalizations each year and is the third ranking cause of hospitalization among children under the age of 15.[4, 5] It also accounts for a considerable economic burden to the healthcare system. In 2007, the annual economic cost of asthma in

the U.S. was estimated to be $19.7 billion.[2] Of this 14.7 billion was attributed to direct costs and $5 billion made up by indirect costs such as lost productivity.

To improve asthma disease management, the National Asthma Education Program (NAEP) Expert Panel, sponsored by the National Heart, Lung, and Blood Institute, published *Guidelines for the Diagnosis and Management of Asthma*.[6] These guidelines suggest that asthma symptoms can be controlled by avoiding exposure to the factors that influence asthma exacerbations and by following medical management guidelines. The guidelines accentuate the appropriate use of preventative and treatment medications and routine measurement of lung function. These guidelines are currently considered the standard of care for patients with asthma in the United States and emphasize the use of daily controller medications in all patients for long-term control of asthma.

Inhaled Corticosteroids (ICS) are important anti-inflammatory, long-term controller medications for people suffering from asthma. ICS work by reducing swelling and mucus production in the airways resulting in airways being less sensitive and less likely to react to triggers.[1] ICS are the most effective asthma maintenance therapy currently available, are widely used in the management of asthma and have become the first line of maintenance therapy for treating chronic asthma in many countries.[1]

Racial and ethnic disparities in asthma management

Racial and ethnic minorities represent one third of the US population.[7] Among minorities, Hispanics are the fastest growing minority group in the United

States. According to the U.S. Census Bureau, in 2010 there were 50.4 million people in the United States who identified themselves as Hispanics, representing 16.3% of the entire population.[7] In 2009, around 2.9 million Hispanics in the United States were diagnosed with asthma.[8]

There is abundant evidence related to the existence of ethnic/racial disparities in asthma prevalence, morbidity, mortality, and medication utilization.[9] Numerous studies report race/ethnicity based disparities in receiving asthma care, demonstrating that minority group patients are less likely to receive recommended elements of care.[10-13] Hispanic patients have been found to have greater frequency of exacerbations requiring emergency department visits and hospitalizations than non-Hispanic White patients.[14] In a study which analyzed the 1997 Nationwide Inpatient Sample, 1997 Current Population Survey, and 1997 National Health Interview Survey, the authors reported that Hispanics have high preventable hospitalization rate for major chronic conditions, including asthma.[15]

Studies which assess medication use and adherence to asthma management guidelines among ethnic minorities, including Hispanics, have reported that fewer minority patients receive prescriptions for ICS. Also minority patients demonstrate non-adherence to recommended guidelines for the use of ICS as compared to non-minority population.[16, 17] A study by Ortega AN, et.al, reported that Hispanic children were significantly less likely to receive inhaled corticosteroids than non-Hispanic white children (OR = 0.3; 95% CI, 0.1 - 0.5), after adjusting for demographic variables.[18] A study by Ferris TG et al reported

that Hispanic children and adults were statistically significantly less likely than Whites to receive a prescription for ICS (OR 0.37, 95% CI 0.23-0.61).[19]

Significance

According to the U.S. Census Bureau the Hispanic population grew from 37.4 million (13.3% of entire U.S. population) in 2002 to 50.4 million (16.3%) in 2010.[7] With this growing population the prevalence of asthma in this group is also expected to rise. Various strategies will need to be employed to prevent, diagnose, and slow the progression of asthma in this population. The non-adherence to ICS medications in asthma is predicted to lead to an increased asthma mortality and morbidity.[20-23] Previous research has reported low compliance to ICS in Hispanic asthma patients. [16, 17] However, such studies were not conducted using nationally representative data.

The Hispanic population is growing in the United States and is becoming the largest minority population. With significant barriers to healthcare access, the impact of asthma on this population may be significant. Given this growing population it is important to understand the use of ICS in Hispanic asthma patients. However, no study with a nationally representative sample of Hispanics has been reported which assess the use of ICS in asthma. Such a study which assesses the use of ICS in a nationally representative sample of asthmatic patients would be valuable in answering the question of whether any possible disparities in the use of ICS exist. The proposed research will help delineate the

reasons for such disparities, if any. Knowing the reasons for disparities in ICS use would help in better asthma management. We propose the following aims:

Study hypotheses and specific aims

Specific aim 1: To determine if there is a difference in the proportion of Hispanic and non-Hispanic White asthmatic patients in the receipt of inhaled corticosteroid prescription for asthma.

Research hypothesis 1: There will be a difference in the proportion of Hispanic and non-Hispanic White asthmatic patients in the receipt of inhaled corticosteroid prescription for asthma.

Specific aim 2: To determine the predictors of the receipt of inhaled corticosteroid prescription in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 2: Certain factors (race/ethnicity, gender, age, level of education, smoking status, health insurance status, geographical region and metropolitan statistical area of residence, and having usual source of care) will influence the likelihood of the receipt of inhaled corticosteroid prescription in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 3: To examine the association of race/ethnicity with the utilization of asthma-related office and outpatient visits (hereafter referred to as office visits) in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 3: Race/ethnicity will influence the likelihood of having asthma-related office visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 4: To examine the association of receipt of inhaled corticosteroids prescription with the utilization of asthma-related office visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 4: Receipt of inhaled corticosteroid prescription will influence the likelihood of having asthma-related office visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 5: To examine the association of race/ethnicity with the utilization of asthma-related prescription fills in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 5: Race/ethnicity will influence the likelihood of having asthma-related prescription fills in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 6: To examine the association of race/ethnicity with the utilization of asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 6: Race/ethnicity will influence the likelihood of having asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 7: To examine the association of receipt of inhaled corticosteroid prescription with the utilization of asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 7: Receipt of inhaled corticosteroid prescription will influence the likelihood of having asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 8: To examine the association of race/ethnicity with the utilization of asthma-related inpatient visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 8: Race/ethnicity will influence the likelihood of having asthma-related inpatient visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 9: To examine the association of receipt of inhaled corticosteroid prescription with the utilization of asthma-related inpatient visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Research hypothesis 9: Receipt of inhaled corticosteroid prescription will influence the likelihood of having asthma-related inpatient visits in Hispanic and non-Hispanic White patients diagnosed with asthma.

Specific aim 10: To determine national prevalence estimates of the receipt of inhaled corticosteroid prescription and utilization of health services for asthma (office visits, prescription fills, emergency room visits, and inpatient visits) in Hispanic and non-Hispanic White patients diagnosed with asthma.

CHAPTER TWO: REVIEW OF LITERATURE

Asthma

Asthma is a chronic inflammatory disorder of the airways and is characterized by episodic and reversible airflow obstruction and airway hyper-responsiveness.[1] The airway hyper-responsiveness leads to recurrent episodes of wheezing, breathlessness, chest tightness, and coughing, particularly at night or in the morning.[1, 24] The factors that influence the risk of asthma can be categorized as those which cause the development of asthma (host factors) and those that trigger asthma symptoms (environmental factors). Host factors are mainly genetic, whereas the environmental factors are allergens such as mites, furred animals, pollen, viral infections and tobacco smoking.[1]

There is sufficient evidence that the clinical manifestations of asthma can be controlled with appropriate treatment, such as following medical management guidelines and avoiding exposure to environmental allergens and irritants that are known to exacerbate asthma.[24] Disease severity stages range from mild (with occasional symptoms) to severe (with persistent symptoms). However, even people with mild asthma may suffer from severe attacks. When asthma is controlled, there are no more than the occasional recurrence of symptoms and rare severe exacerbations. [25]

Approximately, 34.1 million Americans have been diagnosed with asthma by a health professional during their lifetime and in 2007 an estimated 300 million

people worldwide suffer from this condition.[2, 3] The prevalence of asthma in the US has increased 75% from 1980 to 1994; however it has increased 160% in children under the age of five in the same time period.[26] Although the diagnosis of asthma is more difficult among young children, the magnitude of the increase suggests that it is not solely due to changes in diagnostic practices or changes in coding practices.[27] National data suggests that there is an increase in self-reported prevalence of asthma in all age, race, and ethnic groups and among both males and females.[27] The latest data from the Center for Disease Control indicate an asthma prevalence rate of 8.4%, in 2010 in the United States.[8] It is estimated that the number of people with asthma will grow by more than 100 million by 2025.[3]

As the number of patients diagnosed with asthma is increasing, so is the number of deaths due to asthma. Most of the deaths in asthma occur in adults over 35 years of age, especially among adults over 65 years of age.[27] Asthma contributes to about 250,000 annual deaths across the globe.[3] In the United States 3,384 deaths have been attributed to asthma in 2005.[2] The rate of hospitalization has also increased during the late 1980s and has since plateaued.[27] Asthma accounts for nearly 500,000 hospitalizations each year [4]; in fact, asthma is the third ranking cause of hospitalization among children under the age of 15.[5]

The economic burden of asthma to the nation is substantial. A study by Weiss et al. estimated the direct and indirect asthma related costs to be $6.2 billion during 1990.[28] In 2000, asthma related costs increased 50% in 10 years.[28]

Asthma related hospital and emergency department costs have declined and costs for pharmaceuticals had increased. In 2007, the annual economic cost of asthma in the U.S. was estimated to be $19.7 billion.[2] Of this 14.7 billion was attributed to direct cost and $5 billion made up by indirect cost such as lost productivity. Prescription medications alone made up a major chunk of direct costs, over $6 billion. The United States spent an estimated $3,300 per person with asthma each year from 2002 to 2007 in direct and indirect costs.[29]

Asthma medications

Asthma is a reversible pulmonary disease in which an allergen exposure triggers airway constriction.[1] Over time, it results in progressive tissue damage and airway constriction. Currently there is no treatment which completely cures asthma and therefore the aim of any treatment is on improving symptoms and functional status. Early diagnosis and prompt therapeutic interventions along with changes in lifestyle are fundamental to optimizing treatment response and have the potential to reduce the frequency and severity of asthma symptoms.[1]

Medications used to control asthma are classified into two types: long-term controller medications, and quick-relief medications.[1] Long-term controller medications are used for controlling inflammation and preventing chronic symptoms such as coughing or breathlessness at night, in the early morning, or after exertion. Quick-relief medications on the other hand are used for easing asthma attacks when they occur. Asthma medications are categorized into two different classes: reliever medications and controller medications. The first

category is bronchodilators which provide quick relief of symptoms; these asthma medications relieve asthma symptoms by relaxing the muscle bands around the airways. This action rapidly opens the airways, thus leading to an increase the capacity of air in and out of lungs. As a result, breathing improves. Bronchodilators help clear mucus from lungs. As the airways open, mucus moves more freely and can be coughed out more easily.

The second category is of anti-inflammatory drugs which provide long term control. These are regarded as the most important type of therapy for most people with asthma because these medications prevent asthma attacks on an ongoing basis. Inhaled corticosteroids are an important type of anti-inflammatory medication for people suffering from asthma. These act by reducing swelling and mucus production in the airways, as result airways are less sensitive and less likely to react to triggers.

Inhaled corticosteroids

Inhaled corticosteroids (ICS) are widely used in the management of asthma and have become the first line of therapy for treating chronic asthma in many countries.[1] ICS are the most effective asthma therapy currently available, and studies in the past have documented their long-term efficacy in asthma control in adults and in children. [30, 31] ICS affect the transcription of several steroid-responsive genes, and, of particular importance, they may inhibit cytokine gene transcription and cytokine effects, thereby reducing chronic inflammation in asthmatic airways.[31] ICS are used in the initial stages in asthma therapy, and

there is a strong argument for their early introduction in both adults and children to prevent asthma morbidity and mortality and possibly the structural changes resulting from uncontrolled chronic inflammation, which may lead to irreversible airflow obstruction in some patients.[31]

The Global Initiative for Asthma (GINA) is an initiative developed in the early 1990s, under the umbrella of National Heart, Lung and Blood Institute of the National Institute of Health in the United States and the World Health Organization.[1] Its initial purpose was to develop asthma diagnosis and management guidelines that were applicable to both developed and developing countries, as asthma guidelines had been country-specific. Since its inception, GINA has undergone four major iterations and latest iteration is considered to be to rigorously evidence-based. GINA recommends ICS as the first line of therapy for treating asthma in all severity stages. The National Institute for Health and Clinical Excellence (NICE), U.K. also recommends ICS for treating asthma in all stages.[1, 32]

ICS are used as monotherapy as well as in combination with other controller and rescue medications (e.g., β-agonists, leukotriene receptor antagonists) in the treatment of asthma. They are considered to improve asthma control more effectively than any other agent used as a single treatment. ICS have the potential to improve a number of important asthma outcomes such as quality of life, frequency of asthma attacks, asthma symptoms, asthma control, hyper-responsiveness of airways, need for oral steroids, frequency of ER visits, hospitalizations and also mortality.[1]

Asthma disparities

Advances in health care and medicine in the United States in the past century have led to an overall reduction in mortality and morbidity.[31] Despite these improvements, racial and ethnic minorities continue to endure more health status and healthcare disparities than Non- Hispanic Whites. There is abundant evidence about the existence of ethnic/racial disparities in asthma prevalence, morbidity, mortality, medication utilization and other outcomes.[9, 33] Despite evidence documenting disparities in asthma prevalence and outcomes, the reasons behind these differences are poorly understood and do not seem to be fully explained by differences in severity and comorbid conditions.[34-36] Socioeconomic status (SES) and the disproportionate burden of poverty among ethnic/racial minorities in United States likely influence asthma-related health disparities.[18] Research suggests that SES affects race and ethnicity-based disparities in asthma-related emergency department use.[9, 37]

Genetic makeup, environmental risk factors, and differences in health behavior may also contribute to observed ethnic/racial differences in asthma prevalence and health outcomes, yet none of these fully explain asthma-related health disparities.[34, 36, 38] Numerous studies report race/ethnicity based disparities in receiving of asthma care, demonstrating that members of minority groups are less likely to receive recommended elements of asthma care.[10-13] However, other research suggests that despite documented ethnic disparities in asthma care the observed differences in asthma outcomes in the different ethnic groups are not fully explained by these disparities.[39]

Hispanics in the United States

Racial and ethnic minorities represent one third of the US population.[7] Among minorities, Hispanics are the fastest growing minority group in the United States. From 1990 to 2000, the Hispanic population residing in the United States grew by 61%, during the same time period the United States population only increased by 13%. In 2010 there were 50.4 million people in the United States who identified themselves as Hispanics, representing 16.3% of the entire population.[7]

The federal government defines Hispanic or Latino as a person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin.[7] Hispanics may belong to any racial groups. In 2010, 94% of Hispanics reported they were of single race. Approximately 6% of Hispanics reported being biracial or multiracial.[7] In 2010, more than half of the Hispanic Americans traced their ancestry to Mexico, with the remaining having roots in Puerto Rico, Central America, South America, Cuba, or "other Hispanic origin".[40] Approximately 60% of Hispanic Americans reported that they were born in the United States, and 40% reported that they did not speak English at home and that they spoke English less than "very well".[7]

The Hispanic population is more likely to reside in urban areas (46% versus 21%) with geographic population concentration comprising 44% of the regional population in the West versus 8% in the Midwest.[41] In 2002, 21.4% of Hispanics were living in poverty, compared with 7.8% of non-Hispanic Whites.

Hispanics represent approximately 13% of the United States population, however, they represent nearly 24% of those living in poverty.[41] However, there is a variation in the proportion of individuals living in poverty among Hispanic sub-groups. In 2002, 26% of Puerto Ricans were living in poverty, as were 23% of Mexicans, 17% of Cubans, 15% of Central and South Americans, and 18% of other Hispanics.[40] Only 52% of Hispanics had graduated from high school as compared to 80% of the total United States population. This again varied for Hispanic subgroups, ranging from 76% for South Americans to 46% for Mexicans.[40]

Hispanics belong to racially diverse groups partly due to migration to and from Spanish-speaking countries.[40] Hispanics are diverse with respect to racial ancestry, socioeconomic status, cultural practices, and utilization of health care.[40] As compared to non-Hispanic Whites, Hispanics often endure disproportionate burden of disease, mortality and disability and are less likely than Whites to receive healthcare services.[42] Hispanics have lower overall mortality rates compared to Non-Hispanic Whites however, display higher morbidity rates than Non-Hispanic Whites.[43]

Asthma prevalence among Hispanics

The National Health Interview Survey reported an overall increase in prevalence of self-reported asthma in the United States by 74% from 1980 to 1997.[44] In 2009, over 2.9 million Hispanics in the United States were diagnosed with asthma.[8] Most of the available information on asthma in Hispanics comes

from Puerto Rican and Mexican American populations. Current evidence suggests that Puerto Ricans have higher prevalence of asthma than any other ethnic group, including other Hispanic groups.[45] There is however, limited published information about the prevalence of asthma in Hispanic subgroups other than Puerto Rican and Mexican American.

According to the 2002 Behavioral Risk Factor Surveillance System (BRFSS), the prevalence of current asthma among all adults in the United States was 7.3%, whereas the prevalence of asthma in Hispanic adults in the United States was 5%. The prevalence was 11.6% among adults in Puerto Rico.[46] The second National Health and Nutrition Examination Survey (NHANES II) indicates that Puerto Rican children had the highest lifetime and current asthma prevalence of all ethnic groups.[47] According to NHANES III, the prevalence of asthma among Mexican American adults was lower (2.9%) than non-Hispanic Whites (4.7%) or non-Hispanic blacks (5.1%).[48] NHANES III also reported that the prevalence of lifetime asthma among Mexican American children was lower than among African American or White children.[49, 50]

There are concerns about the accuracy of statistics regarding asthma prevalence among minority populations.[45] National surveys that rely on parental report of physician-diagnosed asthma may underestimate the true prevalence of asthma among groups with inadequate access to health care or lower quality of health care. Others argue that poor, minority children may receive the majority of their health care in settings such as the emergency department, in which they are likely to acquire a diagnosis of asthma from an unfamiliar provider as opposed to

a primary care setting in which a provider observes a patient over time before assigning an asthma diagnosis.[51] A study by Akinbami et al. found that Puerto Ricans and non-Hispanic Blacks children, who wheezed in the past 12 months, were more likely to be diagnosed with asthma than Mexican and non-Hispanic White children with similar characteristics.[51] The same study reported that, Puerto Rican and White children were more likely than Black and Mexican American children to have health insurance (proxy for access to care) and to report usual source of care. Validation studies of parental reporting asthma diagnosis by objective measures of airway responsiveness or lung function are needed in Hispanic subgroups in the United States.[45]

Inhaled corticosteroid use for management of asthma in Hispanics

There are numerous studies which assess medication use and adherence to asthma management guidelines among ethnic minorities, including Hispanics.[33, 52] The National Asthma Education Prevention Program recommends that all patients with persistent asthma receive daily anti-inflammatory controller medications such as inhaled corticosteroids.[6] A study by Ortega AN, et.al, found that Hispanic children were less likely to receive inhaled corticosteroids than non-Hispanic white children (OR 0.3; 95% CI, 0.1 - 0.5), after adjusting for demographic variables.[18] A study by Finkelstein and coworkers reported that economically disadvantaged children with asthma were at a higher risk of under-treatment for asthma than non-Hispanic White children.[53] Although substantial underuse of controller medication was found among all children with persistent

asthma, Hispanic children were significantly more likely to be undertreated for asthma than white children.

The reasons for disparities in ICS use in Hispanics in asthma are unclear. In a study conducted among inner city Bronx, New York, 73% believed that complementary and alternative medicines were effective at treating asthma, and 27% reported use of complementary and alternative medicines instead of prescribed medication for the treatment of asthma symptoms. A study by Patcher et al. found that 96% of mothers of children with asthma reported use of asthma medications; they also believed that some complementary and alternative medicines and therapies were effective at treating asthma including Vicks VapoRub or camphor, massage, and folk remedies.[54, 55]

Medical Expenditure Panel Survey (MEPS)

Sponsored by Agency for Healthcare Research and Quality (AHRQ), the MEPS is an annually conducted nationally representative survey which began in 1996 and collects information about respondent's family, along with their health care providers and employers.[56] MEPS objective is to provide national estimates of health expenditures for the U.S. civilian, noninstitutionalized population.[56] MEPS is comprised of 4 surveys: the Household Component, the Medical Provider Component, the Insurance Component and the Nursing Home Component. The first 3 components provide comprehensive data for each surveyed individual in the following areas: demographic characteristics, health conditions, the level and distribution of health care use, prescription drug use,

expenditure on health services and health insurance coverage.[56] The Nursing Home Component collects information from a national sample of nursing homes and its residents. It collects the following information: health status of residents, health expenditures, characteristics of nursing homes, services provided by the nursing homes, sources of payments for the residents and provides information on the use of community-based services before admission to the nursing home.

The households sampled by MEPS are a subsample of respondents of the National Health Interview Survey (NHIS).[56] The NHIS follows a stratified, multistage, probability sampling design. The sampling is conducted in three stages. In the primary sampling unit, county, counties, or metropolitan statistical areas are selected. In the second stage, blocks are selected and finally, in the third stage, households are sampled. All the members of the household are surveyed (except those in the military). Households are interviewed in-person, 5 times in a two year period, approximately four months apart. MEPS uses a revolving panel design, which refers to designs with panels overlapping over time. A new series of data collection rounds is initiated each subsequent year on a new sample of households known as a new panel. For example, at the beginning of 1996, a panel of patients was introduced in the survey, panel 1; at the beginning of 1997, panel 2 was introduced; and so on. The 1996 MEPS was a nationally representative sample of the households in the 1995 NHIS. The 1997 MEPS sample comprises of a new sample of households from the 1996 NHIS in combination with the 1996 MEPS sample. Data from two panels in a year can be combined to provide national estimates on health expenditures,

health services utilization, and others.[56] An advantage of the overlapping panel design is that both continuous and current estimate on, health services utilization and expenditures at both person and household levels can be obtained.[56]

The response rate for MEPS varied from 70.7% in 1996, 63.1% in 1997 to 59.3% in 2008.[56] This high response rate is due to several strategies undertaken by MEPS. First the surveyors contact NHIS household via mail or telephone before the in-person interview. The letters are sent along with a $5 compensation. If households cannot be reached using telephone numbers from NHIS, they are contacted by mail. A computer assisted personal interview system is used for the final interviews. MEPS uses “dependent interviewing method”, in which the respondents are asked to revise or confirm the data provided in the previous interviews.[56] Each respondent in the MEPS data file has a unique identification number thus data from each year for each person can be summarized as 1 data point in the analysis. Therefore there are two data points for each respondent, each corresponding to 1 year.

Household component

The Household component collects detailed person level information on demographics, health conditions, health status, medical service use, access to care, charges and sources of payment, satisfaction with care, health insurance coverage, income and employment. The survey design makes it possible to determine how changes in respondents’ health status, income, employment,

eligibility for public and private insurance coverage, use of services and payment for care are related.

The most recent available dataset is of the year 2009. The Household Component datasets are available in three different files: Full-Year Consolidated Data File, Medical Conditions File and Prescribed Medicines File. The Full-Year Consolidated Data File contains information on demographic variables, geographic variables, employment status, health insurance status, the use of health services such as office-based visits, hospital visits, emergency room visits and home health service, and the expenditures associated with the use of these health services.[56]

Prescribed Medicines File records detailed information for each prescribed medicine event, when a prescribed medicine was purchased or obtained.[56] The file provides comprehensive information is provided for each prescribed medicine used. Information such as the date when the prescribed medication was first taken, and date when medication was filled, medication name, National Drug Code (NDC), quantity of medication dispensed, form of the medication, unit of measure, unit of measure for the strength of dose, dosage strength, total expenditure and sources of payments, whether the prescription is one in which the household received a free sample of it during a round, and full-year person level weight.

The Prescribed Medicines File also provides information on the type of pharmacies that filled the prescription. These include drug store, another store,

mail-order, and health maintenance organization or clinic or hospital. This file also incorporates medical conditions with which the respondents associate their prescriptions, however this information is incomplete and thus Prescribed Medicines File has to be linked to the Medical Conditions File which is useful in identifying the medical conditions of the survey respondents.

The medical conditions and procedures reported by the Household component respondents are recorded by the interviewer as verbatim text, which are then coded by professional coders to fully specified ICD-9 CM codes reported in the Medical Conditions File. These codes are further verified for accuracy. The error rate in reporting medical conditions is less that 2.5%.[56] Subjects in three files can be linked on the basis of the unique identity code assigned to each person.

A limited number of studies examining racial and ethnic disparities have used MEPS.[57-61] These studies examined racial and ethnic disparities in prescription medication expenditures, utilization of prescription medications and new medications. Wang J et.al claim that MEPS can play a significant role in studies of the racial and ethnic disparities in prescription drug use. [39, 56] Also, few studies in the past have utilized MEPS database to study asthma.[62-64] These studies have examined use of inhaled short acting beta-agonists in asthmatic patients, expenditures of treating asthma in the U.S. and characteristics of older adults in the Medicare Medication Therapy Management Program.

Review of studies which analyze the use of ICS in Hispanic and non-Hispanic White asthma patients

A literature review was conducted to identify published studies that reported predictors associated with the use of, or receiving ICS prescription in Hispanics diagnosed with asthma. We used numerous combinations of the following terms to identify relevant articles in the PubMed and International Pharmaceutical Abstracts (IPA) database: asthma, ethnic groups, ethnology, health disparity, healthcare disparities, health status disparities, Hispanic Americans, Hispanic, ethnicity, inhaled corticosteroid, ics, risk factor, steroid, and predictor.

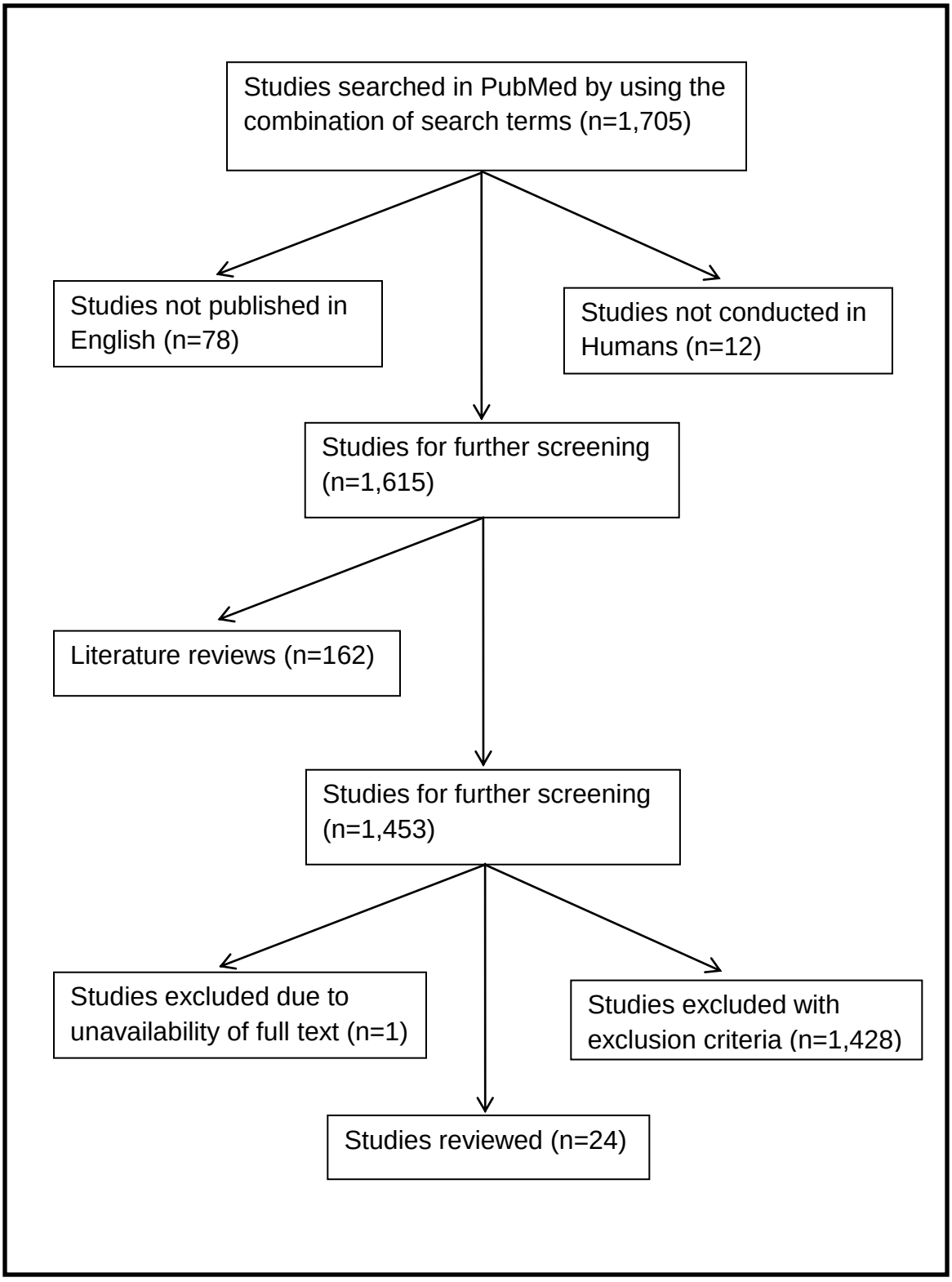
The following are the definitions of the above mentioned search terms presented for clarity. Asthma is defined as a respiratory condition marked by spasms in the bronchi of lungs, causing difficulty in breathing. It usually results from an allergic reaction or other forms of hypersensitivity. Health disparities are differences in the quality of health and health care across different populations. This may include differences in presence of disease, health outcomes, or access to health care across racial, ethnic, and socioeconomic groups. Ethnicity is defined as a state of belonging to a social group that has a common national or cultural tradition. Hispanic is defined as a person or people with origins in the Hispanic countries of Latin America or in Spain. Predictors or risk factors are defined as aspects of personal behavior or lifestyle, environmental exposure, or inborn or inherited characteristics, which, on the basis of epidemiologic evidence, are known to be associated with a health-related condition whose prevention is

considered important to prevent. We searched the databases for articles published in English and imposed no published date limits.

The inclusion criteria for the literature review included: 1) study investigating risk factors or predictors of asthma patients' receiving of ICS prescription, or use of or adherence to ICS; 2) study conducted in a developing or developed country; 3) study published in English; 4) study conducted in humans; 5) study with asthma patients of Hispanic and non-Hispanic White origin. The exclusion criteria for the review included: 1) literature review, commentary or editorial; 2) study on patients without a diagnosis of asthma.

We initially found a total of 1,705 studies using several combinations of our search terms. Of these 78 studies were excluded as these were not published in English. Of the remaining 1,627, 12 were excluded as these were not conducted in humans. We finally excluded 162 studies of the remaining 1,615 as these were literature reviews. We were left with 1,453 potentially useful studies for further screening. After reviewing the abstracts, 24 studies met the inclusion criteria. **(Figure 1)** The excluded articles were mainly related to 1) predictors of asthma mortality, hospitalization, exacerbations, or emergency department visits; 2) oral corticosteroid use in emergency department visits; 3) asthma as a predictor of mortality, hospitalization, health outcomes; 5) ethnicity or race as predictor of: asthma mortality, number of exacerbations, and hospitalization.

Figure 1: Flow diagram of literature review of ICS use in Hispanics and Whites



A total of 14 studies found a statistically significant difference in the use of or receiving an ICS prescription for asthma between Hispanic and non-Hispanic White patients.[16-19, 33, 52, 53, 65-71] All of these studies reported that Hispanics were significantly less likely than non-Hispanic Whites to receive a prescription for ICS, or use ICS for their asthma condition. Ten studies did not find a statistically significant difference in the use of or prescription for ICS for asthma between Hispanics and non-Hispanic Whites.[9, 72-80]

Predictors of receiving a prescription for or adherence to ICS medications in the treatment of asthma:

Predictors of receiving a prescription for or adherence to ICS medication in patients diagnosed with asthma can be summarized as follows: 1) health insurance status; 2) disease severity or co-morbid conditions; 3) provider type; 4) region; 5) metropolitan area; 6) gender; 7) age; 8) educational background; 9) smoking status; 10) prescription for short-acting beta-agonist (SABA); 11) usual source of care.

Health insurance status:

Published studies have reported the association between the types of health insurance and the use of health services.[81, 33, 52] Health insurance is an important factor for reducing patients' out-of-pocket cost of a health service. A patient with health insurance usually does not pay the total price for a good or service; rather, part of the entire price maybe paid by the third party payers on the patient's behalf.

Two studies found lack of health insurance to be a significant predictor of under-utilization of ICS[33, 52] and 1 study found lack of health insurance to be significantly associated with receiving ICS prescription.[72] Stingone JA et al. conducted a cross-sectional survey of 5,250 students children enrolled in 26 randomly selected public elementary schools in New York City.[33] They analyzed the predictors of underutilization of ICS or long-term controller medications prescribed by their primary care providers. Parents of 912 children reported their child to be diagnosed with asthma, and 29% of these reported using any long-term controller medication. The study found that Hispanic children were less likely to use ICS or any type of long-term controller medications as compared to non-Hispanic White children (OR 0.51, 95% CI 0.27-0.98). Having health insurance was associated with using ICS and other long-term controller medications. Children with no health insurance had very low odds of ICS use compared to children with private insurance (OR 0.20, 95% CI 0.04-1.09).

Lieu TA et al. conducted a cross-sectional telephone survey of parents of children diagnosed with asthma and insured by Medicaid in 5 managed care organizations, in 3 states in the U.S.[52] They reported that Latino children were statistically significantly less likely to use daily ICS and anti-inflammatory medications than White children with asthma (OR 0.52, 95% CI 0.33-0.82, p = 0.05) after adjusting for demographic variables and asthma status. The type of health insurance plan was found to be a predictor of ICS use. Cydulka RK conducted a retrospective cohort study to determine the frequency with which primary care physicians added ICS to the regimen of asthmatic patients after an

emergency department visit and to determine the rates at which ICS prescribed in emergency department were continued by primary care physicians. They conducted an electronic medical record review of patients aged 6 to 45 years of age, treated for acute asthma exacerbation in emergency department and followed them for a period of 1 year. Insurance status was found to significantly predict receipt of ICS. Patients with no insurance were significantly less likely to receive a prescription of ICS as compared to people with private insurance (OR 0.14; 95% CI 0.03-0.71).

Severity and co-morbidities:

In our literature review we determined studies which reported severity of Asthma as a predictor for the use and compliance with ICS medications.[16, 65, 75]

Legorreta AP et al. conducted a study in adults with asthma to determine the predictors of medical care in hospital admissions and emergency department visits.[16] A total of 5,580 patients belonging to a large HMO in California were enrolled in the study. Hispanic patients correlated negatively with daily ICS use (Hispanics versus Whites: OR 0.70, 95% CI 0.56-0.87). It was also found that, as compared to mild severity, patients with moderate to severe asthma had 1.29 (95% CI, 1.09-1.53) and 1.58 (95% CI, 1.33-1.87) greater odds of having received a prescription for ICS, respectively. Patients with severe asthma conditions had 1.39 (95% CI, 1.13-1.72) greater odds of using a steroid inhaler daily as compared to patients with mild severity.[16]

Halm EA and colleagues sought to determine whether quality and access to care over time was concordant with National Asthma Education and Prevention Program (NAEPP) guidelines.[75] They conducted a prospective, observational cohort study among a consecutive cohort of 198 New York City adults hospitalized for asthma in an urban academic medical center. Using multivariate analysis they found that greater asthma severity increased the odds of receiving ICS.[75]

Boudreaus ED et al. investigated ethnic differences in the management of acute asthma among children presenting to the emergency department.[74] Data was analyzed for 1,095 patients presenting to the emergency department of hospitals in 18 states between the time periods of 1997 to 1998. There was no difference between Hispanics and non-Hispanic White patients in the rates of ICS prescription after discharge; however the authors provide an interesting discussion about the severity of asthma. They report that Hispanic and Black patients were prescribed the same amount of ICS after discharge from emergency department or an outpatient visit as their White counterparts. This is particularly noteworthy considering Hispanic and Black patients indicated greater per person emergency department visits and hospitalization visits than White patients. This suggests that this population was in more need of ICS than Whites however, were prescribed equal amounts. This could also imply that the Black and Hispanic patients were not filling their prescriptions for various reasons.

Crocker D and colleagues conducted a study to analyze medication usage in children less than 18 years old, diagnosed with asthma and residing in

Alabama, California, Illinois and Texas.[65] They found that significantly fewer Hispanic (22%) children reported using ICS in the past 2 months as compared to white children (33%, p=0.001). They also found that ethnic differences in ICS use were most pronounced among children with persistent asthma.[65]

Provider type:

We identified 5 studies which reported the type of provider (who prescribed ICS in patients diagnosed with asthma) as a significant predictor of receiving a prescription, compliance with, or utilization of ICS medication.[16, 19, 53, 73, 76] Ferris TG et al. sought to determine the changes in relative rates of ICS use overtime in minority and nonminority children and adults with asthma.[19] They conducted a cross-sectional survey for 5 periods of 2 years' each (1989-1990, 1993-1994, 1995-1996, 1997-1998) using a nationally representative survey which provides assessments over time of U.S. office based physician practices. A total of 3,671 visits were included in the final study. They reported that Hispanic children and adults were statistically significantly less likely than Whites to receive a prescription for ICS from 1989 to 1990 and 1995 to 1996 (OR 0.37, 95% CI 0.23-0.61; OR 0.37, 95% CI 0.26-0.51, respectively). Physician specialty was found to be one of the significant predictors of ICS prescription for the time period 1989-1990 and 1995-1996. Visits to "specialists" (pulmonologist and allergists) was associated with significantly higher prescription of ICS as compared to visits to primary care physicians (internal medicine and family practitioners) (1989-1990: OR 3.13, 95% CI 2.58-4.17; 1995-1996: OR 2.20, 95% CI 1.69-2.89).[19]

Finkelstein JA and colleagues conducted a cross-sectional study using telephone surveys among parents of Medicaid insured children (aged 2 to 16 years with asthma) to determine the frequency of underuse of controller medications and to determine the predictors of underuse.[53] The study reported that Latino children, compared to White children, were more likely to underuse ICS (OR 2.2, 95% CI 1.3-3.8). Having seen an asthma specialist was significantly associated with lower rates of under use controller medications including ICS (OR 0.5, 95% CI 0.4-0.7).[53]

Legorreta AP et al. conducted a study in 5580 adults with asthma enrolled in a large HMO in California to determine the predictors of medical care in hospital admissions and emergency department visits.[16] Hispanic patients were correlated negatively with daily ICS use (OR 0.70, 95% CI 0.56-0.87). Patients who received treatment from an asthma specialist were positively correlated with having prescribed ICS (OR 2.40, 95%, CI 2.04-2.82) and daily use of ICS (OR 2.25, 95% CI 1.91-2.64).[16] A study conducted by Shields AE et al. used a sample of 5,773 Medicaid insured children with asthma and found that Hispanic children were 39% less likely than White children to see a specialist for their asthma (OR 0.61, 95% CI 0.46-0.81).[76] Similarly, a study by Stewart KA et al. conducted in children enrolled in TRICARE Prime, a health maintenance organization benefit provided by the U.S. Department of Defense, reported that Hispanic children were significantly less likely to see an asthma specialist for their condition as compared to non-Hispanic White children with asthma (OR 0.88, 95%, CI 0.79-0.98).[73]

Region:

Ferris TG et al. conducted a study to determine the changes in relative rates of ICS use over time in minority and non-minority children and adults with asthma.[19] They conducted a cross-sectional survey for 5 periods of 2 years' each (1989-1990, 1993-1994, 1995-1996, 1997-1998) using a nationally representative survey which provide assessments over time of U.S. office based physician practices. Hispanic children and adults were statistically significantly less likely than Whites to receive a prescription for ICS from 1989 to 1990 and 1995 to 1996 (OR 0.37, 95% CI 0.23-0.61; OR 0.37, 95% CI 0.26-0.51, respectively). Each individual record on the database was assigned a region where the person resided. These regions were classified as Northeast, Midwest, South and West. The study reported that, between 1989 and 1990, people in the South region had 1.52 (95% CI 1.52) greater odds of being prescribed ICS compared to people in the West region. No significant difference was found between other regions.[19] Thus, region is found as a significant predictor of ICS use in asthma and will be analyzed in our study.

Metropolitan area:

A study conducted by Kuo A and Craig TJ examined risk factors for repeated hospital admission for asthma.[77] They performed medical chart review of patients who were hospitalized two or more times with the diagnosis of asthma between 1991 and 1998. Hispanic represented 12% of the study population. The results of the study suggest that patients in the rural/suburban areas, as

compared to urban areas, had repeated hospitalizations for asthma had a higher probability of noncompliance and demonstrated underuse of ICS.[77]Thus, metropolitan area was found to be a significant predictor of ICS use in our literature review and would be analyzed in our study.

Gender:

Forester JP and colleagues sought to evaluate pediatric asthma management and outcomes for different racial groups.[78] Parents of 80 children were administered a survey at two military pulmonary clinics in located in urban areas in Texas. There were no differences associated with the use of ICS between Hispanics and Whites. However, one measurable difference in management practice was that males were less likely than females (OR 0.06, 95% CI 0.01-0.62) to have an active prescription of ICS.[78]

Ferris TG et al. sought to determine the changes in relative rates over time of ICS use in minority and nonminority children and adults with asthma.[19] It was found that for the time period 1989 to 1990, significantly less number of males received a prescription for ICS as compared to females (OR 0.63, 95% CI 0.48-0.84). Legorreta AP et al. conducted a study in adults with asthma to determine the predictors of medical care in hospital admissions and emergency department visits.[16] The number of males ever prescribed ICS for asthma was significantly lower than females (OR 0.79, 95% CI 0.69-0.90).

Age:

Legorreta AP et al. conducted a study in adults with asthma to determine the predictors of medical care in hospital admissions and emergency department visits.[16] A total of 5,580 patients belonging to a large HMO in California were enrolled in the study. Hispanic patients were negatively correlated with daily ICS use (Hispanics versus Whites: OR 0.70, 95% CI 0.56-0.87). The study reported that age groups of 26-35, 36-45, 46-55 and 56-65 years had 1.57 (95% CI 1.23-2.01), 1.81 (95% CI 1.44-2.29), 2.03 (95% CI 1.61-2.57), and 2.45 (95% CI 0.69-0.90) greater odds of being prescribed ICS as compared to 14-25 year olds. It was also reported that age groups of 26-35, 36-45, 46-55 and 56-65 years had 1.82 (95% CI1.32-2.52), 1.77 (95% CI 1.30-2.41), 2.31 (95% CI 1.70-3.15) and 3.29 (95% CI 2.40-4.52) greater odds of using ICS daily as compared to 14-25 year olds.

A study by Ferris TG et al. to determine the changes in relative rates over time of ICS use in minority and nonminority children and adults with asthma found age as a significant predictor ICS use.[19] In the time period 1995-1996 age groups, 0-12 (OR 0.52, 95% CI 0.40-0.66) and 13-20 (OR 0.39, 95% CI 0.28-0.55) reported their ICS use to be significantly lower than people in the age group of 21-60 years. For the time period 1989 to 1990 children in the age group of 0-12 (OR 0.34, 95% CI 0.25-0.47) years reported significantly lower use of ICS as compared to adults in the age group of 21 to 60 years.

Educational background:

Legorreta AP et al. conducted a study in adults with asthma to determine the predictors of medical care in hospital admissions and emergency department visits.[16] Hispanic patients were negatively correlated with daily ICS use (Hispanics versus Whites: OR 0.70, 95% CI 0.56-0.87). It was also reported that patients who reported completing at least some college had 1.48 (95% CI 1.26-1.73) greater odds of receiving an ICS inhaler as compared to people who reported having less than college education. Finkelstein JA and colleagues conducted a cross-sectional study using telephone surveys among parents of Medicaid insured children, aged 2 to 16 years with asthma, to determine the frequency of underuse of controller medications and to determine the predictors of underuse.[53] it was found that Latino children, as compared White children, were more likely to show presence of underuse of ICS (OR 2.2, 95% CI 1.3-3.8). Parental education beyond high school predicted lower rates of underuse of ICS (OR 0.6, 95% CI 0.2-0.8).

Apter AJ et al. conducted a study to examine patient characteristics associated with twice daily dosing of ICS.[17] The sample included fifty adults with moderate to severe asthma who completed a survey that included sociodemographics, asthma severity, and health locus of control. Adherence to ICS was electronically monitored. The study reported that belonging to minority group (Hispanics and African American) was significantly associated with poor adherence to ICS as compared to being White (OR 1.2, 95% CI 1.01-1.55). Also, having less than 12 years of formal education associated positively to being non-adherent (OR 6.72, 95% CI 1.10-41.0).

Smoking Status:

Legorreta AP et al. conducted a study in adults with asthma to determine the predictors of medical care in hospital admissions and emergency department visits.[16] Hispanic patients correlated negatively with daily ICS use (Hispanics versus Whites: OR 0.70, 95% CI 0.56-0.87). Patients who reported having smoked ever, or are current smokers had lower odds of being prescribed ICS as compared to patients who did not report the same (OR 0.88, 95% CI 0.77-1.07).

Prescription for short-acting beta agonist:

Ferris TG et al. conducted a study to determine the changes in relative rates over time of ICS use in minority and nonminority children and adults with asthma.[19] It was found that Hispanics children and adults were statistically significantly less likely than Whites to receive a prescription for ICS from 1989 to 1990 and 1995 to 1996 (OR 0.37, 95% CI 0.23-0.61; OR 0.37, 95% CI 0.26-0.51, respectively). It was also found that people who received a prescription for short-acting beta agonists (SABA) had 2.30 (95% CI 1.76-3.01) and 2.06 (95% CI 1.66-2.54) greater odds of receiving a prescription for ICS for the time periods 1989-1990 and 1995-1996, respectively.

Usual source of care:

Halm EA and colleagues sought to determine whether quality and access to care over time was concordant with National Asthma Education and Prevention Program (NAEPP) guidelines.[75] They conducted a prospective, observational cohort study among a consecutive cohort of 198 New York City

adults hospitalized for asthma in an urban academic medical center. Using multivariate analysis they found that having a usual source of care increased the odds of receiving ICS.[75]

Summary of the literature review

The existing literature in Hispanic and non-Hispanic White asthmatic populations provides an insight into various factors that can potentially influence the receipt of or adherence to ICS medications for asthma. The study samples in our literature review are very heterogeneous making comparisons across studies difficult. The literature suggests that there is significant difference in the receipt of and adherence to ICS medications in asthma between Hispanic and non-Hispanic White asthmatic populations. Hispanic asthmatic patients were statistically significantly less likely than non-Hispanic White asthmatic patients to either receive prescriptions for ICS or to be adherent to ICS medications.

Other socioeconomic factors have also found to be significant predictors of receipt of or adherence to ICS medications in Hispanic and non-Hispanic White asthmatic patients. Having health insurance, visiting asthma specialist, residing in the southern U.S. region, residing in urban areas, being older, having greater asthma severity, being a non-smokers, using beta agonists, and having a usual source of care were all significantly associated with higher use of or receiving prescription for ICS. Our literature review showed mixed association between gender and receiving a prescription for ICS.

Overall the literature review provided important variables which could predict the receipt of or adherence to ICS in Hispanic and non-Hispanic White asthma patients. However, due to heterogeneity of the study samples and limited sample sizes, the results of these studies cannot be extrapolated to the U.S. population. A study conducted in a nationally representative data of the U.S. population can provide a better insight into factors that predict the receipt of or adherence to ICS in nationally representative Hispanic and non-Hispanic White populations.

CHAPTER THREE: METHODS

Data source

We utilized the Household Component of the U.S. Medical Expenditure Panel Survey (MEPS) 2009 dataset. The dataset is available online for public use: http://www.meps.ahrq.gov/mepsweb/. The MEPS dataset contains information on a U.S. nationally representative sample of individuals on demographics, medical conditions, medication use, and healthcare expenditures. As the MEPS dataset is available for public it is not subject to Institutional Review Board (IRB) approval.

Study population

Selection criteria:

Our analysis included MEPS survey participants with a self-reported diagnosis of asthma. Subjects were identified in the MEPS database using the three-digit codes from the *International Classification of Disease, Ninth Revision, Clinical Modification* (ICD-9-CM) system that has been applied to medical conditions reported by survey participants; included ICD-9-CM code for Asthma is 493. Race and ethnicity is documented in the MEPS database. Subjects who reported their ethnicity as Hispanic, irrespective of their race, and subjects who reported their race as non-Hispanic White were included in the study. Subjects with complete data and no missing values on race and ethnicity were included.

Also, subjects above 4 years of age were only included in the study. GINA guidelines do not recommend the use of ICS in children 4 years and below and so these asthmatic patients were excluded.[1]

Variables for the study

For specific aim 1, to determine if there is a difference in the proportion of Hispanic and non-Hispanic White asthmatic patients in the receipt of inhaled corticosteroid prescription for asthma, the dependent variable was receipt of an ICS prescription and the independent variable was ethnicity. In MEPS, each member of the sampled family is asked to report race and ethnicity. If the information is not reported in the interview, it is collected in the following priority order. First, if available, it is collected from NHIS. MEPS includes racial and ethnic groups similar to NHIS, except that some groups are further divided into subgroups.[82] If unavailable from NHIS, race and ethnicity are assigned according to relationships with other members in the same dwelling unit.

There are 5 racial groups in MEPS: American Indian, Aleut Eskimo, Asian or Pacific Islander, Black and White. MEPS also provides additional information on Hispanic origin. Hispanic is an ethnic group, although at least one previous study by Chen and Chang listed Hispanic along with racial groups.[58] MEPS oversamples Blacks and Hispanics in-order to make estimates on these population groups reliable. Most other surveys do not have sufficient number of Hispanics to be representative of the general population and thus lack the statistical power to examine these minorities.[39]

For specific aim 1 the dependent variable is a binary variable. As aforementioned, the Prescribed Medicines File records the healthcare utilization of subjects included in the survey. ICS medications prescribed in patients with asthma were determined from their reported names. Subjects with the receipt of ICS prescription were Hispanic and non-Hispanic White patients diagnosed with asthma and obtained at least one prescription fill of ICS medication in 2009.

For specific aim 2,to determine the predictors of the receipt of inhaled corticosteroid prescription in Hispanic and non-Hispanic White patients diagnosed with asthma, the dependent variable was receipt of ICS prescription and the independent variables were race/ethnicity, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, receipt of SABA prescription, self-perceived overall health status, and self-perceived mental health status.

MEPS categorizes family income into the following 5 groups – poor: <100% of poverty line; near poor: 100 to <125% of poverty line; low income: 125 to <200%; middle income: 200 to <400%; and high income: 400% or greater. We used the same classification provided by MEPS. MEPS dataset provides the exact age of a person as on 12/31/2009. This age is calculated as per the date of birth of the person. Smoking status of subjects is reported in the MEPS survey in the form of closed ended question. It determines the smoking status of the subject during the time of the survey. Survey subjects are asked to report if they consider themselves as smokers during the time of the survey. They report their

smoking status as “yes” and “no”. Marital status of subjects was used as per the MEPS reporting of marital status: married, widowed, divorced, separated, and never married. Educational background was categorized as follows: kindergarten, elementary, high school, and attended some college or above. Region of residence is classified in 4 sub-types as per the MEPS database: Northwest, Midwest, South and West. The same classification was used for the analysis. Patients’ experience of the number of asthma attacks in 2009 is also recorded in the MEPS database. We categorized patients as experiencing asthma attack if they had at least one asthma attack in 2009. Patients who did not experience even one asthma attack in 2009 were considered in the ‘no asthma attack’ category.

MEPS has the following categories of health insurance coverage: any private health insurance, public only (Medicaid or the State Children’s Health Insurance Program; Medicare; or other public plans), and uninsured. Patients’ perceived overall health status is also a predictor for health service use.[81] The better the perceived health status, the lower the number of prescriptions a patient typically uses. Patients’ self-perceived overall health status variable in MEPS includes the following values: excellent, very good, good, fair and poor. The psychological, cognitive, and psychosocial functioning characteristics of patients are important when examining health service use.[81] MEPS has a measure of “perceived mental health status” which has the following values: excellent, very good, good, fair, and poor. For both self-perceived overall health and self-perceived mental health, scores of 5, 4, 3, 2 and 1 are assigned to health states

excellent, very good, good, fair and poor, respectively. Both the self-perceived overall health and self-perceived mental health questions are asked three times in 2009. We used the average of the 3 reported scores in our analysis.

For each individual family member, the MEPS questionnaire ascertains whether there is a particular doctor's office, clinic, health center, or other place that the individual usually goes to if he/she is sick or needs advice about his/her health. This is considered as the person's usual source of care.

The dependent variable in the analysis of aims 3 and 4 were asthma-related office visits; for the analysis of aim 5 was asthma-related prescription fills; for analysis of aims 6 and 7 were asthma-related emergency room visits; and for the analysis of aims 8 and 8 were asthma-related inpatient visits. The MEPS dataset indicates the total number of 2009 events that can be linked to each condition. We used the total number of events associated with asthma. The total number of asthma-related office visits and outpatient visits were combined to get total number of asthma-related office visits. The independent variables for the analyses of aims 3, 4, 5, 6, 7, 8, and 9 were same as those for the analyses of aim 2: race/ethnicity, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, self-perceived overall health status, and self-perceived mental health status.

Analyses

The baseline characteristics of the study population are presented in simple frequencies, means and percentages.

Specific aim 1: Specific aim 1 was to determine if there is a difference in the proportion of Hispanic and non-Hispanic White asthmatic patients in the receipt of inhaled corticosteroid prescription for asthma. We determined the number of Hispanics and the number of non-Hispanic White patients ever prescribed ICS in the year 2009. The dependent variable for analysis was receipt of ICS prescription and the independent variable was race/ethnicity. A simple chi-squared test was conducted to analyze the difference in proportions between the two groups. We conducted separate analyses for children (under 18 years of age) and for adults (above 18 years of age).

Specific aim 2: Specific aim 2 was to determine the predictors of the receipt of inhaled corticosteroid prescription in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed multiple logistic regression analysis to determine the significant factors influencing the receipt of ICS prescription. The dependent variable for the analysis was receipt of ICS prescription and the independent variables were race/ethnicity, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, receipt of SABA prescription, self-perceived overall health status, and self-perceived mental health status. We conducted separate analyses for children (under 18 years of age) and for adults (above 18 years of age). Bivariate logistic regression analyses were performed by taking each predictor one at a time to

determine its influence on receipt of ICS prescription. Variables determined significant at p value less than 0.2 in the bivariate analyses were then incorporated in the final multiple regression models to predict the receipt of ICS prescription. A *p* value ≤ 0.05 was considered in determining statistical significance in the multiple logistic regression analyses.

Specific aim 3: Specific aim 3 was to examine the association of race/ethnicity with the utilization of asthma-related office visits in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed multivariable analyses to examine disparities in asthma-related office visits utilization predicted by race/ethnicity while controlling for other predictors. The independent variables for the analyses were race/ethnicity, receipt of ICS prescription, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, receipt of SABA prescription, self-perceived overall health status, and self-perceived mental health status. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an office visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related office visits. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related office visits was used in the model. The

same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 4: Specific aim 4 was to examine the association of receipt of inhaled corticosteroid prescription with the utilization of asthma-related office visits in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed similar analyses conducted for aim 3 to examine disparities in asthma-related prescription fills predicted by the receipt of ICS prescription while controlling for other predictors. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an office visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related office visits. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related office visits was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling design of the MEPS, thereby

providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 5: Specific aim 5 was to examine the association of race/ethnicity with the utilization of asthma-related prescription fills in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed multivariable analyses to examine disparities in asthma-related prescription fills predicted by race/ethnicity while controlling for other predictors. The independent variables for the analyses were race/ethnicity, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, self-perceived overall health status, and self-perceived mental health status. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had a prescription fill, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related prescription fill. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related prescription fills was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling

design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 6: Specific aim 6 was to examine the association of race/ethnicity with the utilization of asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed multivariable analyses to examine disparities in asthma-related emergency room visits utilization predicted by race/ethnicity while controlling for other predictors. The independent variables for the analyses were race/ethnicity, receipt of ICS prescription, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, receipt of SABA prescription, self-perceived overall health status, and self-perceived mental health status. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an emergency room visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related emergency room visit. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related emergency room visits was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the

complex sampling design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 7: Specific aim 7 was to examine the association of receipt of inhaled corticosteroid prescription with the utilization of asthma-related emergency room visits in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed similar analyses conducted for aim 3 to analyze disparities in asthma-related emergency room visits predicted by the receipt of ICS prescription while controlling for other predictors. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an emergency room visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related emergency room visit. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related emergency room visits was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 8: Specific aim 8 was to examine the association of race/ethnicity with the utilization of asthma-related inpatient visits in Hispanic and non-Hispanic

White patients diagnosed with asthma. We performed multivariable analyses to analyze disparities in asthma-related inpatient visits utilization predicted by race/ethnicity while controlling for other predictors. The independent variables for the analyses were race/ethnicity, receipt of ICS prescription, gender, age, marital status, level of education, smoking status, health insurance coverage, income category, region of residence, metropolitan statistical area, usual source of care, asthma attack, receipt of SABA prescription, self-perceived overall health status, and self-perceived mental health status. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an inpatient visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related inpatient visit. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related inpatient visits was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 9: Specific aim 9 was to examine the association of receipt of inhaled corticosteroid prescription with the utilization of asthma-related inpatient

visits in Hispanic and non-Hispanic White patients diagnosed with asthma. We performed similar analyses conducted for aim 3 to analyze disparities in asthma-related prescription fills predicted by the receipt of ICS prescription while controlling for other predictors. For the multivariable analyses we used multiple logistic regression to estimate odds ratios and negative binomial regression to estimate incidence rate ratios. The 2 estimates represent the use of 2 different types of measures for health service utilization: the first is whether or not patients with asthma ever had an office visit, and second is how often they had it. In estimating odds ratios by using logistic regression, we used dichotomous dependent variable for whether patients used asthma-related office visit. To estimate incidence rate ratios using negative binomial regression, data for the number of times asthma-related office visits was used in the model. The same set of predictors included in the logistic regression was used to estimate incidence rate ratios in the negative binomial regression. All estimates were weighted to account for the complex sampling design of the MEPS, thereby providing nationally representative figures. All estimates were considered significant at $p \leq .05$.

Specific aim 10: Specific aim 10 was to determine national prevalence estimates of the receipt of inhaled corticosteroid prescription and utilization of health services for asthma (office visits, prescription fills, emergency room visits, and inpatient visits) in Hispanic and non-Hispanic White patients diagnosed with asthma. We determined national prevalence estimates by accounting for the complex sampling design of the MEPS, thereby providing nationally

representative figures. All analyses incorporated MEPS person-level weights and variance adjustment weights (strata, cluster and primary sampling unit). Oversampling of Hispanics by MEPS was adjusted for by using Taylor series linearization method. All analyses were conducted in SAS version 9.2 for Windows (SAS Institute, Cary, NC).

Power analysis

Sample size calculations were based on the analysis of aim 2, to determine the predictors of receiving ICS prescription in patients diagnosed with asthma. The independent variable considered for the analysis was ethnicity and the dependent variable was receipt of ICS prescription. The sample size calculations were performed using PASS 11 Software (Kaysville, Utah).

For this calculation, we set the alpha value (the power of rejecting the null hypothesis) as 0.05 and sample sizes were calculated to achieve power of 0.80 and 0.70. Estimates of required total sample size were based on previously reported prevalence of ICS use in patients with asthma. The calculated sample sizes are reported in Table 1.

Table 1: Logistic regression power analysis

Power	N	P0	P1	Odds Ratio	R Squared	Alpha	Beta
0.69154	37	0.400	0.063	0.100	0.000	0.05000	0.30846
0.69703	100	0.400	0.167	0.300	0.000	0.05000	0.30297
0.69986	276	0.400	0.250	0.500	0.000	0.05000	0.30014
0.69991	996	0.400	0.318	0.700	0.000	0.05000	0.30009
0.79660	49	0.400	0.063	0.100	0.000	0.05000	0.20340
0.79756	129	0.400	0.167	0.300	0.000	0.05000	0.20244
0.79947	353	0.400	0.250	0.500	0.000	0.05000	0.20053
0.79977	1270	0.400	0.318	0.700	0.000	0.05000	0.20023

Report Definitions
Power is the probability of rejecting a false null hypothesis. It should be close to one. N is the size of the sample drawn from the population. P0 is the response probability at the mean of X. P1 is the response probability when X is increased to one standard deviation above the mean. Odds Ratio is the odds ratio when P1 is on top. That is, it is [P1/(1-P1)]/[P0/(1-P0)]. R-Squared is the R2 achieved when X is regressed on the other independent variables in the regression. Alpha is the probability of rejecting a true null hypothesis. Beta is the probability of accepting a false null hypothesis.

Summary Statements
A logistic regression of a binary response variable (receipt of ICS prescription) on a binary independent variable (ethnicity) achieves 69% power at a 0.05000 significance level to detect a change in Prob(Receipt of ICS=1) from the baseline value of 0.400 to 0.063. This change corresponds to an odds ratio of 0.100.

A logistic regression of a binary response variable (receipt f ICS prescription) on a binary independent variable (ethnicity) with a sample size of 49 observations achieves 80% power at a 0.05000 significance level to detect a change in Prob(Receipt of ICS=1) from the baseline value of 0.400 to 0.063. This change corresponds to an odds ratio of 0.100.

Based on the above power analysis, the required sample size to achieve a power of 80% is about 1,270. In the MEPS database, there are a total of 1,469 patients (representative of 14,476,600 patients) which satisfy our inclusion criteria. So, we have enough sample size to ensure power sufficiency.

Human Research Review Committee (HRRC) approval

These analyses did not require UNM HRRC approval because the research was secondary analysis of a publicly available dataset. Under the federal regulations for human subject research (45 CFR Part 46), IRB review of analysis of publicly available data sets that are stripped of identifiers is not required.

CHAPTER FOUR: RESULTS

This chapter presents the results of the study aims. A description of the study population is presented, followed by description of the sample as per receipt of ICS prescription and utilization of healthcare services. The results of the multiple logistic regressions and negative binomial regressions are presented.

Description of the study population

Demographic characteristics of the study population are presented in Table 2. A total of 1,469 patients satisfied the criteria for inclusion into the study. This sample is representative of 14,476,600 numbers of US Hispanic and non-Hispanic White patients diagnosed with asthma and above the age of 4 years in 2009. The mean age of the study population was 39.9 ± 0.03 years; the majority of population was in the age group of 41 to 65 years (36.17%) and almost half (49.1%) of the study population was less than or equal to 40 years of age. Of the total study population, 16.09% were Hispanics and 83.91% were non-Hispanic Whites. The majority of patients were female (59.48%) and reported to be non-smokers or had quit smoking (77.72%) at the time of the survey. Only 22.28% of patients reported that they were still active smokers (current smokers).

Three-fourths of the population indicated that they had education level of high school and above (75.89%), with 38.94% reported having a college education; 24.12% indicated they had education level of less than high school.

About, 19.41% of the population was widowed, divorced, or separated at the time of the survey. About 39.25% of the population was married; 41.34% of the population reported to have never married. More than 90% of the population reported having some type of health insurance coverage, either private or public (92.15%), during the survey time period. Of these, 64.01% patients had private health insurance. About, 29.23% and 32.77% of the patients belonged to the middle income and high income groups, respectively. An approximately, equal proportion of patients belonged to the less than middle income poverty categories (38%).

The study population was almost equally geographically distributed in the northeast (19.75%), midwest (22.86%), south (32.99%) and west (24.4%) regions of US. A majority of the study population was residing in urban metropolitan statistical areas (80.5%) and reported having a usual source of care (90.14%). About 63.01% of patients reported experiencing at least one asthma attack during the study period. About 47.26% of the population had received a prescription for short acting beta agonist (SABA) during the study period. The population had a mean self-perceived mental health score of 2.25 (± 0.03, standard error) and a mean self-perceived overall health score of 2.73 (± 0.04, standard error) on a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health. These scores are an average of three scores recorded on three separate occasions during the study time period.

Table 2: Baseline characteristics of the study population

Variable		Total = 14,476,600 [b]		
		Study Sample [a]	Weighted Population [a b]	% [b]
Race/Ethnicity	Hispanic	480	2,329,417	16.09
	White	989	12,147,183	83.91
ICS prescription	No	995	9,134,486	63.1
	Yes	474	5,342,113	36.9
Gender	Male	595	5,865,727	40.52
	Female	874	8,610,873	59.48
Age			39.9*	0.03**
	5 to 18	431	3,574,930	24.82
	19 to 40	347	3,495,833	24.27
	41 to 65	488	5,209,250	36.17
	65 and above	193	2,121,056	14.73
Marital status	Married	512	5,680,698	39.25
	Widowed	95	1,055,647	7.29
	Divorced	149	1,489,995	10.30
	Separated	42	263,534	1.82
	Never married	656	5,983,042	41.34
Education	Kindergarten	84	604,595	4.28
	Elementary	366	2,805,368	19.84
	High school	524	5,224,535	36.95
	College	445	5,505,846	38.94
Smoking status	Yes	210	2,310,718	22.28
	No	748	8,062,870	77.72
Health insurance	Any private	762	9,266,380	64.01
	Public only	565	4,073,932	28.14
	Uninsured	142	1,136,287	7.85
Income category (family income as a percentage of	Poor/negative (<100%)	396	2,431,515	16.8
	Near poor	107	824,014	5.69

Variable		Total = 14,476,600 [b]		
		Study Sample [a]	Weighted Population [a b]	% [b]
poverty line)	(100%-124%) Low income (125%-199%)	238	2,245,740	15.51
	Middle income (200%-399%)	386	4,230,815	29.23
	High income (≥400%)	342	4,744,515	32.77
Region	Northeast	269	2,843,516	19.75
	Midwest	331	3,292,265	22.86
	South	449	4,751,456	32.99
	West	410	3,513,832	24.40
Metropolitan Statistical Area (MSA)	Non-MSA	257	2,808,410	19.50
	MSA	1202	11,592,660	80.50
Usual source of care	Yes	1291	12,925,195	90.14
	No	158	1,414,389	9.86
Asthma attack	Yes	712	6,892,842	63.01
	No	383	4,045,855	36.99
SABA prescription	No	749	7,634,298	52.74
	Yes	720	337,918	47.26
COPD	No	1,112	10,764,149	74.36
	Yes	357	3,712,450	25.64
BMI			28.45*	0.29**
Mental health [c]			2.25*	0.03**
Overall health [c]			2.73*	0.04**

[a] Sample size may vary due to missing data.
[b] Weighted
[c] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health
* Mean
** Standard error

Population characteristics as per receipt of ICS prescription

Table 3 presents the demographics of entire study population as per the receipt of ICS prescription. A total of 9,134,487 (63.1%) patients did not receive a prescription for ICS medications during the study time period. Only 36.9% of patients received an ICS prescription, of these 90.3% were non-Hispanic Whites and 9.7% were Hispanics. Of the total non-Hispanic White asthmatic patients, 39.71% reported receiving an ICS prescription, and of the total Hispanic asthmatic population 22.24% reported receiving an ICS prescription. A significantly lower proportion ($p<0.0001$) of Hispanic asthmatic patients received a prescription for ICS medication as compared to non-Hispanic White asthmatic patients.

In the entire study population about, 34.26% of males, 50.2% in the age group of 65 years and above, 45.7% divorced, 40.9% with college education, 41.32% non-smokers, 41.48% having private health insurance coverage, 50.32% belonging to high income group, 47.6% from northeast, 37.96% residing in a metropolitan statistical area, 39.26% with usual source of care, 48.45% who received an ICS prescription, and 38.34% who experienced an asthma attack in past 6 months had received a prescription for ICS medication. Patients receiving an ICS prescription had a mean self-perceived mental health score of 2.21 (± 0.04, standard error) and a mean self-perceived overall health score of 2.82 (± 0.04, standard error) on a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health.

Children (5 years to 17 years old)

Table 4 presents the demographics of patients under the age of 18 years of age as per the receipt of ICS prescription. About 47.44% of children were of Hispanic ethnicity and 52.56% were non-Hispanic Whites. Of the total Hispanic children in the study sample about 23.8% had received a prescription for ICS medication. Among non-Hispanic White children about 50.7% received a prescription for ICS medication. In the chi-squared analysis this difference was found statistically significant (p=0.0029).

Among Hispanic children about 22.69% of males, 25.56% in the age group of 5 to 10 years, 26.09% with private health insurance coverage, 38.46% belonging to high income group, 25.37% from the west, 24.26% residing in a metropolitan statistical area, 24.84% having a usual source of care, 33.33% with a receipt of SABA prescription, and 35.42% experiencing no asthma attack received a prescription for ICS medication. Among non-Hispanic White children 34.4% of males, 35% in the age group of 11 to 17 years, 41.73% with private health insurance coverage, 56% belonging to high income group, 53.3% from the northeast, 38.18% residing in a metropolitan statistical area, 34.01% having a usual source of care, 43.88% with a receipt of SABA prescription, and 37.5% experiencing no asthma attack received a prescription for ICS medication.

Adults (18 years and above)

Table 5 presents the demographics of adult patients over 17 years of age as per the receipt of ICS prescription. About 26.06% of adults were of Hispanic

ethnicity and 73.94% were non-Hispanic Whites. Of the total Hispanic adults in the study sample about 21.56% had received a prescription for ICS medication. Among non-Hispanic White adults about 39.72% received a prescription for ICS medication. In the chi-squared analysis this difference was found statistically significant ($p<0.0001$).

Among Hispanic adults 25.32% of males, 26.09% in the age group of 41 to 65 years, 42.31% divorced, 23.29% of non-smokers, 25% with private health insurance coverage, 30.56% belonging to high income group, 33.33% from the northeast, 21.6% residing in a metropolitan statistical area, 25.46% having a usual source of care, 28.57% with a receipt of SABA prescription, and 27.12% experiencing no asthma attack received a prescription for ICS medication. Among non-Hispanic White adults 41.22% of females, 51.97% in the age group of 65 years and above, 43.35% married, 42.47% of non-smokers, 43.24% with private health insurance coverage, 50.65% belonging to high income group, 49.58% from the northeast, 40.22% residing in a metropolitan statistical area, 42.09% having a usual source of care, 51.42% with a receipt of SABA prescription, and 44.55% experiencing no asthma attack received a prescription for ICS medication.

Table 3: Characteristics of the study population as per the receipt of ICS prescription (weighted)

Variable		No ICS prescription N = 9,134,487		ICS prescription N = 5,342,114		p value
		N [a]	%	N [a]	%	
Race/Ethnicity	Hispanic	1,811,373	77.76	518,045	22.24	**<.0001**
	White	7,323,114	60.29	4,824,069	39.71	
Gender	Male	3,856,056	65.74	2,009,671	34.26	0.1328
	Female	5,278,430	61.3	3,332,443	38.7	
Age		37.03*	0.89**	44.78*	1.09**	**<.0001**
	5 to 18	2,470,457	69.11	1,104,474	30.89	
	19 to 40	2,521,526	72.13	974,308	27.87	
	41 to 65	3,020,009	57.97	2,189,242	42.03	
	65 and above	1,056,371	49.8	1,064,685	50.2	
Marital status	Married	3,347,141	58.92	2,333,557	41.08	**<.0001**
	Widowed	579,822	54.93	475,825	45.07	
	Divorced	809,074	54.3	680,921	45.7	
	Separated	177,816	67.47	85,718	32.53	
	Never married	4,216,950	70.48	1,766,092	29.52	
Education	Kindergarten	383,983	63.51	220,613	36.49	0.2174
	Elementary	1,944,094	69.3	861,273	30.7	
	High school	3,307,155	63.3	1,917,380	36.7	
	College	3,276,544	59.51	2,229,302	40.49	
Smoking status	Yes	1,667,950	72.18	642,768	27.82	**0.0141**
	No	4,731,085	58.68	3,331,785	41.32	
Health insurance	Any private	5,422,963	58.52	3,843,417	41.48	**<.0001**
	Public only	2,742,401	67.32	1,331,532	32.68	
	Uninsured	969,122	85.29	167,165	14.71	
Income category (family income	Poor/negative (<100%)	1,813,500	74.58	618,015	25.42	**<.0001**

Variable		No ICS prescription N = 9,134,487		ICS prescription N = 5,342,114		p value
		N [a]	%	N [a]	%	
as a percentage of poverty line)	Near poor (100%-124%)	492,361	59.75	331,653	40.25	
	Low income (125%-199%)	1,578,248	70.28	667,492	29.72	
	Middle income (200%-399%)	2,893,438	68.39	1,337,378	31.61	
	High income (≥400%)	2,356,939	49.68	2,387,576	50.32	
Region	Northeast	1,489,920	52.4	1,353,596	47.6	**0.0034**
	Midwest	1,945,104	59.08	1,347,161	40.92	
	South	3,174,640	66.81	1,576,817	33.19	
	West	2,458,698	69.97	1,055,134	30.03	
Metropolitan statistical area	Non-MSA	1,876,631	66.82	931,779	33.18	0.0956
	MSA	7,191,731	62.04	4,400,929	37.96	
Usual source of care	Yes	7,850,511	60.74	5,074,685	39.26	**0.0001**
	No	1,174,668	83.05	239,721	16.95	
Asthma attack	Yes	4,249,950	61.66	2,642,892	38.34	**0.0005**
	No	2,322,233	57.4	1,723,622	42.6	
SABA prescription	No	5,607,276	73.45	2,027,023	26.55	**<.0001**
	Yes	3,527,211	51.55	3,315,091	48.45	
COPD	No	7,029,064	65.30	3,735,085	34.7	**0.010**
	Yes	2,105,422	56.71	1,607,028	43.29	
BMI		28.19*	0.28**	28.88*	0.50**	0.4201
Mental health [b]		2.28*	0.04**	2.21*	0.04**	0.3274
Overall health [b]		2.69*	0.04**	2.82*	0.04**	**0.0214**

[a] Sample size may vary due to missing data.
[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health
* Mean
** Standard error

Table 4: Baseline characteristics of children as per the receipt of ICS prescription (weighted)

Variable		Hispanic N=918,273 n	Hispanic No ICS prescription N=698,637 %	Hispanic ICS prescription N=219,636 %	Non-Hispanic White N=2,402,203[a] n	Non-Hispanic White No ICS prescription N =1,562,319 %	Non-Hispanic White ICS prescription N=839,884 %
Gender	Male	623,587	77.31	22.69	1,476,415	65.60	34.40
	Female	294,686	74.24	25.76	925,788	67.50	32.50
Age			10.84±0.38*	9.74±0.50*		11.06±0.28*	10.82±0.37*
	5 to 10	454,522	74.44	25.56	1,020,323	68.24	31.76
	11 to 17	463,751	77.89	22.11	1,381,880	65.00	35.00
Education	Kindergarten	208,140	63.89	36.11	362,393	69.44	30.56
	Elementary	528,439	78.38	21.62	1,668,671	67.38	32.62
	High school	76,083	76.92	23.08	163,914	61.54	38.46
Health insurance	Any private	268,347	73.91	26.09	1,833,523	58.27	41.73
	Public only	593,470	76.92	23.08	499,194	85.00	15.00
	Uninsured	56,457	77.78	22.22	69,486	66.67	33.33
Income category (family income as a percentage of	Poor/negative (<100%)	346,457	75.00	25.00	322,603	81.82	18.18
	Near poor (100%-124%)	72,245	73.33	26.67	80,896	84.62	15.38

Variable		Hispanic N=918,273 n	Hispanic No ICS prescription N=698,637 %	Hispanic ICS prescription N=219,636 %	Non-Hispanic White N=2,402,203[a] n	Non-Hispanic White No ICS prescription N =1,562,319 %	Non-Hispanic White ICS prescription N=839,884 %
poverty line)							
	Low income (125%-199%)	150,707	77.78	22.22	376,776	69.44	30.56
	Middle income (200%-399%)	252,001	84.21	15.79	850,476	67.74	32.26
	High income (≥400%)	96,862	61.54	38.46	771,452	44.00	56.00
Region	Northeast	160,345	79.41	20.59	423,451	46.67	53.33
	Midwest	69,565	76.47	23.53	599,346	68.12	31.88
	South	370,814	76.12	23.88	968,961	68.18	31.82
	West	317,549	74.63	25.37	410,445	75.00	25.00
Metropolitan statistical area	Non-MSA	89,161	81.25	18.75	445,290	85.00	15.00
	MSA	829,112	75.74	24.26	1,956,913	61.82	38.18
Usual source of care	Yes	852,981	75.15	24.85	2,328,536	65.99	34.01
	No	52,519	85.71	14.29	57,125	85.71	14.29
Asthma attack	Yes	422,576	75.00	25.00	1,183,695	66.67	33.33
	No	244,695	64.58	35.42	695,909	62.50	37.50

Variable		Hispanic N=918,273 n	Hispanic No ICS prescription N=698,637 %	Hispanic ICS prescription N=219,636 %	Non-Hispanic White N=2,402,203[a] n	Non-Hispanic White No ICS prescription N =1,562,319 %	Non-Hispanic White ICS prescription N=839,884 %
SABA prescription	No	381,077	88.75	11.25	1,315,149	75.70	24.30
	Yes	537,196	66.67	33.33	1,087,055	56.12	43.88
COPD	No	845,209	75.86	24.14	2,188,677	64.67	35.33
	Yes	73,064	81.82	18.18	213,526	77.27	22.73
BMI			22.02±0.71*	22.04±0.67*		21.51±0.54*	20.77±0.62*
Mental health[b]			2.00±0.08*	2.00±0.12*		1.83±0.09*	1.61±0.07*
Overall health[b]			2.33±0.10*	2.35±0.13*		2.00±0.08*	2.00±0.08*

[a] Sample size may vary due to missing data.
[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health
* Mean±Standard error

Table 5: Baseline characteristics of adults as per the receipt of ICS prescription (weighted)

Variable		N=1,350,023[a] n	Hispanic No ICS prescription N=1,063,433 %	Hispanic ICS prescription N=286,590 %	N= 9,476,117[a] n	Non-Hispanic White No ICS prescription N=5,534,472 %	Non-Hispanic White ICS prescription N=3,941,645 %
Gender	Male	460793	74.68	25.32	3177531	63.40	36.60
	Female	889230	80.00	20.00	6298586	58.78	41.22
Age			43.43±1.17*	51.21±1.75*		47.62±0.85*	53.91±0.95*
	18 to 40	592604	84.21	15.79	2903229	72.22	27.78
	41 to 65	539843	73.91	26.09	4669407	58.26	41.74
	65 and above	217575	75.00	25.00	1903481	48.03	51.97
Marital status	Married	608061	75.81	24.19	5045653	56.65	43.35
	Widowed	83020	75.00	25.00	965706	56.76	43.24
	Divorced	147196	57.69	42.31	1338447	60.68	39.32
	Separated	92311	86.96	13.04	167312	68.75	31.25
	Never married	419435	88.16	11.84	1958999	70.42	29.58
Education	Kindergarten	20740	40.00	60.00	0	0.00	0.00
	Elementary	272218	74.24	25.76	297460	60.61	39.39
	High school	655663	81.54	18.46	4068934	59.69	40.31
	College	395921	78.46	21.54	5091786	60.82	39.18

Variable		N=1,350,023[a] n	Hispanic No ICS prescription N=1,063,433 %	Hispanic ICS prescription N=286,590 %	N= 9,476,117[a] n	Non-Hispanic White No ICS prescription N=5,534,472 %	Non-Hispanic White ICS prescription N=3,941,645 %
Smoking status	Yes	231904	83.78	16.22	2078814	71.10	28.90
	No	1051874	76.71	23.29	6906919	57.53	42.47
Health insurance	Any private	529909	75.00	25.00	6432655	56.76	43.24
	Public only	574868	77.50	22.50	2300630	59.63	40.37
	Uninsured	245246	86.79	13.21	742833	87.30	12.70
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	408376	79.21	20.79	1239764	68.70	31.30
	Near poor (100%-124%)	140788	92.31	7.69	522619	54.00	46.00
	Low income (125%-199%)	263944	78.00	22.00	1420729	70.91	29.09
	Middle income (200%-399%)	269527	76.79	23.21	2765290	63.05	36.95
	High income (≥400%)	267388	69.44	30.56	3527715	49.35	50.65
Region	Northeast	340819	66.67	33.33	1881174	50.42	49.58
	Midwest	86418	72.22	27.78	2490934	57.82	42.18
	South	370670	80.60	19.40	2945992	63.06	36.94
	West	552115	86.24	13.76	2158017	66.47	33.53

Variable		N=1,350,023[a] n	Hispanic No ICS prescription N=1,063,433 %	Hispanic ICS prescription N=286,590 %	N= 9,476,117[a] n	Non-Hispanic White No ICS prescription N=5,534,472 %	Non-Hispanic White ICS prescription N=3,941,645 %
Metropolitan statistical area	Non-MSA	70199	78.95	21.05	2188880	61.90	38.10
	MSA	1279824	78.40	21.60	7287237	59.78	40.22
Usual source of care	Yes	1099541	74.54	25.46	8409748	57.91	42.09
	No	247115	96.08	3.92	1024701	80.28	19.72
Asthma attack	Yes	707179	75.00	25.00	4518428	58.99	41.01
	No	303563	72.88	27.12	2719701	55.45	44.55
SABA prescription	No	741786	84.00	16.00	5042432	71.31	28.69
	Yes	608237	71.43	28.57	4433684	48.58	51.42
COPD	No	1109136	78.83	21.17	6393437	64.18	35.82
	Yes	240887	76.60	23.4	3082680	53.13	46.87
BMI			30.65±0.66*	32.84±1.21*		30.02±0.4*	30.29±0.53*
Mental health [b]			2.51±0.09*	2.85±0.15*		2.41±0.04*	2.30±0.05*
Overall health [b]			3.05±0.11*	3.41±0.11*		2.87±0.06*	2.97±0.05*

[a] Sample size may vary due to missing data.

[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health
* Mean ± Standard error

Bivariate logistic regression: Unadjusted predictors for receiving ICS prescription

Results of the bivariate logistic regression analyses in children revealed that race (p=0.0304), health insurance (p=0.0147), income category (p=0.0038), metropolitan statistical area (p=0.0484), usual source of care (p=0.0831), receipt of SABA prescription (p<.0001), and self-perceived mental health (p=0.0759) were significant predictors of receiving a prescription for ICS medication. Among adults, race (p<.0001), gender (p=0.196), age (p<.0001), marital status (p=0.006), smoking status (p=0.005), health insurance (p<.0001), income category (p<.0001), region (p=0.0194), usual source of care (p=0.0001), asthma attack (p=0.0016), prescription for SABA (p<.0001), self-perceived mental health (p=0.1977) and self-perceived overall health (p=0.1270) were independently associated with receiving a prescription for ICS medication. Results of the bivariate logistic regression analyses of unadjusted predictors of receiving ICS prescription in children and adults are presented in tables 6 and 7, respectively.

These tests were 2-sided with the level of significance set at 0.20 to be considered for inclusion into the final regression model. The results are unadjusted for the influence of other variables.

Table 6: Bivariate logistic regression analyses (unadjusted odds of receiving ICS prescription in children; weighted)

Variable		ICS Prescription			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
Race/Ethnicity					**0.0304**
	White	Reference			
	Hispanic	0.585	**0.36**	**0.95**	
Gender					
	Male	Reference			0.6101
	Female	0.87	0.51	1.48	
Age					0.7919
	5 to 10	Reference			
	11 to 17	0.98	0.60	1.62	
Education					0.7500
	Kindergarten	Reference			
	Elementary	0.76	0.41	1.41	
	High School	0.91	0.30	2.74	
	College	1.01	0.57	1.79	
Health insurance					**0.0147**
	Any private	Reference			
	Public only	0.40	**0.22**	**0.74**	
	Uninsured	0.69	0.18	2.61	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			**0.0038**
	Near poor (100%-124%)	1.04	0.38	2.85	
	Low income (125%-199%)	1.22	0.57	2.63	
	Middle income (200%-399%)	1.22	0.57	2.63	
	High income (≥400%)	4.38	**2.02**	**9.49**	

Variable		ICS Prescription			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
Region					0.3727
	Northeast	Reference			
	Midwest	0.55	0.23	1.33	
	South	0.49	0.21	1.14	
	West	0.44	0.18	1.07	
Metropolitan statistical area					**0.0484**
	Non-MSA	0.33	**0.13**	**0.85**	
	MSA	Reference			
Usual source of care					**0.0831**
	Yes	Reference			
	No	0.26	**0.07**	**0.94**	
Asthma attack					0.5707
	Yes	Reference			
	No	1.21	0.73	2.01	
SABA prescription	No	Reference			**<.0001**
	Yes	0.33	**0.19**	**0.57**	
Mental health		0.74	0.52	1.03	**0.0759**
Overall health		0.96	0.72	1.27	0.7641

Table 7: Bivariate logistic regression analyses (unadjusted odds of receiving ICS prescription in adults; weighted)

Variable		ICS Prescription			P Value
		Odds Ratio	95% Confidence Interval		
			Lower limit	Upper limit	
Race/Ethnicity					**<.0001**
	White	Reference			
	Hispanic	0.38	**0.26**	**0.55**	
Gender					**0.1962**
	Male	Reference			
	Female	1.21	0.91	1.62	
Age					**<.0001**
	18 to 40	Reference			
	41 to 65	1.88	**1.34**	**2.62**	
	65 and above	2.61	**1.70**	**4.00**	
Marital status					**0.0060**
	Married	Reference			
	Widowed	1.18	0.72	1.95	
	Divorced	1.19	0.76	1.87	
	Separated	0.70	0.27	1.83	
	Never Married	0.54	**0.35**	**0.85**	
Education					0.7599
	Kindergarten	Reference			
	Elementary	0.28	0.03	2.78	
	High School	0.35	0.04	3.13	
	College	0.39	0.04	3.36	
Smoking status					**0.0047**
	Yes	Reference			
	No	1.84	**1.20**	**2.82**	
Health insurance					**<.0001**
	Any private	Reference			
	Public only	0.81	0.60	1.10	
	Uninsured	0.20	**0.10**	**0.40**	

Variable		ICS Prescription			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			**<.0001**
	Near poor (100%-124%)	2.08	**1.11**	**3.88**	
	Low income (125%-199%)	1.23	0.68	2.21	
	Middle income (200%-399%)	1.41	0.92	2.16	
	High income (≥400%)	2.68	**1.80**	**3.97**	
Region					**0.0194**
	Northeast	Reference			
	Midwest	0.81	0.49	1.35	
	South	0.59	**0.36**	**0.96**	
	West	0.47	**0.29**	**0.77**	
Metropolitan statistical area					0.4295
	Non-MSA	0.91	0.60	1.38	
	MSA	Reference			
Usual source of care					**0.0001**
	Yes	Reference			
	No	0.30	**0.15**	**0.58**	
Asthma attack					**0.0016**
	Yes	Reference			
	No	1.20	0.89	1.63	
SABA prescription					**<.0001**
	No	Reference			
	Yes	0.38	**0.28**	**0.52**	
Mental health		0.90	0.76	1.06	**0.1977**
Overall health		1.10	0.97	1.25	**0.1270**

Multiple logistic regression: Independent predictors of receiving ICS prescription

Tables 8 and 9 present the results of the multiple logistic regression analyses of independent predictors of receiving ICS prescription in children and adults, respectively. Results of the logistic regression analyses among children showed that having SABA prescription ($p<.0001$) was statistically significantly associated with receiving a prescription for ICS medication at level of significance of 0.05, independent of other predictors. Among adults, race/ethnicity ($p=0.0001$), age ($p=0.0123$), marital status ($p=0.0123$), smoking status ($p=0.0015$), health insurance ($p=0.0118$), income category ($p=0.0002$), region ($p=0.0352$), asthma attack ($p=0.0145$), having SABA prescription ($p<.0001$), and self-perceived overall health ($p=0.0139$) were independently associated with receiving a prescription for ICS medication.

There was no difference in Hispanic and non-Hispanic White asthmatic children in receiving ICS prescription. However, we found that children who had a SABA prescription had 0.23 (95% CI: 0.12 – 0.43) times lower odds of receiving a prescription for ICS medication as compared to patients who did not have SABA prescription.

Table 8: Multiple logistic regression analyses: odds of receiving ICS prescription in children (weighted)

Variable		ICS Prescription			P Value
		Odds Ratio	95% Confidence Interval		
			Lower limit	Upper limit	
Race/Ethnicity					0.2065
	White	Reference			
	Hispanic	0.65	0.33	1.27	
Health insurance					0.5275
	Any private	Reference			
	Public only	0.56	0.19	1.63	
	Uninsured	1.08	0.32	3.67	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			0.1022
	Near poor (100%-124%)	1.06	0.34	3.32	
	Low income (125%-199%)	0.84	0.31	2.26	
	Middle income (200%-399%)	0.69	0.26	1.82	
	High income (≥400%)	2.17	0.78	6.03	
Metropolitan statistical area					0.0807
	Non-MSA	0.35	**0.13**	**0.94**	
	MSA	Reference			
Usual source of care					0.1622
	Yes	Reference			
	No	0.29	0.07	1.29	
SABA prescription	No	Reference			**<.0001**
	Yes	0.23	**0.12**	**0.43**	
Mental health		0.84	0.53	1.32	0.4494

Table 9: Multiple logistic regression analyses: odds of receiving ICS prescription in adults (weighted)

Variable		ICS Prescription			P Value
		Odds Ratio	95% Confidence Interval		
			Lower limit	Upper limit	
Race/Ethnicity					**0.0001**
	White	Reference			
	Hispanic	0.43	**0.28**	**0.67**	
Gender					0.1184
	Male	Reference			
	Female	1.31	0.93	1.84	
Age					**0.0123**
	18 to 40	Reference			
	41 to 65	1.42	0.90	2.24	
	65 and above	2.23	**1.30**	**3.84**	
Marital status					**0.0123**
	Married	Reference			
	Widowed	0.78	0.40	1.50	
	Divorced	1.29	0.77	2.16	
	Separated	1.51	0.45	5.07	
	Never Married	1.06	0.63	1.81	
Smoking status					**0.0015**
	Yes	Reference			
	No	1.86	**1.13**	**3.07**	
Health insurance					**0.0118**
	Any private	Reference			
	Public only	0.99	0.6	1.59	
	Uninsured	0.34	**0.17**	**0.70**	
Income category (family income as a percentage of	Poor/negative (<100%)	Reference			**0.0002**
	Near poor (100%-124%)	2.03	0.95	4.35	
	Low income	1.25	0.65	2.42	

Variable		ICS Prescription			P Value
		Odds Ratio	95% Confidence Interval		
			Lower limit	Upper limit	
poverty line)	(125%-199%)				
	Middle income (200%-399%)	1.71	0.99	2.95	
	High income (≥400%)	3.07	**1.74**	**5.41**	
Region					**0.0352**
	Northeast	Reference			
	Midwest	0.83	0.48	1.41	
	South	0.64	0.39	1.05	
	West	0.50	**0.31**	**0.82**	
Usual source of care					0.0664
	Yes	Reference			
	No	0.49	0.23	1.03	
Asthma attack					**0.0145**
	Yes	Reference			
	No	1.20	0.85	1.70	
	Missing	0.66	**0.45**	**0.98**	
SABA prescription					**<.0001**
	No	Reference			
	Yes	0.33	**0.23**	**0.46**	
Mental health		0.83	0.66	1.04	0.0990
Overall health		1.32	**1.06**	**1.64**	**0.0139**

Among adults, the odds of receiving ICS prescription were greater for non-Hispanic Whites compared to Hispanics. Hispanics had 0.43 (95% CI: 0.28 – 0.67) times lower odds of receiving ICS prescription as compared to non-Hispanic Whites, controlling for other predictors.

Patients in the age group of 65 years and above had 2.23 (95% CI: 1.30 – 3.84) times greater odds of receiving ICS prescription for asthma as compared to patients in the age group of 19 to 40 years, independent of other variables. Patients who were currently non-smokers had 1.86 (95% CI: 1.13 – 3.07) times higher odds of receiving a prescription for ICS medication as compared to currently smoking patients. Patients who did not have any form of health insurance coverage had 0.34 (95% CI: 0.17 – 0.70) times lower odds of receiving a prescription for ICS medication as compared to patients who private health care insurance, independent of other predictors. There was no significant difference found between patients who had private insurance and patients who had public insurance.

Income category was significantly associated with receiving ICS prescription. Patients in the high income poverty category had 3.07 (95% CI: 1.74 – 5.41) times greater odds of receiving ICS prescription as compared to patients belonging to the poor/negative income category. Patients residing in the west had 0.50 (95% CI: 0.31 – 0.82) times lower odds of receiving ICS prescription as compared to patients residing in the northeast. Asthma attack was also found to be a significant predictor of receiving a prescription for ICS medication. Patients who had missing values on the asthma attack variable or did not report their

asthma attack status had 0.66 (95% CI: 0.45 – 0.98) times lower odds of receiving ICS prescription as compared to patients who had an asthma attack in the past year. However, there was no observed difference between patients who had an asthma attack and patients who did not.

Patients who had a SABA prescription had 0.33 (95% CI: 0.23 – 0.46) times lower odds of receiving a prescription for ICS medication as compared to patients who did not have a SABA prescription. In terms of self-perceived overall health, it was found that with one unit increase in overall health score, the odds of receiving an ICS prescription increase by a factor of 1.32 (95% CI: 1.06 – 1.64).

We assessed the presence of multicollinearity between the predictors in the final model. None of the variables had a variance inflation factor value over 10.00 suggesting the absence of multicollinearity between the predictor variables.

It was found that the likelihood ratio chi-square was 2937208.61 with a *p* value of <0.0001. The *p* value is statistically significant at $\alpha = 0.05$ which suggests that the model as a whole fits significantly better than an empty model. The Score and Wald tests are asymptotically equivalent tests of the same hypothesis tested by the likelihood ratio test. The Score and Wald tests p values were both found to be <0.0001.These tests also indicate that the model is statistically significant.

Population characteristics as per the use of asthma-related office visits in 2009

Table 10 presents the demographics of the patients by whether or not they had an asthma-related office visit in 2009. About 35.8% of the study population had at least one asthma-related office visit in 2009. About 48.53% of the patients who received an ICS prescription had an asthma-related office visit, compared to 28.36% of patients who did not receive an ICS prescription. Patients who did not have asthma-related office visit in 2009 were more likely to not have received a prescription for ICS medication ($p<0.0001$). About, 40% of Hispanics had an asthma-related office visits whereas about 35% of non-Hispanic Whites had an asthma-related office visit in 2009. However, this difference was not found to be statistically significant at α of 0.05.

About, 35% of patients with private health insurance coverage, and 41% with public insurance had an asthma-related office visit in 2009, whereas just about 26% of patients who were uninsured had an asthma-related office visit in 2009. About 38% of patients who had a usual source of care had an asthma-related office visit in 2009, compared to 30% without a usual source of care. About, 43% of patients who experienced an asthma attack and 44% of patients who received a prescription for SABA had an asthma-related office visit in 2009. Patients with asthma-related office visit in 2009, had a self-perceived mental health score of 2.28 (± 0.06 standard error) and a self-perceived overall health score of 2.87 (± 0.05 standard error). The overall health score among patients

with an asthma-related office visit was significantly higher ($p<0.001$) than patients without an asthma-related office visit in 2009.

Table 10: Characteristics of the study population as per the use of asthma-related office visits in 2009 (weighted)

Variable		Mean (SE)	Asthma-related Office Visit			
			N=14,476,600 n [a]	No (n=9,293,629)[a] %	Yes (n=5,182,970)[a] %	P Value
ICS prescription	No	0.73 (0.10)	9,134,486	71.64	28.36	**<.0001**
	Yes	1.51 (0.2)	5,342,113	51.47	48.53	
Race/Ethnicity	Hispanic	0.98 (0.10)	2,329,417	59.82	40.18	0.097
	White	1.03 (0.12)	12,147,183	65.04	34.96	
Gender	Male	0.88 (0.13)	5,865,727	66.75	33.25	0.114
	Female	1.12 (0.13)	8,610,873	62.46	37.54	
Age				39.19 (0.8)*	41.14 (1.14)*	
	5 to 18	0.93 (0.10)	3,574,930	63.30	36.70	0.257
	19 to 40	0.71 (0.17)	3,495,833	68.41	31.59	
	41 to 65	1.28 (0.20)	5,209,250	65.01	34.99	
	65 and above	1.06 (0.08)	2,121,056	57.38	42.62	
Marital status	Married	1.07 (0.15)	5,680,698	65.10	34.90	0.376
	Widowed	1.24 (0.19)	1,055,647	56.65	43.35	
	Divorced	1.15 (0.17)	1,489,995	57.00	43.00	
	Separated	0.52 (0.03)	263,534	71.34	28.66	
	Never Married	0.93 (0.15)	5,983,042	66.19	33.81	
Education	Kindergarten	0.72 (0.07)	604,595	50.00	50.00	0.502
	Elementary	1.07 (0.16)	2,805,368	60.61	39.39	
	High School	1.18 (0.20)	5,224,535	64.33	35.67	
	College	0.91 (0.10)	5,505,846	65.90	34.10	
Smoking Status	Yes	0.83 (0.07)	2,310,718	67.40	32.60	0.417
	No	1.14 (0.15)	8,062,870	64.00	36.00	
Health insurance	Any private	0.88 (0.09)	9,266,380	65.06	34.94	**0.035**
	Public only	1.53 (0.26)	4,073,932	59.45	40.55	
	Uninsured	0.36 (0.04)	1,136,287	74.19	25.81	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	1.36 (0.25)	2,431,515	65.64	34.36	0.774
	Near poor (100%-124%)	1.40 (0.42)	824,014	57.24	42.76	
	Low income (125%-199%)	0.96 (0.26)	2,245,740	64.29	35.71	
	Middle income (200%-399%)	0.82 (0.09)	4,230,815	63.67	36.33	
	High income (≥400%)	1.0 (0.18)	4,744,515	65.09	34.91	

Variable		Mean (SE)	Asthma-related Office Visit			
			N=14,476,600 n [a]	No (n=9,293,629)[a] %	Yes (n=5,182,970)[a] %	P Value
Region	Northeast	1.0 (0.20)	2,843,516	63.23	36.77	0.312
	Midwest	0.90 (0.15)	3,292,265	69.32	30.68	
	South	1.09 (0.19)	4,751,456	62.32	37.68	
	West	1.07 (0.19)	3,513,832	63.08	36.92	
Metropolitan statistical area	Non-MSA	1.07 (0.26)	2,808,410	66.00	34.00	0.672
	MSA	1.01 (0.11)	11,592,660	63.87	36.13	
Usual source of care	Yes	1.11 (0.12)	12,925,195	62.18	37.82	**<0.001**
	No	0.28 (0.04)	1,414,389	81.27	18.73	
Asthma attack	Yes	1.41 (0.20)	6,892,842	57.49	42.51	**<0.001**
	No	0.76 (0.12)	4,045,855	70.77	29.23	
SABA prescription	No	0.74 (0.10)	7,634,298	71.81	28.19	**<0.0001**
	Yes	1.33 (0.17)	6,842,301	55.71	44.29	
COPD	No	0.84 (0.09)	10,764,149	66.44	33.56	**0.0116**
	Yes	1.55 (0.29)	3,712,450	57.70	42.30	
BMI				28.1 (0.32)*	29.07 (0.49)*	0.0759
Mental health[b]				2.24 (0.03)*	2.28 (0.06)*	0.158
Overall health[b]				2.66 (0.04)*	2.87 (0.05)*	**<0.001**

* Mean (Standard error)
[a] Sample size may vary due to missing data
[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health

Bivariate logistic regression analyses: unadjusted predictors of having an asthma-related office visit in 2009

Results of the bivariate logistic regression analyses showed that the receipt of ICS prescription ($p<0.0001$), race ($p=0.083$), gender ($p=0.116$), marital status ($p<0.0001$), health insurance coverage ($p=0.035$), usual source of care ($p=0.004$), asthma attack ($p<0.001$), receipt of SABA prescription ($p<0.0001$), and self-perceived overall health ($p=0.002$) were significant predictors of having at least one asthma-related office visit in 2009. These tests were 2-sided with the level of significance set at 0.20 to be considered for inclusion into the final regression model. The results are unadjusted for the influence of other variables.

Results of the bivariate logistic regression analyses of unadjusted predictors of having asthma-related office visits are presented in Table 11.

Table 11: Bivariate logistic regression analyses (unadjusted odds of having an asthma-related office visit in 2009; weighted)

Variable		Asthma-related Office Visit			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
ICS prescription					**<.0001**
	No	0.42	**0.32**	**0.55**	
	Yes	Reference			
Race/Ethnicity					**0.083**
	White	Reference			
	Hispanic	1.25	0.97	1.61	
Gender					**0.116**
	Male	Reference			
	Female	1.21	0.96	1.52	
Age					0.321
	5 to 18	Reference			
	19 to 40	0.80	0.55	1.14	
	41 to 65	0.93	0.67	1.28	
	65 and above	1.28	0.84	1.95	
Marital status					**<.0001**
	Married	Reference			
	Widowed	1.43	0.85	2.40	
	Divorced	1.41	0.92	2.17	
	Separated	0.75	0.31	1.79	
	Never Married	0.95	0.71	1.27	
Education					0.488
	Kindergarten	Reference			
	Elementary	0.91	0.47	1.79	
	High School	0.78	0.41	1.48	
	College	0.73	0.40	1.31	

Variable		Asthma-related Office Visit			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
Smoking Status	Yes	Reference			0.642
	No	1.16	0.80	1.70	
Health insurance	Any private	Reference			**0.035**
	Public only	1.27	0.99	1.63	
	Uninsured	0.65	0.39	1.08	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			0.725
	Near poor (100%-124%)	1.43	0.85	2.39	
	Low income (125%-199%)	1.06	0.69	1.63	
	Middle income (200%-399%)	1.09	0.78	1.53	
	High income (≥400%)	1.03	0.72	1.47	
Region					0.374
	Northeast	Reference			
	Midwest	0.76	0.52	1.12	
	South	1.04	0.73	1.48	
	West	1.01	0.67	1.51	
Metropolitan statistical area					0.583
	Non-MSA	0.91	0.59	1.42	
	MSA	Reference			
Usual source of care					**0.004**
	Yes	Reference			
	No	0.38	**0.21**	**0.69**	
Asthma attack					**<0.001**
	Yes	Reference			
	No	0.56	**0.41**	**0.76**	

Variable		Asthma-related Office Visit			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
SABA prescription	No	Reference			**<0.0001**
	Yes	2.03	**1.52**	**2.69**	
Mental health		1.05	0.91	1.21	0.535
Overall health		1.20	**1.07**	**1.35**	**0.002**

Multiple logistic regression: Independent predictors of having an asthma-related office visit in 2009

Table 12 presents the results of the multiple logistic regression analyses of independent predictors of having at least one asthma-related office visit. Results of the logistic regression analyses revealed that receiving a prescription for ICS medication ($p<0.0001$), patient's race ($p=0.008$), asthma attack history ($p=0.0013$), and having of SABA medication ($p=0.0019$) were statistically significantly associated with having at least one asthma-related office visit in 2009, at level of significance of 0.05, independent of other variables.

The odds of having at least one asthma-related office visit were less for non-Hispanic Whites as compared to Hispanics. Hispanics had 1.46 (95% CI: 1.10 – 1.93) times higher odds of having an asthma-related office visits as compared to non-Hispanic Whites, controlling for other predictors. Receipt of ICS prescription was also significantly associated with having at least one asthma-related office visit. Patients who were not prescribed ICS medication had 0.47 (95% CI: 0.35 – 0.63) times lower odds of having an asthma-related office visits as compared to patients who received an ICS prescription, independent of other factors.

Patients who did not experience an asthma attack in 2009 had 0.56 (95% CI: 0.41 – 0.78) times lower odds of having at least one asthma-related office visit as compared to patients who experienced an asthma attack in 2009. Patients who received a SABA prescription had 1.56 (95% CI: 1.18 – 2.07) times

higher odds of having an asthma-related office visit as compared to patients who did not receive a SABA prescription. After controlling for other factors, patient's gender and health insurance coverage status, usual source of care, and self-perceived overall health did not have significant effect on the odds of having asthma-related office visit.

We assessed the presence of multicollinearity between the predictors in the final model. None of the variables had a variance inflation factor value over 10.00 suggesting the absence of multicollinearity between the predictor variables.

It was found that the likelihood ratio chi-square was 1329676.11 with a *p* value of <.0001. The *p* value is statistically significant at $\alpha = 0.05$ which suggests that the model as a whole fits significantly better than an empty model. The Score and Wald tests are asymptotically equivalent tests of the same hypothesis tested by the likelihood ratio test. The Score and Wald tests p values were both found to be <.0001.These tests also indicate that the model is statistically significant.

Table 12: Multiple logistic regression analyses: odds of having an asthma-related office visit in 2009 (weighted)

Variable		Asthma-related Office Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
ICS prescription					**<.0001**
	No	0.47	**0.35**	**0.63**	
	Yes	Reference			
Race/Ethnicity					**0.008**
	White	Reference			
	Hispanic	1.46	**1.10**	**1.93**	
Sex					0.425
	Male	Reference			
	Female	1.11	0.85	1.45	
Marital status					**<.0001**
	Married	Reference			
	Widowed	1.28	0.74	2.21	
	Divorced	1.16	0.74	1.82	
	Separated	0.74	0.32	1.72	
	Never Married	1.09	0.78	1.51	
Health insurance					0.443
	Any private	Reference			
	Public only	1.09	0.81	1.48	
	Uninsured	0.76	0.45	1.27	
Usual source of care					0.092
	Yes	Reference			
	No	0.50	**0.26**	**0.98**	
Asthma attack					**0.0013**
	Yes	Reference			
	No	0.56	**0.41**	**0.78**	
SABA					**0.0019**

Variable		Asthma-related Office Visit			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
prescription	No	Reference			
	Yes	1.56	**1.18**	**2.07**	
Overall health		1.10	0.96	1.26	0.1588

Negative binomial regression: Number of asthma-related office visit in 2009

Table 13 presents the results of the negative binomial regression analyses to estimate the number of times asthma-related office visits were used by the study population. Results of the negative binomial regression analyses showed that, receiving a prescription for ICS medication ($p<0.0001$), type of health insurance coverage ($p=0.0029$), having usual source of care ($p<0.0001$), having an asthma attack ($p=0.008$), having a SABA prescription ($p<.0001$), and self-perceived overall health ($p=<0.0001$) were statistically significantly associated with having asthma-related office visit in 2009, at level of significance of 0.05, independent of other predictors.

Patients who received a prescription for ICS medication had 1.74 (95% CI: 1.38 – 2.18) times as many asthma-related office visits as patients who did not receive a prescription for ICS medication. Patients who were uninsured had 0.50 (95% CI: 0.32 – 0.79) times fewer asthma-related office visits as compared to patients who had private health insurance coverage.

Patients who reported to have a usual source of care had 3.01 (95% CI: 1.95 – 4.63) times more asthma-related office visits as patients who did not have a usual source of care. Patients who had a SABA prescription had 1.57 (95% CI: 1.26 – 1.95) times more asthma-related office visits as patients who did not have a SABA prescription. It was found that with one unit increase in self-perceived overall health score the incidence of asthma-related office visits increase by a factor of 1.46 (95% CI: 1.29 – 1.64). Patients who experienced an asthma attack

had 1.35 (95% CI: 1.08 – 1.68) times more asthma-related office visits as compared to patients who did not.

Table 13: Negative binomial regression: number of asthma-related office visits in 2009 (weighted)

Variable		Number of Asthma-related Office Visits			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
ICS prescription	No	Reference			
	Yes	1.74	**1.38**	**2.18**	**<.0001**
Race					
	Hispanic	1.16	0.91	1.47	0.2453
	White	Reference			
Sex					
	Male	0.85	0.68	1.06	0.1479
	Female	Reference			
Marital Status	Married	Reference			
	Widowed	0.84	0.54	1.30	0.4271
	Divorced	0.94	0.65	1.36	0.7306
	Separated	0.85	0.42	1.69	0.6384
	Never Married	0.98	0.75	1.26	0.8558
Health Insurance	Any private	Reference			
	Public only	1.13	0.87	1.46	0.3641
	Uninsured	0.50	**0.32**	**0.79**	**0.0029**
Asthma attack	Yes	1.35	**1.08**	**1.68**	**0.0080**
	No	Reference			
Usual Source of Care	Yes	3.01	**1.95**	**4.63**	**<.0001**
	No	Reference			

Variable		Number of Asthma-related Office Visits			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
SABA prescription	No	Reference			**<.0001**
	Yes	1.57	**1.26**	**1.95**	
Overall Health		1.46	**1.29**	**1.64**	**<.0001**

[a] IRR = incidence rate ratio

Population characteristics as per the use of asthma-related prescription fills in 2009

Table 14 presents the demographics of the patients by their use of asthma-related prescription fills in 2009. About, 70.87% study population had at least one asthma-related prescription fill in 2009. About, 66% of Hispanics and 72% of non-Hispanic Whites had an asthma-related prescription fill in 2009.

About, 72% of patients with private health insurance coverage and public health insurance had an asthma-related prescription fill in 2009 compared to about 56% of uninsured patients had an asthma-related prescription fill in 2009. About, 73% of patients with usual source of care had an asthma-related prescription fill in 2009 whereas 53% of patients without usual source of care had an asthma-related prescription fill in 2009. Patients with an asthma-related prescription fill in 2009 had a self-perceived metal health score of 2.33 ± 0.98 standard deviations and a self-perceived overall health score of 2.77 ± 1.08 standard deviations. The overall health score among patients with an asthma-related prescription fill was significantly higher ($p<0.001$) than patients without an asthma-related prescription fill in 2009.

Table 14: Characteristics of the study population as per the use of asthma-related prescription fills in 2009 (weighted)

Variable		Mean (SE)	Asthma-related Prescription fills			
			N=14,476,600 n [a]	No (n=4,217,323)[a] %	Yes (n=10,259,277) [a] %	P Value
Race/Ethnicity	Hispanic	1.78 (0.12)	2,329,417	34.35	65.65	0.0573
	White	2.22 (0.09)	12,147,183	28.13	71.87	
Gender	Male	2.18 (0.13)	5,865,727	29.53	70.47	0.8235
	Female	2.13 (0.10)	8,610,873	28.86	71.14	
Age				37.55 (1.08)*	40.85 (0.9)*	
	5 to 18	1.84 (0.09)	3,574,930	27.68	72.32	**0.0106**
	19 to 40	1.66 (0.10)	3,495,833	35.04	64.96	
	41 to 65	2.55 (0.16)	5,209,250			
	65 and above	2.55 (0.12)	2,121,056	20.49	79.51	
Marital status	Married	2.29 (0.13)	5,680,698	29.37	70.63	0.3050
	Widowed	2.55 (0.12)	1,055,647	22.23	77.77	
	Divorced	2.91 (0.2)	1,489,995	22.81	77.19	
	Separated	1.73 (0.01)	263,534	35.32	64.68	
	Never Married	1.78 (0.09)	5,983,042	31.44	68.56	
Education	Kindergarten	2.16 (0.19)	604,595	26.92	73.08	0.9121
	Elementary	1.91 (0.13)	2,805,368	27.35	72.65	
	High School	2.33 (0.19)	5,224,535	28.62	71.38	
	College	2.16 (0.12)	5,505,846	30.15	69.85	
Smoking status	Yes	1.96 (0.12)	2,310,718	33.94	66.06	0.1888
	No	2.34 (0.11)	8,062,870	28.89	71.11	
Health insurance	Any private	2.22 (0.11)	9,266,380	27.92	72.08	**0.0165**
	Public only	2.21 (0.11)	4,073,932	27.70	72.30	
	Uninsured	1.40 (0.12)	1,136,287	44.17	55.83	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	1.81 (0.10)	2,431,515	30.57	69.43	0.1311
	Near poor (100%-124%)	2.91 (0.25)	824,014	23.67	76.33	
	Low income (125%-199%)	1.95 (0.19)	2,245,740	35.72	64.28	
	Middle income (200%-399%)	1.92 (0.10)	4,230,815	31.39	68.61	
	High income (≥400%)	2.50 (0.15)	4,744,515	24.21	75.79	
Region	Northeast	2.53 (0.17)	2,843,516	21.58	78.42	**0.0107**
	Midwest	2.31 (0.16)	3,292,265	27.56	72.44	

Variable		Mean (SE)	Asthma-related Prescription fills			
			N=14,476,600 n [a]	No (n=4,217,323)[a] %	Yes (n=10,259,277) [a] %	P Value
	South	2.07 (0.13)	4,751,456	28.25	71.75	
	West	1.07 (0.19)	3,513,832	37.31	62.69	
Metropolitan statistical area	Non-MSA	2.23 (0.17)	2,808,410	30.82	69.18	0.5904
	MSA	2.14 (0.09)	11,592,660	28.54	71.46	
Usual source of care	Yes	2.30 (0.09)	12,925,195	26.66	73.34	**0.0009**
	No	1.0 (0.04)	1,414,389	47.31	52.69	
Asthma attack	Yes	2.61 (0.12)	6,892,842	24.79	75.21	0.8051
	No	2.33 (0.76)	4,045,855	24.05	75.95	
COPD	No	2.00 (0.09)	10,764,149	30.50	69.50	0.1089
	Yes	2.60 (0.15)	3,712,450	25.17	74.83	
BMI				28.37 (0.32)*	28.48 (0.36)*	0.755
Mental health[b]				2.26 (0.05)*	2.25 (0.03)*	0.158
Overall health[b]				2.67 (0.05)*	2.76 (0.04)*	**<0.001**

* Mean
** Standard error
[a] Sample size may vary due to missing data
[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health

Bivariate logistic regression analyses: unadjusted predictors of having an asthma-related prescription fill in 2009

Results of the bivariate logistic regression analyses showed that race (p=0.0535), age (p=0.0093), marital status (p<.0001), smoking status (p=0.1629), health insurance status (p=0.0041), income category (p=0.1274), region (p=0.0061), MSA (p=0.18), usual source of care (p<.0001), asthma attack (p<.0001), and self-perceived overall health (p=0.2337) were significant predictors of having at least one asthma-related prescription fill in 2009. These tests were 2-sided with the level of significance set at 0.20 to be considered for inclusion into the final regression model. The results are unadjusted for the influence of other variables.

Results of the bivariate logistic regression analyses of unadjusted predictors of having asthma-related prescription fills are presented in Table 15.

Table 15: Bivariate logistic regression analyses (unadjusted odds of having an asthma-related prescription fill in 2009; weighted)

Variable		Asthma-related Prescription Fill			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
Race/Ethnicity					**0.0535**
	White	Reference			
	Hispanic	0.75	0.56	1.00	
Gender					0.8225
	Male	Reference			
	Female	1.03	0.78	1.37	
Age					**0.0093**
	5 to 18	Reference			
	19 to 40	0.71	0.49	1.02	
	41 to 65	0.93	0.65	1.32	
	65 and above	1.49	0.91	2.42	
Marital status					**<.0001**
	Married	Reference			
	Widowed	1.46	0.82	2.59	
	Divorced	1.41	0.86	2.30	
	Separated	0.76	0.32	1.84	
	Never Married	0.91	0.66	1.24	
Education					0.7596
	Kindergarten	Reference			
	Elementary	0.98	0.49	1.95	
	High School	0.92	0.46	1.82	
	College	0.85	0.41	1.77	
Smoking status					**0.1629**
	Yes	Reference			
	No	1.26	0.89	1.80	
Health					**0.0041**

Variable		Asthma-related Prescription Fill Odds Ratio	95% Confidence Interval Lower limit	Upper limit	P Value
insurance	Any private	Reference			
	Public only	1.01	0.76	1.35	
	Uninsured	0.49	**0.32**	**0.75**	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			**0.1274**
	Near poor (100%-124%)	1.42	0.76	2.67	
	Low income (125%-199%)	0.79	0.52	1.22	
	Middle income (200%-399%)	0.96	0.64	1.44	
	High income (≥400%)	1.38	0.90	2.10	
Region					**0.0061**
	Northeast	Reference			
	Midwest	0.72	0.43	1.22	
	South	0.70	0.45	1.09	
	West	0.46	**0.30**	**0.72**	
Metropolitan statistical area	Non-MSA	0.90	0.61	1.32	**0.1800**
	MSA	Reference			
Usual source of care	Yes	Reference			**<.0001**
	No	0.41	**0.26**	**0.63**	
Asthma attack	Yes	Reference			**<.0001**
	No	1.04	0.75	1.44	
Mental health		0.98	0.84	1.14	0.7724
Overall health		1.09	0.95	1.25	**0.2337**

Multiple logistic regression: Independent predictors of having an asthma-related prescription fill in 2009

Table 16 presents the results of the multiple logistic regression analyses of independent predictors of having at least one asthma-related prescription fill in 2009. Results of the logistic regression analyses showed that, region of residence (p=0.0103), having usual source of care (p=0.0006), and asthma attack (p<0.0001) were statistically significantly associated with having at least one asthma-related prescription fill in 2009, at level of significance of 0.05, independent of other predictors.

There was no significant difference between Hispanics and non-Hispanic Whites associated with having a prescription fill in 2009. Having usual source of care was also significantly associated with having at least one asthma-related prescription fill. Patients who did not have an usual source of care status had 0.52 (95% CI: 0.33 – 0.83) times lower odds of having at least one asthma-related prescription fill as compared to patients who had an usual source of care, independent of other variables. We found that patients who did not report their usual source of care status had 0.09 (95% CI: 0.02 – 0.43) times lower odds of having at least one asthma-related prescription fill as compared to patients who had usual source of care, independent of other variables. On similar line patients who had missing values on asthma attack status were found to have 0.43 (95% CI: 0.32 – 0.59) times lower odds of having at least one asthma-related prescription fill as compared to patient who experienced an asthma attack in 2009. Patients who were residing in the west had 0.48 (95% CI: 0.31 – 0.75)

times lower odds of having at least one asthma-related prescription fill as compared to patients residing in the northeast.

Patient's age, smoking status, health insurance coverage, income category, MSA, and self-perceived overall health did not have significant effect on the odds of having an asthma-related prescription fill. We assessed the presence of multicollinearity between the predictors in the final model. None of the variables had a variance inflation factor value over 10.00 suggesting the absence of multicollinearity between the predictor variables.

It was found that the likelihood ratio chi-square was 1261425.97 with a *p* value of <.0001. The *p* value is statistically significant at $\alpha = 0.05$ which suggests that the model as a whole fits significantly better than an empty model. The Score and Wald tests are asymptotically equivalent tests of the same hypothesis tested by the likelihood ratio test. The Score and Wald tests p values were both found to be <.0001.These tests also indicate that the model is statistically significant.

Table 16: Multiple logistic regression analyses: odds of at having an asthma-related prescription fill in 2009 (weighted)

Variable		Asthma-related Prescription Fill Odds Ratio	95% Confidence Interval Lower limit	Upper limit	P Value
Race/Ethnicity					0.3525
	White	Reference			
	Hispanic	0.86	0.62	1.19	
Age					0.2286
	5 to 18	Reference			
	19 to 40	1.29	0.57	2.90	
	41 to 65	1.13	0.50	2.54	
	65 and above	2.05	0.80	5.20	
Marital status					**<.0001**
	Married	Reference			
	Widowed	1.03	0.50	2.15	
	Divorced	1.46	0.87	2.44	
	Separated	1.03	0.39	2.73	
	Never Married	0.96	0.61	1.52	
Smoking status					0.0596
	Yes	Reference			
	No	1.32	0.92	1.90	
Health insurance					0.6152
	Any private	Reference			
	Public only	0.92	0.60	1.43	
	Uninsured	0.76	0.44	1.31	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			0.2175
	Near poor (100%-124%)	1.27	0.65	2.50	
	Low income (125%-199%)	0.78	0.47	1.28	
	Middle	1.05	0.60	1.82	

Variable		Asthma-related Prescription Fill Odds Ratio	95% Confidence Interval Lower limit	Upper limit	P Value
	income (200%-399%)				
	High income (≥400%)	1.36	0.77	2.42	
Region					**0.0103**
	Northeast	Reference			
	Midwest	0.72	0.42	1.22	
	South	0.69	0.43	1.11	
	West	0.48	0.31	0.75	
Metropolitan statistical area					0.9604
	Non-MSA	1.01	0.67	1.53	
	MSA	Reference			
Usual source of care					**0.0006**
	Yes	Reference			
	No	0.52	**0.33**	**0.83**	
	Missing	0.09	**0.02**	**0.43**	
Asthma attack					**<.0001**
	Yes	Reference			
	No	0.95	0.68	1.34	
	Missing	0.43	**0.32**	**0.59**	
Overall health		1.16	0.99	1.36	0.0643

Negative binomial regression: Number of asthma-related prescription fills in 2009

Table 17 presents the results of the negative binomial regression analyses to estimate the number of times the patients had asthma-related prescription fills in 2009. Results of the negative binomial regression analyses showed that being divorced (p=0.0335), belonging to high income group (p=0.0018), residing in the west (p=0.0011), having usual source of care (p<0.0001), experiencing an asthma attack (p<0.0001), and overall health (p=0.0004) were statistically significantly associated with asthma-related prescription fills in 2009, at level of significance of 0.05, independent of other predictors.

Patients who reported to have a usual source of care had 1.90 (95% CI: 1.51 – 2.39) times more asthma-related prescription fills as patients who did not have a usual source of care. Patients who experienced an asthma attack had 1.48 (95% CI: 1.31 – 1.66) times more asthma-related fills as patients who did not experience as asthma attack. It was found that with one unit increase in self-perceived overall health score the incidence of asthma-related prescription fill increase by a factor of 1.13 (95% CI: 1.06 – 1.21). Patients who belonged to high income group had 1.39 (95% CI: 1.13 – 1.70) times more asthma-related prescription fills as patients who belonged to poor income group. Patients who were residing in the west had 0.75 (95% CI: 0.63 – 0.89) times lower asthma-related prescription fills as patients residing in the northeast.

Table 17: Negative binomial regression: number of asthma-related prescription fills in 2009 (weighted)

Variable		Number of Asthma-related Prescription Fills			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
Race/Ethnicity					
	Hispanic	0.96	0.83	1.11	0.5531
	White	Reference			
Age	5 to 18	Reference			
	19 to 40	0.84	0.68	1.03	0.0913
	41 to 65	1.02	0.80	1.29	0.8847
	65 and above	1.14	0.86	1.51	0.3538
Marital status					
	Married	Reference			
	Widowed	0.93	0.71	1.20	0.5610
	Divorced	1.24	**1.02**	**1.52**	**0.0335**
	Separated	0.91	0.62	1.33	0.6141
	Never Married	0.93	0.77	1.14	0.5042
Health insurance					
	Any private	Reference			
	Public only	0.97	0.83	1.15	0.7573
	Uninsured	0.80	0.63	1.02	**0.0736**
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			
	Near poor (100%-124%)	1.17	0.92	1.48	0.1902
	Low income (125%-199%)	0.88	0.73	1.08	0.2188
	Middle income (200%-399%)	1.05	0.87	1.28	0.5890
	High income (≥400%)	1.39	1.13	1.70	**0.0018**

Region					
	Northeast	Reference			
	Midwest	1.01	0.84	1.21	0.9163
	South	0.85	0.72	1.01	0.0647
	West	0.75	**0.63**	**0.89**	**0.0011**
Smoking status	Yes	0.85	0.71	1.02	0.0830
	No	Reference			
Metropolitan statistical area	Non-MSA	Reference			
	MSA	0.99	0.85	1.15	0.8722
Asthma attack					
	Yes	1.48	**1.31**	**1.66**	**<.0001**
	No	Reference			
Usual source of care					
	Yes	1.90	**1.51**	**2.39**	**<.0001**
	No	Reference			
Overall health					
	Yes	1.13	**1.06**	**1.21**	**0.0004**

[a] IRR = incidence rate ratio

Population characteristics as per the use of asthma-related emergency room (ER) visits in 2009

Table 18 presents the demographics of the patients by whether or not they had at least one asthma-related ER visit in 2009. About 3.57% of the study population had at least one asthma-related ER visit in 2009. About 9% of Hispanics had asthma-related ER visits as compared to just about 2.5% of non-Hispanic Whites. There was significant difference ($p<0.001$) found between the proportion of Hispanic and non-Hispanic White patients in term of their asthma-related ER visit in 2009. About 4% of patients who received an ICS prescription and 3% of patients who did not receive an ICS prescription had an asthma-related ER visit in 2009. This difference was not found to be statistically significant.

About, 6% and 9% of patients with private and public health insurance had an asthma-related ER visit in 2009, respectively. However, just about 2% of the patients had an asthma-related ER visit in 2009. Patients with an asthma-related ER visit in 2009 had a self-perceived metal health score of 2.53 (± 0.05 standard error) and a self-perceived overall health score of 3.15 (± 0.1 standard error).

Table 18: Characteristics of the study population as per the use of asthma-related ER visits in 2009 (weighted)

Variable		Mean (SE)	Asthma-related ER Visits			
			N=14,476,600	No (n=13,960,136)[a]	Yes (n=516,464)[a]	P Value
			n[a]	%	%	
ICS prescription	No	0.05 (0.01)	9,134,486	96.86	3.14	0.3642
	Yes	0.05 (0.01)	5,342,113	95.71	4.29	
Race/Ethnicity	Hispanic	0.12 (0.02)	2,329,417	91.14	8.86	**0.0007**
	White	0.03 (0.01)	12,147,183	97.45	2.55	
Gender	Male	0.04 (0.01)	5,865,727	96.85	3.15	0.5401
	Female	0.05 (0.01)	8,610,873	96.15	3.85	
Age				39.99 (0.78)*	37.2 (0.92)*	0.3911
	5 to 18	0.03 (0.01)	3,574,930	97.14	2.86	
	19 to 40	0.04 (0.10)	3,495,833	96.37	3.63	
	41 to 65	0.07 (0.02)	5,209,250	95.52	4.48	
	65 and above	0.02 (0.01)	2,121,056	98.11	1.89	
Marital status	Married	0.04 (0.01)	5,680,698	96.71	3.29	0.1296
	Widowed	0.01 (0.00)	1,055,647	98.77	1.23	
	Divorced	0.10 (0.06)	1,489,995	94.91	5.09	
	Separated	0.01 (0.00)	263,534	98.88	1.12	
	Never Married	0.05 (0.01)	5,983,042	96.09	3.91	
Education	Kindergarten	0.02 (0.00)	604,595	98.40	1.60	0.1433
	Elementary	0.03 (0.01)	2,805,368	97.58	2.42	
	High School	0.08 (0.02)	5,224,535	94.85	5.15	
	College	0.03 (0.01)	5,505,846	97.34	2.66	
Smoking status	Yes	0.10 (0.04)	2,310,718	93.52	6.48	0.1777
	No	0.04 (0.01)	8,062,870	96.89	3.11	
Health insurance	Any private	0.02 (0.00)	9,266,380	98.38	1.62	**0.0004**
	Public only	0.08 (0.02)	4,073,932	93.64	6.36	
	Uninsured	0.17 (0.01)	1,136,287	90.55	9.45	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	0.08 (0.02)	2,431,515	94.95	5.05	**0.0220**
	Near poor (100%-124%)	0.09 (0.01)	824,014	90.67	9.33	
	Low income (125%-199%)	0.09 (0.01)	2,245,740	94.45	5.55	
	Middle income (200%-399%)	0.03 (0.01)	4,230,815	97.23	2.77	
	High income (≥400%)	0.02 (0.01)	4,744,515	98.42	1.58	

Variable		Mean (SE)	Asthma-related ER Visits N=14,476,600 n [a]	No (n=13,960,136)[a] %	Yes (n=516,464)[a] %	P Value
Region	Northeast	0.06 (0.01)	2,843,516	94.21	5.79	0.4969
	Midwest	0.03 (0.00)	3,292,265	97.25	2.75	
	South	0.05 (0.02)	4,751,456	97.18	2.82	
	West	0.05 (0.02)	3,513,832	96.77	3.23	
Metropolitan statistical area	Non-MSA	0.03 (0.01)	2,808,410	96.94	3.06	0.7115
	MSA	0.05 (0.01)	11,592,660	96.41	3.59	
Usual source of care	Yes	0.05 (0.01)	12,925,195	96.38	3.62	0.2640
	No	0.03 (0.01)	1,414,389	97.58	2.42	
SABA prescription	No	0.02 (0.01)	7,634,298	97.76	2.24	**0.016**
	Yes	0.07 (0.02)	6,842,301	94.95	5.05	
COPD	No	0.03 (0.01)	10,764,149	97.37	2.63	**0.0341**
	Yes	0.10 (0.03)	3,712,450	93.70	6.30	
BMI				28.43 (0.28)*	28.82 (0.29)*	0.7296
Mental health[b]				2.24 (0.03)*	2.53 (0.05)*	0.158
Overall health[b]				2.72 (0.04)*	3.15 (0.1)*	**<0.001**

* Mean (Standard error)
[a] Sample size may vary due to missing data
[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health

Bivariate logistic regression analyses: unadjusted predictors of having an asthma-related ER visit in 2009

Results of the bivariate logistic regression analyses showed that the race (p<.0001), marital status (p<0.0001), age (p=0.1065), education (p=0.0483), smoking status (p=0.1498), health insurance (p<.0001), income category (p=0.0422), region (p=0.0916), MSA (p=0.1179), SABA prescription (p=0.013), and self-perceived mental health (p=0.0082) and overall health (p=0.0156) were significant predictors of having at least one asthma-related ER visit in 2009. These tests were 2-sided with the level of significance set at 0.20 to be considered for inclusion into the final regression model. The results are unadjusted for the influence of other variables.

Results of the bivariate logistic regression analyses of unadjusted predictors of having asthma-related ER visit are presented in Table 19.

Table 19: Bivariate logistic regression analyses (unadjusted odds of having an asthma-related ER visit in 2009; weighted)

Variable		Asthma-related ER Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
ICS prescription					0.3341
	No	0.723	0.375	1.395	
	Yes	Reference			
Race/Ethnicity					**<.0001**
	White	Reference			
	Hispanic	3.71	**2.03**	**6.80**	
Gender					0.5415
	Male	Reference			
	Female	1.230	0.633	2.387	
Age					**0.1065**
	5 to 18	Reference			
	19 to 40	1.281	0.540	3.038	
	41 to 65	1.595	0.847	3.005	
	65 and above	0.655	0.174	2.461	
Marital status					**<.0001**
	Married	Reference			
	Widowed	0.366	0.081	1.642	
	Divorced	1.579	0.517	4.823	
	Separated	0.332	0.044	2.510	
	Never Married	1.197	0.629	2.280	
Education					**0.0483**
	Kindergarten	Reference			
	Elementary	1.524	0.430	5.395	
	High School	3.344	0.927	12.059	
	College	1.685	0.435	6.518	
Smoking status					**0.1498**
	Yes	Reference			

Variable		Asthma-related ER Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
	No	0.464	0.193	1.116	
Health insurance					**<.0001**
	Any private	Reference			
	Public only	4.129	**2.159**	**7.896**	
	Uninsured	6.345	**2.564**	**15.701**	
Income category (family income as a percentage of poverty line)					**0.0422**
	Poor/negative (<100%)	Reference			
	Near poor (100%-124%)	1.936	0.658	5.691	
	Low income (125%-199%)	1.105	0.517	2.359	
	Middle income (200%-399%)	0.536	0.239	1.203	
	High income (≥400%)	0.302	**0.111**	**0.825**	
Region					**0.0916**
	Northeast	Reference			
	Midwest	0.460	0.173	1.219	
	South	0.472	0.197	1.132	
	West	0.544	0.245	1.207	
Metropolitan statistical area					**0.1179**
	Non-MSA	0.847	0.336	2.136	
	MSA	Reference			
Usual source of care					0.2509
	Yes	Reference			
	No	0.661	0.300	1.455	
SABA prescription					**0.013**
	No	Reference			
	Yes	2.33	**1.19**	**4.53**	
Mental health		1.356	**1.082**	**1.700**	**0.0082**
Overall health		1.446	**1.072**	**1.949**	**0.0156**

Multiple logistic regression: Independent predictors of having an asthma-related ER visit in 2009

Table 20 presents the results of the multiple logistic regression analyses of independent predictors of having at least one asthma-related ER visit in 2009. Results of the logistic regression analyses showed that, race (p=0.0009), level of education (p=0.0099), health insurance (p=0.0016), and receipt of SABA prescription (p=0.0273) were statistically significantly associated with having at least one asthma-related ER visit in 2009, at level of significance of 0.05, independent of other predictors.

It was found that Hispanics had higher odds of having an ER visit in 2009, independent of other factors. Hispanics had 3.38 (95% CI: 1.64 – 6.95) times higher odds of having an ER visit in 2009 as compared to non-Hispanic Whites. Receipt of ICS prescription was not significantly associated with having an asthma-related ER visit in 2009.

After controlling for other factors, patients who had public health insurance or who were uninsured in 2009 were found to have 3.29 (95% CI: 1.30 – 8.35) and 3.70 (95% CI: 1.59 – 8.64) times higher odds of having at least one asthma-related ER visits as compared to patients who had private health insurance, respectively. Patients who had elementary, high school, and college education had 11.37 (95% CI: 1.36 – 95.06), 26.72 (95% CI: 3.09 – 231.35), and 20.73 (95% CI: 1.97 – 217.89) times less odds of having an ER visit in 2009 as compared to patients who had just kindergarten education. Patients who had

SABA prescription had 2.21 (95% CI: 1.09 – 4.47) times higher odds of having at least one asthma-related ER visits as compared to patients who did not have SABA prescription.

Patient's age, smoking status, income category, region of residence, MSA, self-perceived mental health, and self-perceived mental health did not have significant effect on the odds of having an asthma-related ER visit. We assessed the presence of multicollinearity between the predictors in the final model. None of the variables had a variance inflation factor value over 10.00 suggesting the absence of multicollinearity between the predictor variables.

It was found that the likelihood ratio chi-square was 1261245.97 with a *p* value of <.0001. The *p* value is statistically significant at $\alpha = 0.05$ which suggests that the model as a whole fits significantly better than an empty model. The Score and Wald tests are asymptotically equivalent tests of the same hypothesis tested by the likelihood ratio test. The Score and Wald tests p values were both found to be <.0001.These tests also indicate that the model is statistically significant.

Table 20: Multiple logistic regression analyses: odds of at having an asthma-related ER visit in 2009 (weighted)

Variable		Asthma-related ER Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
Race/Ethnicity					**0.0009**
	White	Reference			
	Hispanic	3.38	**1.64**	**6.95**	
Age					0.4488
	5 to 18	Reference			
	19 to 40	0.43	0.06	3.05	
	41 to 65	0.76	0.09	6.61	
	65 and above	0.35	0.04	2.85	
Marital status					**<.0001**
	Married	Reference			
	Widowed	0.28	0.05	1.56	
	Divorced	0.66	0.23	1.91	
	Separated	0.13	0.02	1.08	
	Never Married	1.37	0.53	3.54	
Education					**0.0099**
	Kindergarten	Reference			
	Elementary	11.37	**1.36**	**95.06**	
	High School	26.72	**3.09**	**231.35**	
	College	20.73	**1.97**	**217.89**	
Smoking status					0.4227
	Yes	Reference			
	No	0.68	0.29	1.63	
Health insurance					**0.0016**
	Any private	Reference			
	Public only	3.29	**1.30**	**8.35**	
	Uninsured	3.70	**1.59**	**8.64**	
Income category	Poor/negative (<100%)	Reference			0.2592

Variable		Asthma-related ER Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
(family income as a percentage of poverty line)	Near poor (100%-124%)	2.69	0.89	8.19	
	Low income (125%-199%)	2.12	0.90	4.97	
	Middle income (200%-399%)	1.40	0.49	4.01	
	High income (≥400%)	1.11	0.28	4.32	
Region					0.6355
	Northeast	Reference			
	Midwest	0.66	0.22	2.02	
	South	0.59	0.22	1.60	
	West	0.57	0.24	1.37	
Metropolitan statistical area					0.9019
	Non-MSA	0.93	0.32	2.76	
	MSA	Reference			
SABA prescription					**0.0273**
	No	Reference			
	Yes	2.21	**1.09**	**4.47**	
Mental health		0.80	0.54	1.18	0.2591
Overall health		1.26	0.78	2.02	0.3516

Negative binomial regression: Number of asthma-related ER visits in 2009

Table 21 presents the results of the negative binomial regression analyses to estimate the number of times the patients had asthma-related ER visits in 2009. Results of the negative binomial regression analyses showed that patient's race, health insurance status, and SABA prescription were statistically significantly associated with asthma-related ER visits in 2009, at level of significance of 0.05, independent of other predictors.

Hispanic asthmatic patients had 3.15 (95% CI: 1.61 – 6.17) times as many asthma-related ER visits as non-Hispanic White asthmatic patients. Patients who were covered by public insurance and who were uninsured had 3.79 (95% CI: 1.61 – 8.94) and 4.63 (95% CI: 1.88 – 11.42) times as many asthma-related ER visits as compared to patients who had private health insurance coverage. Patients received a SABA prescription had 3.15 (95% CI: 1.61 – 6.17) times as many asthma-related ER visits as compared to patients who did not.

Table 21: Negative binomial regression: number of asthma-related ER visits in 2009 (weighted)

Variable		Number of Asthma-related ER Visits			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
Race					
	Hispanic	3.15	**1.61**	**6.17**	**0.0008**
	White	Reference			
Age					
	5 to 18	Reference			
	19 to 40	0.94	0.30	2.90	0.9104
	41 to 65	2.38	0.70	8.10	0.1642
	65 and above	0.72	0.15	3.44	0.6833
Marital status					
	Married	Reference			
	Widowed	0.47	0.47	0.47	0.3582
	Divorced	0.64	0.24	1.69	0.3642
	Separated	0.23	0.03	2.03	0.1878
	Never Married	1.18	0.52	2.69	0.6901
Education					
	Kindergarten	Reference			
	Elementary	6.27	0.77	50.93	0.0857
	High School	8.21	0.91	74.10	0.0606
	College	5.60	0.56	55.63	0.1415
Smoking status					
	Yes	1.26	0.59	2.68	0.5506
	No	Reference			
Health Insurance					
	Any private	Reference			
	Public only	3.79	**1.61**	**8.94**	**0.0023**
	Uninsured	4.63	**1.88**	**11.42**	**0.0009**
Region					

Variable		Number of Asthma-related ER Visits			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
	Northeast	Reference			
	Midwest	1.18	0.48	2.90	0.7252
	South	1.01	0.46	2.21	0.9766
	West	0.98	0.47	2.06	0.9580
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	Reference			
	Near poor (100%-124%)	1.03	0.37	2.88	0.9544
	Low income (125%-199%)	1.46	0.69	3.07	0.3219
	Middle income (200%-399%)	0.94	0.40	2.22	0.8887
	High income (≥400%)	1.12	0.39	3.22	0.8290
Metropolitan Statistical Area	Non-MSA	Reference			
	MSA	1.38	0.58	3.28	0.4684
SABA prescription	Yes				**0.0062**
	No	3.15	**1.61**	**6.17**	
Mental health		0.78	0.53	1.13	0.1917
Overall health		0.94	0.30	2.90	0.6807

[a] IRR = incidence rate ratio

Population characteristics as per the use of asthma-related inpatient visits in 2009

Table 22 presents the demographics of the patients by whether or not they had at least one asthma-related inpatient visit in 2009. Just about 0.97% of the study population had at least one asthma-related inpatient visit in 2009. Of these patients 34.26% were Hispanics, and 61.31% had received a prescription for ICS medication. About, 2% of Hispanics and 0.76% of non-Hispanic patients had an asthma-related inpatient visit in 2009. About, 1.6% of patients with a receipt of ICS prescription and 0.6% of patients without a receipt of ICS prescription had an asthma-related inpatient visit in 2009.

The mean age of the patients who had an asthma-related inpatient visit was found to be 54.9 ± 0.1 years. About 1.8% of patients with public health insurance coverage and 1.97% of uninsured patients had an asthma-related inpatient visit in 2009 whereas, about 0.5% of privately insured patients had asthma-related inpatient visit in 2009. Patients with an asthma-related inpatient visit in 2009 had a self-perceived metal health score of 2.25 (± 0.03 standard error) and a self-perceived overall health score of 2.73 (± 0.77 standard error).

Table 22: Characteristics of the study population as per the use of asthma-related inpatient visits in 2009 (weighted)

Variable		Mean (SD)	Asthma-related Inpatient Visit			
			N=14,476,600	No (n=14,335,771)[a]	Yes (n=140,828)[a]	P Value
			n [a]	%	%	
ICS prescription	No	0.01 (0.00)	9,134,486	99.40	0.60	0.1508
	Yes	0.02 (0.01)	5,342,113	98.38	1.62	
Race/Ethnicity	Hispanic	0.03 (0.01)	2,329,417	97.93	2.07	0.0809
	White	0.01 (0.00)	12,147,183	99.24	0.76	
Gender	Male	0.01 (0.00)	5,865,727	98.90	1.10	0.7397
	Female	0.01 (0.00)	8,610,873	99.11	0.89	
Age				39.74 (0.77)*	54.9 (0.1)*	
	5 to 18	0.01 (0.00)	3,574,930	99.68	0.32	0.1605
	19 to 40	0.01 (0.00)	3,495,833	99.72	0.28	
	41 to 65	0.01 (0.00)	5,209,250	50.00	50.00	
	65 and above	0.03 (0.01)	2,121,056	97.47	2.53	
Marital status	Married	0.02 (0.01)	5,680,698	98.60	1.40	0.412
	Widowed	0.01 (0.00)	1,055,647	99.28	0.72	
	Divorced	0	1,489,995	100.00	0.00	
	Separated	0	263,534	100.00	0.00	
	Never Married	0.01 (0.00)	5,983,042	99.10	0.90	
Education	Kindergarten	0.01 (0.00)	604,595	99.39	0.61	0.412
	Elementary	0.02 (0.01)	2,805,368	98.75	1.25	
	High School	0.02 (0.01)	5,224,535	98.51	1.49	
	College	0.01 (0.00)	5,505,846	99.56	0.44	
Smoking status	Yes	0.02 (0.01)	2,310,718	98.31	1.69	0.6854
	No	0.01 (0.00)	8,062,870	98.83	1.17	
Health insurance	Any private	0.01 (0.00)	9,266,380	99.51	0.49	0.1715
	Public only	0.02 (0.01)	4,073,932	98.20	1.80	
	Uninsured	0.02 (0.01)	1,136,287	98.03	1.97	
Income category (family income as a percentage of poverty line)	Poor/negative (<100%)	0.03 (0.01)	2,431,515	98.05	1.95	0.4521
	Near poor (100%-124%)	0.01 (0.00)	824,014	98.63	1.37	
	Low income (125%-199%)	0.01 (0.00)	2,245,740	99.52	0.48	
	Middle income (200%-399%)	0.01 (0.01)	4,230,815	98.82	1.18	
	High income (≥400%)	0.01 (0.00)	4,744,515	99.55	0.45	

Variable		Mean (SD)	Asthma-related Inpatient Visit			
			N=14,476,600	No (n=14,335,771)[a]	Yes (n=140,828)[a]	P Value
			n [a]	%	%	
Region	Northeast	0.02 (0.01)	2,843,516	98.62	1.38	0.4354
	Midwest	0.01 (0.01)	3,292,265	98.98	1.02	
	South	0.01 (0.00)	4,751,456	99.60	0.40	
	West	0.02 (0.01)	3,513,832	98.71	1.29	
Metropolitan statistical area	Non-MSA	0.03 (0.01)	2,808,410	97.52	2.48	0.1125
	MSA	0.01 (0.00)	11,592,660	99.42	0.58	
Usual source of care	Yes	0.01 (0.00)	12,925,195	99.00	1.00	0.4856
	No	0.01 (0.00)	1,414,389	99.44	0.56	
Asthma attack	Yes	0.01 (0.00)	6,892,842	98.78	1.22	0.1120
	No	0.01 (0.00)	4,045,855	99.58	0.42	
SABA prescription	No	0.01 (0.00)	7,634,298	99.27	0.73	0.394
	Yes	0.01 (0.01)	6,842,301	98.76	1.24	
COPD	No	0.01 (0.00)	10,764,149	99.31	0.69	0.2187
	Yes	0.02 (0.01)	3,712,450	98.20	1.80	
BMI				28.47 (0.28)*	26.13 (0.20)*	0.4933
Mental health[b]				2.25 (0.03)*	2.25 (0.03)*	0.158
Overall health[b]				2.73 (0.04)*	2.73 (0.77)*	**<0.001**

* Mean (Standard error)

[a] sample size may vary due to missing data

[b] On a scale of 1 to 5 where 1 represents poor health and 5 represents excellent health

Bivariate logistic regression analyses: unadjusted predictors of having an asthma-related inpatient visit in 2009

Results of the bivariate logistic regression analyses showed that the receipt of ICS prescription (p=0.0717), race (p=0.0546), age (p=0.0339), marital status (p=0.0772), education (p<.0001), smoking status (p=0.0387), health insurance (p=0.1052), MSA (p=0.0194), self-perceived mental health (p=0.0224), and self-perceived overall health (p=0.0060) were significant predictors of having at least one asthma-related inpatient visit in 2009. These tests were 2-sided with the level of significance set at 0.20 to be considered for inclusion into the final regression model. The results are unadjusted for the influence of other variables.

Results of the bivariate logistic regression analyses of unadjusted predictors of having asthma-related inpatient visit are presented in Table 23.

Table 23: Bivariate logistic regression analyses (unadjusted odds of having an asthma-related inpatient visit in 2009; weighted)

Variable		Asthma-related Inpatient Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
ICS prescription					**0.0717**
	No	0.37	0.12	1.09	
	Yes	Reference			
Race/Ethnicity					**0.0546**
	White	Reference			
	Hispanic	2.75	0.98	7.74	
Gender					0.7280
	Male	Reference			
	Female	0.81	0.25	2.67	
Age					**0.0339**
	5 to 18	Reference			
	19 to 40	0.88	0.10	7.79	
	41 to 65	3.83	0.69	21.38	
	65 and above	8.19	**1.41**	**47.46**	
Education					**<.0001**
	Kindergarten	Reference			
	Elementary	2.08	0.25	17.49	
	High School	2.48	0.29	21.06	
	College	0.72	0.05	11.70	
Smoking status					**0.0387**
	Yes	Reference			
	No	0.69	0.14	3.39	
Health insurance					**0.1052**
	Any private	Reference			
	Public only	3.76	**1.01**	**14.01**	
	Uninsured	4.11	0.70	24.14	
Income	Poor/negative	Reference			0.3772

Variable		Asthma-related Inpatient Visit			P Value
		Odds Ratio	95% Confidence Interval Lower limit	Upper limit	
category (family income as a percentage of poverty line)	(<100%)				
	Near poor (100%-124%)	0.70	0.12	3.95	
	Low income (125%-199%)	0.24	0.04	1.48	
	Middle income (200%-399%)	0.60	0.14	2.58	
	High income (≥400%)	0.22	0.04	1.24	
Region					0.3995
	Northeast	Reference			
	Midwest	0.74	0.13	4.26	
	South	0.29	0.04	2.07	
	West	0.93	0.19	4.57	
Metropolitan statistical area					**0.0194**
	Non-MSA	4.34	**1.31**	**14.39**	
	MSA	Reference			
Usual source of care					0.5417
	Yes	Reference			
	No	0.56	0.07	4.32	
Asthma attack					0.2836
	Yes	Reference			
	No	0.34	0.09	1.32	
SABA prescription					0.351
	No	Reference			
	Yes	1.69	0.56	5.13	
Mental health		1.66	**1.08**	**2.57**	**0.0224**
Overall health		1.98	**1.22**	**3.23**	**0.0060**

Multiple logistic regression: Independent predictors of having an asthma-related inpatient visit in 2009

Table 24 presents the results of the multiple logistic regression analyses of independent predictors of having at least one asthma-related inpatient visit in 2009. Results of the logistic regression analyses showed that, race (p=0.0217), age (p<.0001), smoking status (p=0.0086), and metropolitan statistical area (p=0.0321) were statistically significantly associated with having at least one asthma-related inpatient visit in 2009, at level of significance of 0.05, independent of other predictors.

It was found that Hispanics had higher likelihood of having an asthma-related inpatient visit in 2009. Hispanic asthmatic patients had 6.94 (95% CI: 1.33 – 36.24) times higher odds of having an asthma-related inpatient visit as compared to Hispanic asthmatic patients. There was however, no significant difference associated with receiving an ICS prescription.

Patients who belonged to 19 to 40 years of age were found to have 0.022 (95% CI: 0.001 – 0.438) times lower odds of having an asthma-related inpatient visit as compared to patients in the age group of 5 to 18 years. Patients residing in an MSA were also found to have 6.62 (95% CI: 1.18 – 37.28) times higher odds of having an asthma-related inpatient visit as compared to patients not residing in an MSA.

Patient's health insurance coverage status, self-perceived mental health, and self-perceived overall health did not have significant effect on the odds of

having at least one asthma-related inpatient visit. We assessed the presence of multicollinearity between the predictors in the final model. None of the variables had a variance inflation factor value over 10.00 suggesting the absence of multicollinearity between the predictor variables.

It was found that the likelihood ratio chi-square was 393584.546 with a *p* value of <.0001. The *p* value is statistically significant at α = 0.05 which suggests that the model as a whole fits significantly better than an empty model. The Score and Wald tests are asymptotically equivalent tests of the same hypothesis tested by the likelihood ratio test. The Score and Wald tests p values were both found to be <.0001.These tests also indicate that the model is statistically significant.

Table 24: Multiple logistic regression analyses: odds of at having an asthma-related inpatient visit in 2009 (weighted)

Variable		Asthma-related Inpatient Visit			
		Odds Ratio	95% Confidence Interval		P Value
			Lower limit	Upper limit	
ICS prescription					0.0551
	No	0.27	0.07	1.03	
	Yes	Reference			
Race/Ethnicity					**0.0217**
	White	Reference			
	Hispanic	6.94	**1.33**	**36.24**	
Age					**<.0001**
	5 to 18	Reference			
	19 to 40	0.02	**0.001**	**0.44**	
	41 to 65	0.10	0.004	2.04	
	65 and above	0.19	0.02	1.75	
Smoking status					**0.0086**
	Yes	Reference			
	No	0.76	0.13	4.44	
Health insurance					0.3347
	Any private	Reference			
	Public only	1.72	0.58	5.07	
	Uninsured	4.81	0.48	48.04	
Metropolitan statistical area					**0.0321**
	Non-MSA	6.62	**1.18**	**37.28**	
	MSA	Reference			
Mental health		1.08	0.57	2.05	0.8154
Overall health		1.20	0.57	2.52	0.6249

Negative binomial regression: Number of asthma-related inpatient visits in 2009

Table 25 presents the results of the negative binomial regression analyses to estimate the number of times the patients had asthma-related inpatients visits in 2009. Results of the negative binomial regression analyses showed that none of the factors entered in the model were statistically significantly associated with asthma-related inpatient visits in 2009, at level of significance of 0.05. Race, age, overall health and MSA which were determined significant in the multiple logistic regression analyses were not significantly predictive of the number of asthma-related inpatient visits.

Table 25: Negative binomial regression: number of asthma-related inpatient visits in 2009 (weighted)

Variable		Number of Asthma-related Inpatient Visits			
		IRR [a]	95% Confidence Interval		P Value
			Lower limit	Upper limit	
ICS prescription	No	Reference			
	Yes	1.05	0.83	1.33	0.6599
Race					
	Hispanic	1.08	0.87	1.33	0.4653
	White	Reference			
Age					
	5 to 18	Reference			
	19 to 40	1.06	0.81	1.39	0.6609
	41 to 65	1.07	0.81	1.42	0.5899
	65 and above	1.16	0.84	1.61	0.3518
Health Insurance					
	Any private	Reference			
	Public only	1.08	0.83	1.40	0.5484
	Uninsured	1.06	0.75	1.50	0.7175
Smoking status					
	Yes	1.05	0.76	1.45	0.7514
	No	Reference			
Metropolitan statistical area	Non-MSA	Reference			
	MSA	0.89	0.67	1.17	0.4184
Mental Health		1.00	0.87	1.14	0.9579
Overall Health		0.99	0.87	1.13	0.9866

[a] IRR = incidence rate ratio

CHAPTER FIVE: DISCUSSION

This chapter presents the discussion of the study results and recommendations for future research. The chapter begins with a discussion of the results with respect to each of the study aims and other important findings in the study. Following the discussion of the results, the limitations of the study design and recommendations for future research are presented. Finally, strengths and conclusions from this study are presented.

Effect of Race/Ethnicity on the receipt of ICS prescription

About 2,420 patients in the MEPS, 2009 database were diagnosed with asthma which is representative of 19,913,829 asthmatic patients in the United States. In this study, we found that about 37% of the study population diagnosed with asthma received a prescription for ICS medication in 2009 (Table 2). The care in terms of ICS prescription received by the patients in our study did not meet the guidelines established by NAEPP.[6] The NAEPP guidelines indicate that a steroid inhaler should be used as the first line of treatment in asthma.[6] However, only 37% of the patients in our study had received a prescription for steroid inhaler. We did not analyze the receipt of other medications received by the patients, however, since ICS are considered by GINA to be the most preferred and recommended medications in asthma[1] nearly 63% of the patients in our study had not received the most preferred and recommended line of medications.

Among asthmatic patients, race/ethnicity has been associated with increased prevalence and morbidity and lower quality of care for asthma. Non-white race has been specifically associated with suboptimal medical regimens in adults and children.[9, 33, 53, 83] Results of the study revealed significant racial and ethnic disparities in receipt of ICS medications among adult asthmatic patients. We found that overall, nearly 40% of non-Hispanic Whites (35% children and 41.6% adults) had received a prescription for ICS for their asthma compared to only 22% of Hispanics (23.9% children and 21.2% adults) (Tables 3, 4, and 5), a statistically significant difference. The odds of receiving an ICS prescription were significantly lower in Hispanic adults as compared to non-Hispanic White adults (OR: 0.43; 95% CI: 0.28 – 0.67) (Table 9). The finding that race/ethnicity is associated with disparity in receipt of medications is disturbing, but is consistent with findings of other studies on access to other medications.[57] However, we did not find any difference in the receipt of ICS prescription between Hispanic and non-Hispanic White children. Our literature review identified a total of fourteen studies that reported a statistically significant difference in the receipt of ICS prescription for asthma between Hispanic and non-Hispanic White patients.[16-19, 33, 52, 53, 65-71] All of these studies reported that Hispanics were significantly less likely than non-Hispanic Whites to receive a prescription for ICS, or use ICS for their asthma condition.

The persistence of racial/ethnic disparities in receipt of ICS prescription is an important finding that may help us understand the diverse factors that could contribute to racial/ethnic differences in asthma medication utilization. Lower use

of ICS medications in ethnic minority groups may be surrogates for underlying differences in social determinants of health such as access to care, quality of care delivery, and cultural beliefs.[84] The under-prescribing of preventative medications, particularly ICS, in minority groups may be due in part to the disproportionate amount of asthma care received by minority patients in emergency facilities.[85, 86] These facilities are less likely to prescribe controller medications, which may also further lead to the differences in asthma medication usage.

Potential reasons for decreased access to primary care services by minorities include insurance issues, lack of social support, and transportation issues.[86] The quality of asthma care must also be considered. Minority patients are less likely to be referred to an asthma specialist for treatment and also are less likely to show up for follow-up treatment as compared to white patients.[10] Previous studies indicate a particular reluctance among physicians to prescribe inhaled corticosteroids, even though data have clearly demonstrated improved outcomes.[72] Specialists are more likely to follow treatment guidelines and prescribe controller medications; because specialists are compared to generalists many take a more aggressive approach to pharmacological asthma treatment.[16, 87] Decreased access to asthma specialty care could in turn affect appropriate ICS prescribing in asthmatic Hispanics. A study by Ferris et al found that health care providers are less likely to prescribe newer medications and technologies to minority patients.[19]

The variation in receipt of an ICS prescription that was observed in our study might also be attributable to racial/ethnic differences in health beliefs and concepts of diseases, differences in beliefs about the value of prevention, and fears about steroids. Cultural beliefs regarding asthma and steroids may also influence prescribing behavior and has been previously documented. [84] A large study of patients' beliefs about asthma medications found that Hispanic patients reported greater concerns about preventative medications as well as less need for preventative medications in managing their asthma, both of which greatly affect both receiving and adherence to a medication regimen.[84] Previous studies have reported that Hispanic patients have low expectations from treatment outcomes and this may contribute to underuse of controller medications.[70, 88] Low expectations may stem from a family's previous experience of poor asthma control, which could lead patients to think that good control in not achievable. Our study did not assess the utilization of complementary and alternative medication treatments, which previous studies have found are more common in minority families. [66] Hispanics are more likely to use alternative treatments in place of traditional medications, which may potentially explain some of the disparity between Hispanic and non-Hispanic Whites observed in our study. [66]

Despite these barriers, studies have shown that it is possible to improve the quality of asthma care and outcomes in minorities through health care provider education and culturally competent patient education.[89] Patient-physician discussion of actual and perceived medication adverse effects has been identified as an important factor governing controller medication adherence

among African American adults with asthma.[89] Also, health care provider interventions to improve asthma control may need to focus on identifying Hispanic patients with low expectations; providers can then work with these minority patients to raise their expectations. [90] Other specific strategies include greater use of interpretation services and supplemental education by primary care clinicians with interventions that address cultural differences.[91-93]

As MEPS survey does not record asthma severity we could not assess the effect of severity of asthma symptoms in our analyses. However, there is abundant evidence that minorities, especially Hispanics, have higher severity of asthma than non-Hispanic Whites.[45] Because asthma is of higher severity among Hispanics it is reasonable to expect at least equal rates of prescribed inhaled steroids in this group.

Effect of other independent predictors on the receipt of ICS prescription

Patients in the age group of 65 years and above had significantly greater odds of receiving an ICS prescription for asthma as compared to patients in the age group of 18 to 40 years, independent of other variables (Table 9). Our findings echo the findings of prior studies that younger individuals are less likely to receive prescription for ICS medications for their asthma.[16, 19] A study conducted by Ferris TG et al. found that individuals in the age group of 0 to 20 years of age reported their ICS use to be significantly lower than people in the age group of 21 to 69 years.[19] Similarly, a study by Legorreta AP et al. found that individuals below 25 years of age had significantly lower odds of receiving ICS

prescription as compared to individuals in the age group of 25 to 65 years.[16] Some of the following known factors could be responsible for this difference in receipt of ICS prescription in children. Clinical trials of new therapies rarely include children causing potential reluctance on part of providers to prescribe ICS to children.

Among adults, patients who were currently non-smokers had 1.86 (95% CI: 1.13 – 3.07) times, significantly higher odds of receiving a prescription for ICS medication as compared to currently smoking patients (Table 9). This result was consistent with findings from the previous studies. A study by Legorreta AP et al. found that patients who reported having smoked ever, or who were current smokers had lower odds of being prescribed ICS as compared to patients who reported to be non-smokers.[16] Smokers have been associated with having more uncontrolled symptoms of asthma as compared to non-smokers, in turn being prescribed more reliever medications like SABA.[94] We were not able to analyze the severity of asthma in our study but one possible explanation could be that current smokers in our study might have experienced severe asthma symptoms which lead to these patients receiving higher prescription of SABA medications and lower odds of having a receipt for ICS medication. We found that among smokers 54% had received a prescription for SABA whereas in non-smokers about 46% had received a prescription for SABA which further strengthens our explanation.

Adult patients who were uninsured had lower odds of receiving a prescription for ICS medication as compared to patients who had private health

care insurance coverage (Table 9). There was no significant difference found between patients who had private insurance and patients who had public insurance. These findings are similar to the findings of previous studies.[33, 52] Health insurance is an important factor for reducing patients' out-of-pocket cost of a health service. Patients with health insurance usually do not pay the total price for a good or service. Our finding suggests that financial barriers like healthcare coverage play an important role in receiving medication prescription. Further, uninsured patients may also be less likely than insured patients to obtain refills for their prescriptions, even when they were prescribed.

Our study found that income category (household income) was also significantly associated with odds of receiving an ICS prescription among adult asthmatic patients (Table 9). Patients in the high income groups had higher odds of receiving ICS prescription as compared to patients in the poor/negative income group. Previous studies which analyzed the receipt of ICS prescription have not documented the association of income category or family income with receipt of ICS prescription. The association of high income to the receipt of ICS prescription may be attributable to the fact that people belonging to higher income groups are more likely to be covered by health insurance, and thus receive prescriptions for ICS. Our results also reveal that adult patients residing in the west had lower odds of receiving ICS prescription as compared to patients residing in the northeast US. We also found that with increase in overall score for health status, the odds of receiving an ICS prescription also increase. We believe

that this is an important finding since studies published in the past have not analyzed the association of health status with receipt of ICS prescription.

Utilization of asthma-related office visits among Hispanic and non-Hispanic White asthmatic patients

About 36% of the study population had at least one asthma-related office visit in 2009 (Table 10). Mean number of asthma-related office visits in 2009 for Hispanic and non-Hispanic Whites were found to be 0.98 (± 0.1 SE) and 1.03 (± 0.12 SE), respectively. This mean score is low as per NAEPP guidelines, suggesting an inadequate number of contacts to optimally manage asthma. [6] This low rate of utilization is an important finding of our study and contradicts the results from previously published literature. A study by Shields AE et al. found that the mean asthma-related office visits utilization rate in 1994 in Medicaid-insured patients to be 1.33 (± 2.46 SD).[76] It is however important to note that all the patients in this study were insured. The mean utilization in Hispanic and non-Hispanic white children in 1994 was found to be 1.27 (± 2.14 SD) and 1.38 (± 2.66 SD). Similarly a study by Kim H et al reported the mean number of asthma-related office visits from 1996 to 2000 for Hispanics and non-Hispanic Whites to be 2.74 (± 0.51 SD) and 2.11 (± 0.23 SD), respectively.[95]

We found that Hispanic patients had 1.46 (95% CI: 1.10 – 1.93) times higher odds of having an asthma-related office visit than non-Hispanic White patients (Table 12). This finding was found to be consistent with a previously published study.[95] This difference however, was not prevalent in the negative

binomial regression (Table 13). Hispanic patients did not have significantly more number of asthma-related office visits than non-Hispanic Whites. This finding is contradictory to previously published studies.[95] One explanation for this phenomenon could lie in the reporting of office visits in MEPS. It is important to note that MEPS does not record whether the office visit is a scheduled visit or an unscheduled visit. It is possible that Hispanics had more number of unscheduled visits than non-Hispanic Whites. In separate analyses we found that Hispanic patients had a significantly higher level of asthma-related ER visits than non-Hispanic White patients (Table 21); an ER visit represents poor control of asthma symptoms thus, strengthening our assumption that Hispanics had more unscheduled visits. This shows that Hispanic patients use more emergency department care and use less preventative care, assuming that the office visits were unscheduled visits. Part of the explanation may also lie with the lack of usual source of care, with level of asthma management skills, or with attitudes, as described earlier.[53] If patients rely on emergency department care for having acute asthma episodes because they lack home management skills, then intervention programs designed to improve caregivers' asthma management skills or attitudes would be useful. However, if patients seek emergency department care for asthma episodes because they lack usual source of care, then more system-oriented changes such as providing usual source of care may be needed.

Our analyses also found that patients who received a prescription for ICS medication had a higher level of asthma-related office visits (Tables 12, and 13).

One explanation for this finding could be that patients who receive ICS prescription have more routine checkups. We also found that patients who experienced asthma attack in 2009 had higher levels of asthma-related office visits. As mentioned earlier, MEPS database does not record whether the office visit was a scheduled visit or an unscheduled meeting. One explanation for patients with a history of asthma-attack having higher office visits could be that these patients had more unscheduled visits. An unscheduled visit can be considered as a marker of poor asthma control; in contrast a scheduled visit may reflect optimal asthma management because routine periodic review of disease control is an important component of recommended management.[6] Also, comprehensive scheduled visits for asthma for patients previously given a diagnosis of asthma also may be included even without an asthma-specific diagnostic code due to the likelihood that asthma was addressed at these visits. Patient-initiated remote care events, such as e-mail or telephone consultation, increasingly supplement traditional face-to-face encounters. However, the MEPS database does not capture these events and future research should incorporate these encounters in the analyses.

We also found that patients who were uninsured had a significantly lower level of asthma-related office visits than patients who had private insurance (Table 13). We also found that these uninsured patients had a higher level of asthma-related ER visits (Tables 20, and 21). Thus it is reasonable to say that uninsured patients use more emergency department care and less preventative care. This finding is consistent with previously published studies.[95] Patients who

reported to have a usual source of care were also found to have higher asthma-related office visits as compared to patients who did not have a usual source of care (Table 13). One possible explanation for this phenomenon could be that patients with usual source of care have more routine check-ups and thus more office visits. Our analyses also showed that patients with better self-perceived overall health had higher utilization of asthma-related office visits. This is an important finding and has not been documented before. A reason for this could be that patients with regular asthma-related office visits may have regular checkups for their condition and thus better control of their asthma symptoms in turn having better overall health.

Utilization of asthma-related prescription fills among Hispanic and non-Hispanic White asthmatic patients

Our analyses revealed that nearly 71% of our study population had at least one asthma-related prescription fill in 2009 (Table 14). The mean number of asthma-related prescription fills in 2009 for Hispanic and non-Hispanic Whites was found to be 1.78 (± 0.12 standard error) and 2.22 (± 0.09 standard error), respectively. We found this rate to be lower than previously published studies which reported the mean prescription fills from 1996 to 2000 in Hispanic and non-Hispanic White patients to be 7.02 (± 0.85 standard error) and 6.45 (± 0.78 standard error), respectively.[95] It is important to note that the mean utilization for Hispanics was found to be lower than non-Hispanic Whites in our study, which was inconsistent with the previously published studies.[65, 76, 95] However, another

study has reported that Hispanic asthmatic patients have lower mean prescription fills as compared to non-Hispanic Whites.[74]

After adjusting for other variables, our study found no significant differences in prescription fills between Hispanics and non-Hispanic Whites (Table 16). In another analyses we found that Hispanics patients had lower odds of receiving ICS prescription (Table 9). Previous studies have reported that minority patients are less likely to use controller medications to prevent asthma exacerbations and more likely to use reliever mediations like short acting β-agonists.[52, 96] Since there was no difference in prescription fills between Hispanics and Whites we believe that Hispanic patients could have filled more prescriptions of reliever mediations like short acting β-agonists.

We also found that patients who experienced an asthma attack had a higher level of prescription fills than patients who did not experience a single asthma attack in 2009 (Tables 16, and 17). Patients who experience asthma attacks have poor control of asthma symptoms and are prescribed more reliever medication like short-acting β-agonists. We do not report the analysis of reliever medications but we believe that reliever medication fills in patients with a history of asthma attack might have contributed to the higher utilization of prescription fills. We found that patients who had a usual source of care had higher rates of prescription fills as compared to patients who did not have a usual source of care (Table 17). A possible explanation for this phenomenon could be that patients with usual source of care may have more routine check-ups and thus more prescription fills of controller medications.

Utilization of asthma-related ER visits among Hispanic and non-Hispanic White asthmatic patients

We found that nearly 4% of patients in our study population had at least one asthma-related ER visit in 2009 (Table 18). A higher proportion of Hispanics had an asthma-related ER visit as compared to non-Hispanic Whites. The mean number of asthma-related ER visits for Hispanics and non-Hispanic Whites was found to be 0.12 (± 0.02 SE) and 0.03 (± 0.01 SE), respectively. Consistent with findings from other studies conducted among asthmatics, Hispanics in our study had significantly higher levels of ER visits than non-Hispanic Whites (Tables 20, and 21).[65, 74, 76, 95, 97] These results are however, not consistent with results of a previous study of children with asthma treated in a military treatment facility, which found no significant differences between Hispanics and non-Hispanic Whites for asthma-related ER visits.[78] However, the previous study's small sample size, limited number of clinics studied, equal coverage in all patients, and difference in access to care preclude definitive conclusions.

In a separate logistic regression analysis, we found that Hispanic patients were less likely to have a steroid inhaler (Table 9). ICS has been associated with reduction in ER visits and since less Hispanics were prescribed ICS they could have more ER visits. [98, 65] However, our study did not find any difference in the number of ER visits between patients who received an ICS prescription and patients who did not. This contradicts the previously published studies which found that receiving an ICS prescription was associated with reduction in ER visits.[98] Part of the explanation why Hispanics had more ER visits may lie with the

lack of health insurance, with level of asthma management skills, or with attitudes, as described earlier.[53] Also, our study assessed only the receipt of ICS prescription, we did not analyze adherence profile of patients to ICS medications. Previous studies have documented that patients who were adherent to ICS medications or had more utilization of ICS medications in the past 3 months had fewer ER visits.[65] Receipt of ICS prescription does not indicate whether the patients were adherent to ICS or had even used ICS. Thus, patients in our study could have received ICS prescription but were non-adherent to the appropriate medication regimen leading to higher ER visits.

We also found that patients who had public insurance and who were uninsured had a higher level of ER visits than patients who had private health insurance coverage (Tables 20, and 21). Our previous analyses found that patients who were uninsured had a lower likelihood of using asthma-related office visits (Table 13). Having an office visits is a preventative measure and represents a better control of asthma symptoms. Since uninsured patients had a lower use of office visits it is reasonable to say that these patients did not have a proper control of their asthma symptoms or had higher severity of asthma and in turn had a higher level of emergency department use. Thus uninsured patients use more emergency department care and less preventative care. This finding is found consistent with a previously published study.[95]

If patients rely on emergency department care for having acute asthma episodes because they lack home management skills, then intervention programs designed to improve caregivers' asthma management skills or attitudes

would be useful. However, if patients seek emergency department care for asthma episodes because they lack usual source of care, then more system-oriented changes may be need.

Utilization of asthma-related inpatient visits among Hispanic and non-Hispanic White asthmatic patients

We found that just 1% of the study population had an inpatient visit during 2009 (Table 22). The mean number of inpatient visits in 2009 for Hispanics and non-Hispanic Whites was found to be 0.03 (± 0.01 SE) and 0.01 (± 0.01 SE), respectively. Our analysis reveals that Hispanics had higher odds of having at least one asthma-related inpatient visit during the study period compared to non-Hispanic Whites, after adjusting for other predictors (Table 24). This result is consistent with previously published studies which report that Hispanics had 2 to 3 times more asthma-related inpatient visits than non-Hispanic Whites.[16, 73, 99-101] The results are, however, inconsistent with a previously published study which found no difference between Hispanic and non-Hispanic Whites in terms of asthma-related inpatient visits.[78] However, the previous study's small sample size, and uniform health insurance coverage in all patients preclude definitive conclusions.

One possible explanation for the observed ethnic disparity in inpatient visits in our study could be due to the utilization of ICS medications. However, we did not find any association between receipt of ICS prescription and having an asthma-related inpatient visit. This contradicts the results of previously published

studies which found that patients who followed ICS guidelines had lower asthma-related inpatient visits.[67, 79,102,103] This variation in results may be attributable to our study design; first our study does not assess the adherence to ICS medications, it only assesses the receipt of ICS prescription. A receipt of ICS prescription does not necessarily relate to adherence of ICS medications. The patients in our study who had a receipt of ICS prescription may have not been adherent to ICS utilization guidelines and thus had more inpatient visits. Also, MEPS does not report the date of inpatient visit so we could not ascertain if ICS was prescribed after the inpatient visit or before having an ER visit.

In our study we found that patients in the age group of 19 to 40 years had lower odds of having an inpatient visit as compared to patients below 19 years of age (Table 24). This finding is consistent with previously published study which found that patients in the age group of 26 to 35 years had 50% lower odds of having an asthma-related inpatient visit as compared to patients in the age group of 14 to 25 years.[16] We also found that patients who were residing in rural areas (non-MSA) had almost 7 times higher odds of having an inpatient visits. The explanation for this finding may lie in access to healthcare. Patients in the rural areas might not have similar level of access to healthcare services as patients residing in urban areas, leading to improper control of asthma symptoms thus leading to more inpatient visits.

Limitations

The results of this study should be interpreted in the light of some limitations. The study uses a cross-sectional design and therefore, cause and effect relationship between the independent and the dependent variables cannot be established. This study is based on self-report and previous research has shown that self-reported conditions might be underreported, and the extent might vary by race and ethnicity. Another drawback of all self-report surveys is the tendency of respondents to give socially desirable answers. Another potential limitation of the study is recall bias. Patients were asked to recall the use of healthcare services like number of asthma-related office visits, ER visits, inpatient visits and prescription fills.

Previously conducted studies have provided evidence that severity of asthma symptoms is associated with the receipt of ICS prescription. The MEPS survey does not record the severity of asthma symptoms, and thus we could not assess the effect of asthma severity in our study. Previous studies have used Charlson's comorbidity index as a proxy for severity of asthma symptoms. MEPS does not provide the fully-specified ICD-9-CM codes, but instead provides a three digit code for medical conditions for security concerns. This coding pattern does not allow for the calculation of Charlson's comorbidity index, as some conditions are grouped together to form a single 3 digit code.

We identified asthma patients based on medical conditions reported by respondents in the MEPS. The reported medical conditions were coded by professional coders to fully-specified ICD-9-CM codes. However, it is likely that some individuals who presented with milder or intermittent symptoms of asthma

did not receive a diagnosis of asthma. These respondents with milder or intermittent symptoms of asthma then would be classified as non-asthmatics resulting in underestimation of national prevalence.

The drug mentions in the MEPS do not necessarily indicate either the filling of prescription or compliance to the medication regime, only that it was prescribed, dispensed, or administered during the visit. As a result we could not analyze the adherence pattern to ICS medications to provide more conclusive association of the use of ICS with the use of health care services. Another problem with the MEPS database is the presence of missing values. We could not analyze the type of provider seen by the patients in the regression analyses due to missing values for the variable for over half of the sample.

Although we controlled for many important patient-level factors in assessing asthma care, we could not assess the effects of unmeasured provider-level factors such as training, cultural competence, technological resources, or availability of care management programs. We also could not assess the use of complementary and alternate medications use by the sample.

Strengths

A strength of our study is that we used nationally representative data from MEPS. MEPS provides extensive information on health care utilization during the 2009 year and concurrent socioeconomic and health insurance information for patients with asthma. This is the first study to determine the receipt of ICS prescription for asthma using a nationally representative sample.

Previously published studies have assessed prescription of ICS in much smaller and focused populations like Medicaid insured children. Most surveys lack the capabilities to perform analysis on minority populations like Hispanic as they are underrepresented. MEPS provides an advantage in analyzing minority population as these populations are oversampled. Our study also has the statistical power to provide robust estimates of healthcare utilizations which other studies with smaller sample sizes lack.

Generalizability of our study is high as MEPS uses a nationally representative sample of individuals living in households and non-institutionalized civilian population. Use of large sample size provides precise estimates of ICS and other health care utilization and facilitates comparison within subgroups of population. Use of sampling weights in this study helps to account for the complex sampling methodology in the MEPS. This helps to obtain robust estimates of ICS prescription and utilization of other health care services. Accounting for the complex survey designs used in MEPS provides appropriate parameter estimates and standard errors thereby yielding accurate estimates of ICS prescription and utilization of other health care services. Also, use of multiple logistic regression and negative binomial regression provides the ability to analyze multiple variables in the same analysis and adjust for the effect of other variables.

Implications for future research

Future studies should be designed to address the limitations mentioned earlier. Future research should address how additional factors – such as caregiver's time, skills, and attitudes – relate to health services utilization in the Hispanic population. Additional research is needed that places the dynamics of care in a broader context that takes into account the different values and experiences of Hispanic populations interacting with health care providers and the medical system. Studies should analyze the patients' health beliefs, social and physical environment, physicians' comprehensive knowledge of patients, patients' trust in their physicians and patient-physician communication. Efforts to broaden the range of variables addressed in health services research are essential to understanding the dynamics underlying racial/ethnic disparities.

Conclusion

Although further research is needed, this study suggests that racial/ethnic differences are significant in receipt of an ICS prescription for asthmatic patients. Our study shows that a significantly lower proportion of asthmatic Hispanics are prescribed ICS than asthmatic non-Hispanic Whites. The care in terms of ICS prescription received by asthmatic Hispanic patients in this study did not meet the standard guidelines set by NAEPP. [6] Lack of prescribing of ICS medications for asthma in ethnic minority groups may be surrogates for underlying differences in social determinants of health such as access to care, quality of care delivery, and cultural beliefs and warrants additional investigation.

Consistent with previous findings we found significant racial/ethnic disparities in asthma-related inpatient visits, ER visits, office visits and prescription fills. Additionally, differences in household income did not fully explain the differences in asthma hospitalization, ER visits, office visits or prescription fills. We conclude that Hispanic asthmatic patients use more urgent care and less preventative care for asthma and families without health insurance use lower asthma-related health care services overall. Providing health insurance to patients who do not have it may be crucial in managing asthma, especially for preventative services such as regular office visits and prescription fills. The US passed The Affordable Care Act which is a health care law that aims at improving the current US health care system by increasing access to health coverage for Americans and introducing new protections for people who have health insurance. The law offers health plans for people with pre-existing conditions such as asthma who had trouble finding coverage due to such pre-existing coverage. Providing health insurance to asthmatic patients who are uninsured would help in increasing prescribing ICS for asthma and thus better control of asthma symptoms.

Provider training is essential if more asthmatic Hispanics are to be properly medicated. Research on physician education shows, that provider groups who have received training implement changes in their practices that improved disease control for patients.[104, 105] Therefore, provider practices may be a key intervention area for reducing health disparities in asthma medication use.

Additional research is needed to better understand the experience of Hispanic patients as they interface with the health care system and the changes needed to facilitate access and utilization of effective case management for Hispanics with asthma. Such an effort will require additional data collection, efforts and resources, but only such a path will help to achieve the goal of eliminating racial disparities in health and health care.

REFERENCES

1. Global Initiative for Asthma. Global strategy for asthma management and prevention. 2010;2011.

2. American Lung Association. Epidemiology & Statistics Unit, Research and Program Services. Trends in Asthma Morbidity and Mortality. 2011;2011.

3. Bousquet J, Khaltaev N, Cruz AA. Global surveillance, prevention and control of chronic respiratory diseases: a comprehensive approach. World Health Organization, 2007.

4. Akinbami L. Asthma prevalence, health care use and mortality: United States, 2003-05. US Department of Health and Human Services, Centers for Disease Control and Prevention. National Center for Health Statistics Web site.http://www.cdc.gov/nchs/products/pubs/pubd/hestats/ashtma03-05/asthma03-05.htm 2006;:11-.

5. DeFrances CJ, Lucas CA, Buie VC, Golosinskiy A. 2006 National Hospital Discharge Survey. US Centers for Disease Control and Prevention National Health Statistics Reports 2008;:1-20.

6. National Asthma Education, Prevention Program (National Heart, Lung, Blood Institute). Second Expert Panel on the Management of Asthma. Expert Panel report 2: guidelines for the diagnosis and management of asthma. DIANE Publishing, 1998.

7. U.S. Census Bureau. Profile of General Population and Housing Characteristics: 2010. 2010 Demographic Profile Data. 2011.

8. Akinbami L, Moorman JE, Liu X. Asthma prevalence, health care use and mortality: United States, 2005-2009. National health statistics reports 2011;:1.

9. Mosen DM, Schatz M, Gold R, Mularski RA, Wong WF, Bellows J. Medication use, emergency hospital care utilization, and quality-of-life outcome disparities by race/ethnicity among adults with asthma. Am J Manag Care 2010;16:821-8.

10. Krishnan JA, Diette GB, Skinner EA, Clark BD, Steinwachs D, Wu AW. Race and sex differences in consistency of care with national asthma guidelines in managed care organizations. Arch Intern Med 2001;161:1660.

11. Rand CS, Apter AJ. Mind the widening gap: Have improvements in asthma care increased asthma disparities? Ambulatory Pediatrics 2008;122:319-21.

12. Cabana MD, Lara M, Shannon J. Racial and Ethnic Disparities in the Quality of Asthma Care*. Chest 2007;132:810S.

13. Smedley BD, Stith AY, Nelson AR. Unequal treatment: confronting racial and ethnic disparities in health care. Natl Academy Pr, 2003.

14. Jones R, Lin S, Munsie JP, Radigan M, Hwang SA. Racial/ethnic differences in asthma-related emergency department visits and hospitalizations among children with wheeze in Buffalo, New York. Journal of Asthma 2008;45:916-22.

15. Laditka JN, Laditka SB. Race, ethnicity and hospitalization for six chronic ambulatory care sensitive conditions in the USA. Ethnicity and Health 2006;11:247-63.

16. Legorreta AP, Christian-Herman J, O'Connor RD, Hasan MM, Evans R, Leung KM. Compliance with national asthma management guidelines and specialty care: a health maintenance organization experience. Arch Intern Med 1998;158:457.

17. Apter AJ, Reisine ST, Affleck G, Barrows E, ZuWallack RL. Adherence with twice-daily dosing of inhaled steroids. Socioeconomic and health-belief differences. American Journal of Respiratory and Critical Care Medicine 1998;157:1810.

18. Ortega AN, Gergen PJ, Paltiel AD, Bauchner H, Belanger KD, Leaderer BP. Impact of site of care, race, and Hispanic ethnicity on medication use for childhood asthma. Pediatrics 2002;109:e1.

19. Ferris TG, Kuhlthau K, Ausiello J, Perrin J, Kahn R. Are minority children the last to benefit from a new technology?: Technology diffusion and inhaled corticosteriods for asthma. Med Care 2006;44:81.

20. Birkhead G, Attaway NJ, Strunk RC, Townsend MC, Teutsch S. Investigation of a cluster of deaths of adolescents from asthma: Evidence implicating inadequate treatment and poor patient adherence with medications. J Allergy Clin Immunol 1989;84:484-91.

21. Brooks CM, Richards JM, Kohler CL, et al. Assessing adherence to asthma medication and inhaler regimens: a psychometric analysis of adult self-report scales. Med Care 1994;:298-307.

22. Bailey WC, Richards Jr JM, Brooks CM, Soong S, Windsor RA, Manzella BA. A randomized trial to improve self-management practices of adults with asthma. Arch Intern Med 1990;150:1664.

23. Belda A. Misuse of asthma-medication inhalers. CMAJ: Canadian Medical Association Journal 1995;153:1069.

24. Moorman JE, Centers for Disease Control and Prevention (US). National surveillance for asthma--United States, 1980-2004. Department of Health and Human Services, Centers for Disease Control and Prevention, 2007.

25. Reddel H, Ware S, Marks G, Salome C, Jenkins C, Woolcock A. Differences between asthma exacerbations and poor asthma control. The Lancet 1999;353:364-9.

26. Mannino DM, Homa DM, Pertowski CA, et al. Surveillance for asthma—United States, 1960–1995. MMWR CDC Surveill Summ 1998;47:1-27.

27. Redd SC. Asthma in the United States: burden and current theories. Environ Health Perspect 2002;110:557.

28. Weiss KB, Gergen PJ, Hodgson TA. An economic evaluation of asthma in the United States. N Engl J Med 1992;326:862-6.

29. Center for Disease Control and Prevention, Vital Signs. Asthma in the US. 2011.

30. Maspero JF, Nolte H, Chérrez-Ojeda I. Long-term safety of mometasone furoate/formoterol combination for treatment of patients with persistent asthma. Journal of Asthma 2010;47:1106-15.

31. Barnes PJ, Pedersen S. Efficacy and safety of inhaled corticosteroids in asthma. Report of a workshop held in Eze, France, October 1992. Am Rev Respir Dis 1993;148:S1-26.

32. National Institute of Health and Clinical Excellence. Inhaled corticosteroids for the treatment of chronic asthma in adults and in children aged 12 years and over. 2008;2011.

33. Stingone JA, Claudio L. Components of recommended asthma care and the use of long-term control medication among urban children with asthma. Med Care 2009;47:940.

34. Healthy People 2010. Chapter 5. 2010;2011.

35. Erickson SE, Iribarren C, Tolstykh IV, Blanc PD, Eisner MD. Effect of race on asthma management and outcomes in a large, integrated managed care organization. Arch Intern Med 2007;167:1846.

36. Wright RJ, Subramanian S. Advancing a Multilevel Framework for Epidemiologic Research on Asthma Disparities*. Chest 2007;132:757S.

37. Ginde AA, Espinola JA, Camargo Jr CA. Improved overall trends but persistent racial disparities in emergency department visits for acute asthma, 1993-2005. J Allergy Clin Immunol 2008;122:313-8.

38. Barnes KC. Genetic epidemiology of health disparities in allergy and clinical immunology. J Allergy Clin Immunol 2006;117:243-54.

39. Wang J, Mullins CD, Zuckerman IH, et al. Medical Expenditure Panel Survey: A valuable database for studying racial and ethnic disparities in prescription drug use. Research in Social and Administrative Pharmacy 2008;4:206-17.

40. Ramirez RR. We the people: Hispanics in the United States. US Census Bureau. US Dept. of Commerce, Economic and Statistics Administration, US Census Bureau, 2004.

41. Ramirez RR, De La Cruz GP. The Hispanic Population in the United States: March 2002. Fed Regist 1997;62.

42. O'Reilly J, Jones MM, Parnham J, Lovibond K, Rudolf M. Management of stable chronic obstructive pulmonary disease in primary and secondary care: summary of updated NICE guidance. BMJ 2010;340.

43. Adams SG, Anzueto A, Pugh JA, Lee S, Hazuda HP. Mexican American elders have similar severities of COPD despite less tobacco exposure than European American elders. Respir Med 2006;100:1966-72.

44. Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. Surveillance for asthma—United States, 1980–1999. MMWR Surveill Summ 2002;51:1-13.

45. Cohen RT, Celedon JC. Asthma in Hispanics in the United States. Clin Chest Med 2006;27:401,12, v.

46. Rhodes L, Bailey C, Moorman J. Asthma prevalence and control characteristics by race/ethnicity–United States, 2002. MMWR Morbidity and Mortality Weekly Report 2004;53:145-8.

47. Carter-Pokras OD, Gergen P. Reported asthma among Puerto Rican, Mexican-American, and Cuban children, 1982 through 1984. Am J Public Health 1993;83:580.

48. Arif A, Delclos G, Lee E, Tortolero S, Whitehead L. Prevalence and risk factors of asthma and wheezing among US adults: an analysis of the NHANES III data. European Respiratory Journal 2003;21:827.

49. Eldeirawi K, McConnell R, Freels S, Persky VW. Associations of place of birth with asthma and wheezing in Mexican American children. J Allergy Clin Immunol 2005;116:42-8.

50. Rodriguez MA, Winkleby MA, Ahn D, Sundquist J, Kraemer HC. Identification of population subgroups of children and adolescents with high asthma

prevalence: findings from the Third National Health and Nutrition Examination Survey. Archives of Pediatrics and Adolescent Medicine 2002;156:269.

51. Akinbami LJ, Rhodes JC, Lara M. Racial and ethnic differences in asthma diagnosis among children who wheeze. Pediatrics 2005;115:1254.

52. Lieu TA, Lozano P, Finkelstein JA, et al. Racial/ethnic variation in asthma status and management practices among children in managed Medicaid. Pediatrics 2002;109:857.

53. Finkelstein JA, Lozano P, Farber HJ, Miroshnik I, Lieu TA. Underuse of controller medications among Medicaid-insured children with asthma. Archives of Pediatrics and Adolescent Medicine 2002;156:562.

54. Pachter LM, Cloutier MM, Bernstein BA. Ethnomedical (folk) remedies for childhood asthma in a mainland Puerto Rican community. Archives of Pediatrics and Adolescent Medicine 1995;149:982.

55. Bearison DJ, Minian N, Granowetter L. Medical management of asthma and folk medicine in a Hispanic community. J Pediatr Psychol 2002;27:385.

56. Data overview, Agency for Healthcare Research and Quality. 2011;2011.

57. Hahn BA. Children's health: racial and ethnic differences in the use of prescription medications. Pediatrics 1995;95:727.

58. Chen AY, Chang RKR. Factors associated with prescription drug expenditures among children: an analysis of the Medical Expenditure Panel Survey. Pediatrics 2002;109:728.

59. Wang J, Noel JM, Zuckerman IH, Miller NA, Shaya FT, Mullins CD. Disparities in access to essential new prescription drugs between non-Hispanic whites, non-Hispanic blacks, and Hispanic whites. Medical care research and review 2006;63:742.

60. Wang J, Zuckerman IH, Miller NA, Shaya FT, Noel JM, Mullins CD. Utilizing New Prescription Drugs: Disparities among Non-Hispanic Whites, Non-Hispanic Blacks, and Hispanic Whites. Health Serv Res 2007;42:1499-519.

61. Wang J, White-Means SI, Hufstader MA, Walker GD. The economic implications of the racial and ethnic disparities in the use of selective serotonin reuptake inhibitors. Current Medical Research and Opinion® 2007;23:853-63.

62. Hee Hong S, Sanders BH, West D. Inappropriate use of inhaled short acting beta-agonists and its association with patient health status. Current Medical Research and Opinion® 2005;22:33-40.

63. Kamble S, Bharmal M. Incremental direct expenditure of treating asthma in the United States. Journal of Asthma 2009;46:73-80.

64. Daniel GW, Malone DC. Characteristics of older adults who meet the annual prescription drug expenditure threshold for Medicare medication therapy management programs. Journal of Managed Care Pharmacy 2007;13:142.

65. Crocker D, Brown C, Moolenaar R, et al. Racial and ethnic disparities in asthma medication usage and health-care utilization. Chest 2009;136:1063.

66. McQuaid EL, Vasquez J, Canino G, et al. Beliefs and barriers to medication use in parents of Latino children with asthma. Pediatr Pulmonol 2009;44:892-8.

67. Finkelstein JA, Brown RW, Schneider LC, et al. Quality of care for preschool children with asthma: the role of social factors and practice setting. Pediatrics 1995;95:389.

68. Galbraith AA, Smith LA, Bokhour B, et al. Asthma Care Quality for Children With Minority-Serving Providers. Archives of Pediatrics and Adolescent Medicine 2010;164:38.

69. Vila D, Rand CS, Cabana MD, et al. Disparities in asthma medication dispensing patterns: the case of pediatric asthma in Puerto Rico. Journal of Asthma:1-6.

70. Smith LA, Bokhour B, Hohman KH, et al. Modifiable risk factors for suboptimal control and controller medication underuse among children with asthma. Pediatrics 2008;122:760.

71. Inkelas M, Garro N, McQuaid EL, Ortega AN. Race/ethnicity, language, and asthma care: findings from a 4-state survey. Annals of Allergy, Asthma & Immunology 2008;100:120-7.

72. Cydulka RK, Tamayo-Sarver JH, Wolf C, Herrick E, Gress S. Inadequate follow-up controller medications among patients with asthma who visit the emergency department. Ann Emerg Med 2005;46:316-22.

73. Stewart KA, Higgins PC, McLaughlin CG, Williams TV, Granger E, Croghan TW. Differences in prevalence, treatment, and outcomes of asthma among a diverse population of children with equal access to care: findings from a study in the military health system. Archives of Pediatrics and Adolescent Medicine 2010;164:720.

74. Boudreaux ED, Emond SD, Clark S, Camargo Jr CA. Race/ethnicity and asthma among children presenting to the emergency department: differences in disease severity and management. Pediatrics 2003;111:e615.

75. Halm EA, Wisnivesky JP, Leventhal H. Quality and Access to Care Among a Cohort of Inner-city Adults With Asthma*. Chest 2005;128:1943.

76. Shields AE, Comstock C, Weiss KB. Variations in asthma care by race/ethnicity among children enrolled in a state Medicaid program. Pediatrics 2004;113:496.

77. Kuo A, Craig TJ. A retrospective study of risk factors for repeated admissions for asthma in a rural/suburban university hospital. JAOA: Journal of the American Osteopathic Association 2001;101:14S.

78. Forester JP, Ong BA, Fallot A. Can Equal Access to Care Eliminate Racial Disparities in Pediatric Asthma Outcomes? Journal of Asthma 2008;45:211-4.

79. Chandra D, Clark S, Camargo CA. Race/ethnicity differences in the inpatient management of acute asthma in the United States. Chest 2009;135:1527.

80. Wright K. Examining racial and ethnic disparities and predictors of medication use among California's African-American, Latino, and White children with asthma. Journal of National Black Nurses' Association: JNBNA 2007;18:1.

81. Iezzoni LI. Risk and outcomes. In: Risk Adjustment for Measuring Healthcare Outcomes. 2nd ed. Chicago, IL: Health Administration Press, 1992:1-41.

82. National health interview survey, Centers of Disease Control and Prevention. 1992;2011.

83. Diette GB, Wu AW, Skinner EA, et al. Treatment patterns among adult patients with asthma: factors associated with overuse of inhaled {beta}-agonists and underuse of inhaled corticosteroids. Arch Intern Med 1999;159:2697.

84. Shanawani H. Health disparities and differences in asthma: concepts and controversies. Clin Chest Med 2006;27:17.

85. Stingone JA, Claudio L. Disparities in the use of urgent health care services among asthmatic children. Annals of Allergy, Asthma & Immunology 2006;97:244-50.

86. Flores G, Tomany-Korman SC. Racial and ethnic disparities in medical and dental health, access to care, and use of services in US children. Pediatrics 2008;121:e286-98.

87. Vollmer WM, O'Hollaren M, Ettinger KM, et al. Specialty differences in the management of asthma: a cross-sectional assessment of allergists' patients and generalists' patients in a large HMO. Arch Intern Med 1997;157:1201.

88. Yoos HL, Kitzman H, McMullen A. Barriers to anti-inflammatory medication use in childhood asthma. Ambulatory Pediatrics 2003;3:181-90.

89. Conn KM, Halterman JS, Fisher SG, Yoos HL, Chin NP, Szilagyi PG. Parental beliefs about medications and medication adherence among urban children with asthma. Ambulatory Pediatrics 2005;5:306-10.

90. Halterman JS, Fisher S, Conn KM, et al. Improved preventive care for asthma: a randomized trial of clinician prompting in pediatric offices. Archives of Pediatrics and Adolescent Medicine 2006;160:1018.

91. Morales LS, Elliott M, Weech-Maldonado R, Hays RD. The impact of interpreters on parents' experiences with ambulatory care for their children. Medical care research and review 2006;63:110-28.

92. Weil CM, Wade SL, Bauman LJ, Lynn H, Mitchell H, Lavigne J. The relationship between psychosocial factors and asthma morbidity in inner-city children with asthma. Pediatrics 1999;104:1274-80.

93. Shalowitz MU, Berry CA, Quinn KA, Wolf RL. The relationship of life stressors and maternal depression to pediatric asthma morbidity in a subspecialty practice. Ambulatory Pediatrics 2001;1:185-93.

94. Siroux V, Pin I, Oryszczyn M, Le Moual N, Kauffmann F. Relationships of active smoking to asthma and asthma severity in the EGEA study. Epidemiological study on the Genetics and Environment of Asthma. European Respiratory Journal 2000;15:470-7.

95. Kim H, Kieckhefer GM, Joesch JM, Greek AA, Baydar N. Health Care Utilization by Children With Asthma. Preventing chronic disease 2009;6.

96. Finkelstein JA, Lozano P, Farber HJ, Miroshnik I, Lieu TA. Underuse of controller medications among Medicaid-insured children with asthma. Archives of Pediatrics and Adolescent Medicine 2002;156:562.

97. Legorreta AP, Christian-Herman J, O'Connor RD, Hasan MM, Evans R, Leung KM. Compliance with national asthma management guidelines and specialty care: a health maintenance organization experience. Arch Intern Med 1998;158:457.

98. Sin DD, Man S. Low-dose inhaled corticosteroid therapy and risk of emergency department visits for asthma. Arch Intern Med 2002;162:1591.

99. Kruse LK, Deshpande S, Vezina M. Disparities in asthma hospitalizations among children seen in the emergency department. Journal of Asthma 2007;44:833-7.

100. Herrod HG, Chang CF. Potentially Avoidable Pediatric Hospitalizations as Defined by the Agency for Healthcare Research and Quality: What Do They Tell Us About Disparities in Child Health? Clin Pediatr 2008;47:128-36.

101. Kelley E, Moy E, Stryer D, Burstin H, Clancy C. The national healthcare quality and disparities reports: an overview. Med Care 2005;43:I.

102. Bosco LA, Gerstman BB, Tomita DK. Variations in the use of medication for the treatment of childhood asthma in the Michigan Medicaid population, 1980 to 1986. Chest 1993;104:1727.

103. Crater DD, Heise S, Perzanowski M, et al. Asthma hospitalization trends in Charleston, South Carolina, 1956 to 1997: twenty-fold increase among black children during a 30-year period. Pediatrics 2001;108:e97-.

104. Clark NM, Bailey WC, Rand C. Advances in prevention and education in lung disease. American journal of respiratory and critical care medicine 1998;157:S155-67.

105. Kelly CS, Morrow AL, Shults J, Nakas N, Strope GL, Adelman RD. Outcomes evaluation of a comprehensive intervention program for asthmatic children enrolled in Medicaid. Pediatrics 2000;105:1029-35.