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Explanatory Power of the Behavior Model of Utilization for Pediatric Asthma Health Care in an Urban Managed Care Setting

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EXPLANATORY POWER OF THE BEHAVIOR MODEL OF UTILIZATION FOR PEDIATRIC ASTHMA HEALTH CARE IN AN URBAN MANAGED CARE SETTING

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Abstract

The Behavior Model of Utilization played a key role in explaining health services use for pediatric members with asthma in one urban, regional managed care company. The critical role the asthma management program played in promoting the health and well-being of enrolled members was elucidated. Information gleaned from this empirical study can be used to encourage appropriate resource utilization, formulate pediatric asthma health policy, and deliver cost-effective, quality health care. More importantly, managed care company administrators and clinicians can demonstrate the value of their efforts by achieving measurable improvements in the health and well-being of children in the communities they serve.

To improve the health and well-being of children with asthma, health policy makers and clinicians must understand both the context within which asthma health services occur and the relative contribution of patient-related factors and contextual factors to health services use. Therefore, this research used the Behavior Model of Utilization to explore the relative contribution of patient-related factors and contextual factors to pediatric asthma health services utilization behaviors. The conceptual framework offered a systematic and organized approach to identify and test various factors that influence pediatric asthma health services. More importantly, the conceptual model ensured all available factors were equally considered.

A non-experimental, observational, longitudinal historical research design with three independent groups was used to test the explanatory power of the Behavior Model of Utilization. This study was unique in that one of the comparison groups included participants who declined to enroll in the asthma management program despite referral by

their primary care providers. Data sets were linked to create an individual sample of children with their primary care providers. Explanatory models, based on logistic regression analyses, were developed at the participant and primary care provider level. Previously unexplored variables, such as primary care provider gender and the availability of neighborhood-based primary care provider services, were included in the model. In this study, the child was the unit of analysis instead of the health services resource claim.

Study results revealed that the asthma management program, a contextual factor, significantly reduced the likelihood of using health services and controlled cost for this insured pediatric population. Participants enrolled in the asthma management program were significantly less likely to be admitted to the hospital, use emergency department services, or use specialist services. Participants were also significantly less likely to be classified high total health care cost. These results were further supported when pre-test year results were compared to post-test year results. Finally, these participants were significantly less likely to use beta-agonist medications than participants not enrolled in the program.

Study results also revealed that the asthma management program was the only significant predictor variable across all health services outcome measures, when holding the pre-test year measures constant. The asthma management program contributed more to the explanatory power of the Behavior Model of Utilization than population-related factors or environment-related factors. Additionally, the program contributed as much or more to the explanatory power of the model than pre-test year measures. Finally, the asthma management program enabled the managed care company to meet health policy objectives and positions the company to receive a favorable review for the asthma quality indicator defined by the National Committee for Quality Assurance.

DEDICATION

Across American, in urban areas and small towns, people are working hard to improve the health and well-being of children in their communities. As a result, many wonderful things are being achieved. However, many are struggling to demonstrate the value of their efforts. Community leaders want results. Public and private funders, underwriting the work, also want results. (Health Forum, American Hospital Association, 1999). Administrators and clinicians, in managed care organizations, are working hard to achieve and demonstrate measurable improvements in the health and well-being of children in the communities they serve. This dissertation is dedicated to these stewards of community health and well-being, my colleagues.

ACKNOWLEDGMENTS

Many sacrifices were made by my family during the completion of this work. I would like to acknowledge and thank my husband, Donnie, for his unconditional love and support. To my sons, Michael and Chris, thanks for the words of encouragement. To my parents, Billy and Marie, thanks for teaching me that life's journey has many roads from which to choose and giving me the wisdom to make the best choice. To the rest of my family and friends, thanks for being there. A special thank you to Dr. Randy Axelrod, my mentor and friend, whose vision provides the premise for this work.

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CHAPTER I: INTRODUCTION

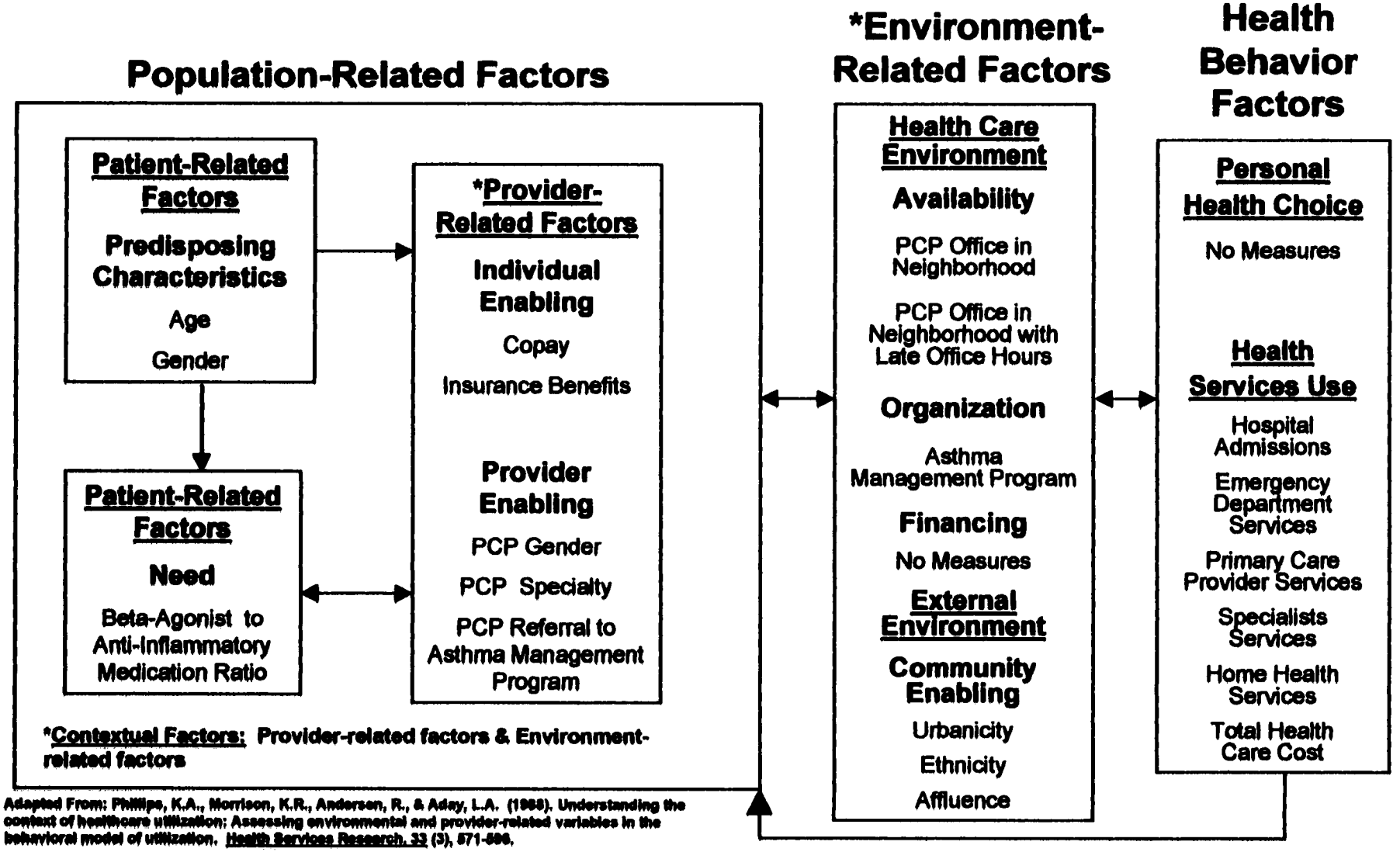
Research Overview

The purpose of this research was to test the explanatory power of the Behavior Model of Utilization (Phillips, Morrison, Andersen, & Aday, 1998; Aday, Begley, Lairson, & Slater, 1998) for pediatric asthma health services use in one urban, regional managed care company (Figure 1). By design, the model integrated three broad factors: population-related factors; environment-related factors; and health behavior factors. Contextual factors, or the context within which pediatric asthma health care utilization occurred, were defined as provider-related factors (individual enabling and provider enabling) and environment-related factors (health care environment and external environment).

In this research, relationships between patient-related factors and contextual factors (provider-related factors and environment-related factors) were tested (Phillips, et al., 1998; Aday, et al., 1998). Patient-related factors included predisposing characteristics and need. Provider-related factors included individual enabling and provider enabling. Environment-related factors included health care environment and external environment. Health behavior factors included pediatric health services use. Reference to contextual factors in this research includes both provider-related and environment-related factors. Reference to health services use includes both health services utilization and associated cost.

Second, the influence of patient-related factors and contextual factors on pediatric asthma utilization behavior was measured (Phillips, et al., 1998; Aday, et al.,

Behavior Model of Utilization Pediatric Asthma Health Care



Adapted From: Phillips, K.A., Morrison, K.R., Andersen, R., & Aday, L.A. (1998). Understanding the context of healthcare utilization: Assessing environmental and provider-related variables in the behavioral model of utilization. Health Services Research, 33 (3), 571-596.

1998). Specifically, the context within which pediatric asthma healthcare utilization occurred and the relative contribution of patient-related factors and contextual factors to use of pediatric asthma health care services was measured.

Understanding relationships between patient-related factors, contextual factors and utilization behaviors is of interest from a pediatric asthma health policy and programmatic perspective (Phillips, et al., 1998; Weiss & Budetti, 1993; McDermott, Marden, Shannon, Weiss, Sonenthal, & Donald, 1997). For example, policy makers and health care administrators want to know the relative contribution of patient-related factors and contextual factors to use of pediatric asthma health care services. Historically, utilization studies focused on patient-related factors, such as predisposing characteristics and need for health care services (Phillips, et al., 1998; Aday, et al., 1998). As a result, limited information exists concerning the relative contribution of contextual factors to use of pediatric asthma health care services. Exploring both patient-related factors and contextual factors that influence utilization behaviors can provide information needed to promulgate pediatric asthma health policies; encourage appropriate resource utilization; and promote cost-effective care.

Behavior Model of Utilization Empirical Study

Empirical studies testing the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in an urban, regional managed care company have not been reported in the literature. For example, Phillips and colleagues (1998) used meta-analysis to determine whether empirical studies (conducted between 1975 and 1995) employing the Behavior Model of Utilization to evaluate health services

use, included contextual factors in the analyses. According to the authors only 14 percent (n=20) of the studies reviewed included both provider-related and environment-related factors. No studies reviewed by these authors explored the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in an urban, regional managed care company. However, one study (Geller, Burns, & Brailer, 1996) reviewed has relevance to this research in that the influence of physician referral on utilization behavior was explored.

Geller and colleagues investigated the role of provider enabling factors on decisions to perform hysterectomies (Geller, Burns, & Brailer, 1996). In this study, multiple sources of data were linked to explore 35,104 hysterectomy cases performed by 339 physicians in 43 hospitals. The purpose of the study was to calculate the relative contribution of three sets of factors (patient, hospital and physician) to hysterectomy rates. Overall, study results revealed physician variables as a set ($R^2 = .090$) contributed more to the explanatory power of the model than hospital variables ($R^2 = .042$) after patient-related variables entered the regression model. The authors concluded that identifying appropriate clinical indicators for hysterectomy as well as providing information to physicians and patients may reduce hysterectomy utilization rates.

Behavior Model Of Utilization For Pediatric Asthma Health Services Use

For this research, the Behavior Model of Utilization (Aday, et al., 1998; Phillips, et al., 1998) provided a conceptual framework to measure the relative contribution of patient-related factors and contextual factors to utilization of pediatric asthma health care services for one urban, regional managed care company (Figure 1). According to

Phillips and colleagues (1998), provider-related factors measure the context within which utilization occurs. Provider-related factors are believed to be important determinants of health services use but their contribution to utilization behaviors remains relatively unexplored (Weiss, Gergen, & Crain, 1992; Phillips, et al., 1998). Like provider-related factors, environment-related factors measure the context of asthma health care utilization behaviors (Phillips, et al., 1998). These factors also have important, but poorly understood, influence on use of health care services in urban, managed care settings (Weiss, Gergen, & Crain, 1992; Department of Health and Human Services, 1998; Phillips, et al., 1998).

Exploring patient-related factors and contextual factors that influence pediatric asthma utilization behaviors can provide opportunities for managed care administrators and practitioners to understand differences in resource utilization, member satisfaction, and behavior outcomes (Phillips, 1998). Information gleaned from this empirical study can be used to formulate pediatric asthma health policies and programs; encourage appropriate resource utilization; and promote cost-effective care. The need to contribute to this scientific body of knowledge provided the premise for this empirical research.

Background

In the 1990s, asthma emerged as a chronic airway disorder which presented serious national public health problems and warranted attention from both public and private health policy makers (Greineder, 1996; Weiss & Budetti, 1993). In the United States, people diagnosed with asthma totaled 12 million in 1996; four million of which were children (U.S. Department of Health and Human Services, 1998). The prevalence of

asthma has increased 40 percent since the 1980s, particularly in children under the age of 18 years (Greineder, 1996; Lawrence, 1998; Greineder, Loane, & Parks, 1998; Plaut, 1997).

According to Weiss & Budetti (1993), unexplained increases in both asthma-related mortality and morbidity have occurred over the past decade. Specifically, the age-adjusted death rate for Americans with chronic asthma increased 40 percent (Hanchak, Murray, Arkans, McHugh, McDermott, & Schlackman, 1996). In 1995, the National Heart Lung and Blood Institute (1998) reported 5,637 deaths per 100,000 population related to asthma in the United States. When asthma-related disability occurred, it was considered a preventable outcome of a "functional disturbance that is reversed completely with proper care" (Weiss & Budetti, 1993, p. MS 9).

Health Policy

Phillips et al., (1998) argued that the role of patient-related factors and contextual factors, in explaining health care utilization behaviors, are key policy issues in health services. Specifically, policy makers and administrators are interested in understanding the relationships between health policies, such as asthma disease management, and utilization of pediatric asthma health care services. For example, in 1991, the National Heart, Lung and Blood Institute advocated changes in asthma-related health policy. Specifically, the *Guidelines For The Diagnosis And Management Of Asthma* were promulgated to assist managed care companies in the redesign of asthma health care services. These programs were designed to promote appropriate asthma health care use and control asthma-related health care costs. However, strategies to address

environmental factors targeted patients' living environment. Strategies to address provider-related variables targeted decision making and referral.

In 1993, the Public Health Service incorporated three asthma-related health policies in the *National Health Objectives for 2000* (Weiss & Budetti, 1993). These policies focused on patient-related variables associated with utilization of health care services. For example, children and minorities were identified as high risk groups. The need to develop accurate and reliable mechanisms to identify at risk populations and track health changes over time was advocated. Asthma-related objectives included: 1) reductions in hospital admissions; 2) reductions in asthma-related disability; and 3) improvement in community knowledge about the disease. Strategies to influence environmental factors were designed to address health care information systems and community enabling variables. Strategies to address provider-related variables were unclear.

In 1999, the National Committee for Quality Assurance (NCQA) advocated changes in asthma health policy for managed care companies. These policies also focused on patient-related factors associated with utilization of health care services. Strategies to improve contextual factors which influence utilization decisions were noticeably lacking. For example, NCQA added asthma-related quality indicators to identify members at risk within the asthma population. Improved health was defined as a reduction in mortality and morbidity associated with the disease. Specifically, managed care companies must demonstrate a reduction in the number of asthma-related hospital admissions and emergency department visits coupled with appropriate use of anti-

inflammatory medications to achieve a favorable accreditation review for this measure. Strategies to influence patient use of asthma health services were unclear.

Economic Issues In Asthma Health Care

The economic toll associated with asthma has been staggering (Greineder, 1996; Lawrence, 1998; Greineder, Loane, & Parks, 1998; Plaut, 1997; Weiss & Budetti, 1993). In 1996, approximately 6.2 billion dollars were spent on asthma representing one percent of all health care dollars spent in the United States. Forty-three percent of asthma's economic cost were related to inpatient admissions, emergency department services and death (Hanchak et al., 1996; Greineder, 1996). Direct costs associated with hospitalizations and medications accounted for 3.6 billion dollars with 2.6 billion dollars reported in indirect cost, loss of income from asthma-related morbidity and death (Weiss & Budetti, 1993). These costs were exacerbated as primary care physicians referred patients to specialists (allergists and pulmonologists), anti-inflammatory medications were prescribed but not taken, patients were managed in acute care settings, and fragmented communication among health care professionals minimized coordinated care (Greineder, 1996; Hanchak et al., 1996; Weiss & Budetti, 1993).

Urban Issues In Asthma Health Care

Asthma-related hospitalization rates increased significantly during the last two decades as total hospitalization rates demonstrated a general decline, particularly for children (Weiss, Gergen, & Crain, 1992). Ethnic minorities, who are both poor and reside in certain urban environments, were among the highest risk subpopulations. Only recently have population based studies elucidated the magnitude of asthma-related risk

present in America's urban poor.

According to the Department of Health and Human Services (1998), access to and appropriate utilization of health care services can prevent severe episodes of asthma requiring hospitalization. A recent study published by the Department of Health and Human Services (1998) indicated African-American children were 3.3 times more likely to be admitted to the hospital than Caucasian children. Similar racial disparities were noted within neighborhood income groups. For example, an inverse relationship was noted between median income and hospital admission rates for asthma among children. Children living in low-income neighborhoods (median family income below $20,000) were more than twice as likely to be hospitalized for asthma as children in neighborhoods with a median family income of at least $40,000.

Disparities in physician office visits and ambulatory utilization by median income level were also noted (Department of Health and Human Services, 1998). For example, poor children were 2.5 to 2.7 times more likely to lack recent physician visits compared to high income children. Between 1994 and 1995, 11 percent of poor children and 10 percent of near poor children lacked a recent physician visit compared to four percent for high income children. In 1995, ambulatory care utilization was about 50 percent higher for children residing in low-income neighborhoods compared to children in high-income neighborhoods. Twenty-two percent of ambulatory visits for children in low-income neighborhoods involved hospital emergency department visits compared to eight percent for children residing in high-income neighborhoods.

Weiss and colleagues (1992) indicated that the effect of ethnicity on asthma prevalence remains unknown. The authors postulated that the effect is small compared to the effects of ethnicity on asthma-related morbidity and mortality. Additionally, ethnic differences are confounded by socioeconomic status in that poverty is directly correlated with morbidity. Interestingly, the relative contributions of ethnicity or poverty to asthma prevalence remains ill-defined. Poverty, like ethnicity appears to have large effects on variations in both asthma-related hospitalization and mortality rates.

Asthma Disease Management

Public and private policy makers have placed new demands on managed care administrators to influence patient decisions to seek asthma health care (Weiss & Budetti, 1993; Lairson, & Slater, 1998). Asthma disease management strategies have been touted as critical to influence asthma patient health behaviors; particularly in America's urban poor (National Asthma Education Program, 1991; Lawrence, 1998; Ward & Rieve, 1995; McDermott, Marder, Shannon, Sonenthal, & McDonald, 1997; Kelly, Shield, Gowen, Jaganjac, Anderson, & Strope, 1998).

Disease management is defined, within the health care segment, as "the integration of services across the continuum of care to treat a given disease with the goals of improved [health] outcomes and reduced cost" (Ward & Rieve, 1995, p. 7). From a managed care company perspective, disease management is a process designed to identify members who are at risk for chronic disease and manage their care to promote appropriate health behaviors while controlling costs (National Asthma Education Program, 1991; National Council for Quality Assurance, 1999). Historically, most

disease management strategies targeted chronically ill populations with high self-management potential (Ward and Rieve, 1995). Of particular interest were members with asthma.

Successful implementation of asthma disease management programs has been questionable at best. For example, Decision Resources (1997), a national consulting group, queried 282 managed care companies and health maintenance organizations to evaluate success rates for asthma disease management program implementation (Greineder, 1996). Investigators reported 65.9 percent of companies responding had developed asthma disease management programs but few were implemented. Failure to explore contextual factors, such as provider-related and environment-related variables, influencing health care utilization behaviors may explain the low implementation rate (Phillips, et al., 1998).

Given the implementation rate of asthma disease management programs (Greineder, 1996), the need to understand the context in which pediatric asthma health care utilization occurs is evident. Tracking outcomes for individual asthma-related events, once initiated, has merit. However, understanding the relative contribution of both patient-related and contextual factors to health care utilization behaviors may assist policy makers and administrators in formulating pediatric asthma health policies and programs; encouraging appropriate resource utilization; and promoting cost-effective pediatric asthma health care.

Statement of the Problem

Policy makers and administrators from one urban, regional managed care company, located in the southeastern United States, reviewed administrative data to determine the number of pediatric members with asthma along with utilization of pediatric asthma health care services. Data analysis revealed the total number of pediatric asthma members doubled (n=4,158) between calendar year 1995 and 1996, representing four percent of the total covered population. Between 1996 and 1998, the number of children with asthma doubled again to approximately 8,183 members. These increases resulted, in part, from acquiring the state managed care contract for Medicaid recipients. Increases in asthma populations were also noted, but to a lesser degree, for the commercial health maintenance organization (HMO) and self-funded product lines. During the same time period, the number of pediatric asthma members with one or more hospital admissions or more than one emergency room visit tripled, escalating health care costs.

Asthma Management Program

Findings from the administrative data analysis prompted administrators to change pediatric asthma-related health policy. In 1997, an asthma disease management program, based on the *Guidelines For The Diagnosis And Management Of Asthma* (National Asthma Education Program, 1991), was piloted. The asthma management program was designed to meet the needs of members with asthma, based on the severity level of their disease. Specifically, the program targeted members with severe, persistent asthma and provided them with in depth education and follow up. Follow up health care was

provided through the company's home health agency. The program was reviewed and endorsed by locally recognized asthma management specialists and primary care providers prior to implementation.

Potential program participants were identified through the managed care company's pharmacy data base, the after hours program, the health and prevention program, or hospital medical records. Using pharmacy claims data, members with a beta-agonist to anti-inflammatory medication ratio equal to or greater than 3:1 were considered high risk for severe asthma and eligible for the program. Access to the program required a referral from the member's primary care provider.

Program Effect. In this research, program effect was defined as the extent to which participation in the program resulted in changes in health services use and associated cost for enrolled members. Administrators believed the program would promote appropriate utilization behaviors and reduce costs for pediatric asthma members, particularly in the Medicaid population. Interestingly, provider-related and environment-related factors, believed to influence pediatric asthma health services, were not assessed prior to program development. Instead, program development focused on patient-related variables, such as predisposing characteristics and need for services. Contextual factors were considered important but were poorly understood for the subject managed care company's pediatric asthma population. Consequently, program strategies to address these factors were not implemented.

Case managers, responsible for managing utilization behaviors and cost outcomes for the pediatric asthma population, expressed concern about the recent changes in

pediatric asthma health policy implemented by the subject managed care company. For example, several issues emerged when case managers attempted to evaluate utilization behavior changes related to the asthma disease management program. First, optimum allocation of asthma health resources was ill-defined. Second, empirical studies that examined the context within which pediatric asthma-related utilization occurred were not available for review. Provider-related factors and environment-related factors associated with utilization behaviors for this patient population had not been measured. Finally, measures of the relative contribution of these contextual factors to pediatric asthma-related health care services for use as benchmarks were not available.

Administrators and case managers, for the subject managed care company, wanted to know whether the asthma disease management program promoted appropriate pediatric asthma resource utilization. Additionally, they wanted to understand the relationship between contextual factors and asthma utilization behaviors. They believed exploring both patient-related and contextual factors that influence utilization behavior would provide opportunities to understand differences in pediatric asthma health services use, improve member satisfaction, and control asthma-related health services costs.

Purpose

Managed care administrators and practitioners must understand the context of health care utilization and the relative contribution of these factors to utilization behaviors to make appropriate pediatric asthma health policy decisions (Phillips, et al., 1998). Therefore, the purpose of this research was threefold: 1) to test the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in

one urban, regional managed care company; 2) to explore the context within which pediatric asthma health care services occurred; and 3) to measure the relative contribution of patient-related factors and contextual factors to pediatric asthma health services use.

Overview of the Conceptual Framework

This research used a modified version of the Behavior Model of Utilization (Figure 1) developed by Aday and colleagues (Phillips, et al., 1998; Aday, et al., 1998). Specifically, relationships between patient-related, provider-related and environment-related factors influencing pediatric asthma utilization behaviors were explored. The conceptual framework also includes social and individual determinants of health conceptualized by Evans, Barer and Marmora (1994) and extended by Room et al., (1996).

Aday and colleagues (1998) indicated that health services research is generally motivated by issues related to development and evaluation of health policy. Specifically, empirical information concerning provider-related factors and environment-related factors are required to provide knowledge and expertise needed to address pediatric asthma health care policy changes. This conceptual framework was selected because it acknowledged the important role contextual factors, coupled with patient-related factors, play in pediatric asthma health services utilization behaviors.

In the context of the conceptual framework (Figure 1), this research measured contextual factors in pediatric asthma health care and tested the relative contribution of patient-related, provider-related and environment-related factors to pediatric asthma

health services use. Patient-related variables included predisposing characteristics (age and gender) and need for health services (beta-agonist to anti-inflammatory medication ratio). Provider-related factors included individual enabling variables (copay and insurance benefits) and provider enabling variables (primary care provider gender, primary care provider specialty, and primary care provider referral). Environment-related factors included health care environment variables (availability and organization) and community enabling variables (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence). Health services use included hospital admissions, emergency department services, primary care provider services, specialists services, home health services, and cost.

Research Questions

This research attempted to address the basic question, "What population-related factors and environment-related factors are related to pediatric asthma health service use? Specific questions explored in this research included the following:

* When considered together in one model, which patient-related factors, provider-related factors or environment-related factors have the greatest influence on pediatric asthma health services use?
* How do patient-related factors, provider-related factors and environment-related factors interact to influence pediatric asthma health services use?
* How are patient-related factors associated with provider-related factors?
* How are patient-related factors associated with environment-related factors?
* How are patient-related factors associated with health services use?

* How are provider-related factors associated with environment-related variables?

* How are provider-related factors associated with health services use?

* How are environment-related factors associated with health services use?

Significance of the Study

This research is the first study attempting to empirically test the explanatory power of the Behavior Model of Utilization for pediatric asthma health care utilization in an urban, regional managed care company. Specifically, the study expands current research reported in the literature in that interactions between patient-related factors, provider-related factors, environment-related factors, and pediatric asthma utilization behaviors were measured. For example, contextual factors measured the context or milieu in which pediatric asthma health care utilization occurred (Phillips, et al., 1998). More importantly, the relative contribution of patient-related, provider-related, and environment-related factors to pediatric asthma health services use was tested.

Second, patient-level and provider-level data were extracted from one integrated database. Use of the integrated database facilitated linking of individual patient data with individual primary care provider data. Additionally, urbanicity, ethnicity and affluence data were available for the neighborhoods in which patients resided and primary care providers practiced. These data were integrated to test interactions between patient residence and primary care provider practice locations.

Third, two comparison groups were selected from the subject managed care company's pediatric asthma population to explore patient-related factors and contextual factors associated with pediatric asthma health services use. Of particular note, one

comparison group included pediatric asthma members who declined to enroll in the asthma disease management program despite referral by their primary care providers. To date, most empirical studies have used research subjects as their own control or have elected not to use a comparison group. According to Greineder and colleagues (1996), it may not be possible to separate asthma-related health policy results from the disease's natural tendency or statistical regression to the mean without use of control groups for comparison (Greineder, Loane, & Parks, 1998). Therefore, net program effect, defined as the case group findings minus the comparison group findings, was used to control for this phenomenon.

In this research, participants were tracked longitudinally for two 12 month periods. Specifically, data for case group participants (members enrolled in the asthma management program) collected 12 months before enrollment in the asthma management program were considered the pre-test year. Data collected from the date of enrollment to 12 months following enrollment in the asthma management program were considered the post-test year. Tracking participants longitudinally and extending the observation period may provide better assurances that health utilization behavior and cost changes resulting from pediatric asthma health policy decisions, such as asthma disease management programs, are real.

Data for the two comparison groups were collected for two continuous years without introduction of the asthma management program. Data collected during the first 12 months were compared to the case group pre-test year to assess group comparability. Data collected during the second 12 months were compared to the case group post-test

year to compare differences in pediatric asthma health services use. The post-test year data were also used to test the explanatory power of the Behavior Model of Utilization (Figure 1).

Finally, a better understanding of the context of health care utilization for pediatric members with asthma may improve patient utilization behaviors. More importantly, information gleaned from empirical study may be used to formulate pediatric asthma health policies and programs; encourage appropriate resource utilization; and promote cost-effective care. Over time, policy research, grounded in the Behavior Model of Utilization, may improve the health of all chronically ill citizens by empirically testing the influence of both patient-related and contextual factors on health behavior.

Limitations of the Study

Limitations are inherent in this research and may affect both external validity (generalizability of the study findings) and internal validity. Selection bias may pose a threat to external validity. According to Campbell and Stanley (1963), selection bias is particularly problematic when research is predicated on non-experimental, ex post facto research designs. In this study, variables were explored in retrospect which may limit understanding of relationships (Loether & McTavish, 1988; Kerlinger, 1986; Polit & Hungler, 1987). Additionally, subjects were selected from one geographic region in the southeastern United States. Consequently, group characteristics may not be representative when compared to a larger national sample.

Potential threats to internal validity may include history, maturation, or statistical regression (Campbell & Stanley, 1963). For example, specific events may have occurred between the pre-test year and the post-test year in addition to the treatment of interest. Maturation may pose a threat since study participants ranged in age from 0 years to 18 years and data were collected over a 24 month period. Finally, statistical regression to the mean may pose a threat since members with severe asthma were selected for inclusion in the study.

Second, this research did not attempt to explore all patient-related factors, provider-related factors or environment-related factors influencing pediatric asthma health services utilization behaviors. Specifically, patient-related factors, such as parental work status, family structure, or parental perceptions of the need for asthma health services, were not measured. Additionally, beta-agonist to anti-inflammatory medication ratio were used as proxy for illness severity. Further, neighborhood ethnicity and neighborhood affluence were used as proxy for participant-specific variables. Individual enabling variables, such as regular source of care, were not measured since all study participants were assigned a primary care provider. Provider enabling variables, such as convenience of care and medical staff practice patterns, were not explored. Health care environment variables, such as distance between participants' residence and their primary care provider offices, were not available. Additionally, data related to health care financing and personal health choices were not available. These factors need to be considered in a full Behavior Model of Utilization but were beyond the scope of this research. Finally, other limitations, such as data quality in administrative databases,

also existed. Given the potential threats to internal and external validity, generalizations of research results beyond the study sample population must be done with caution. Conservative interpretation of study results is recommended.

CHAPTER II: LITERATURE REVIEW

Introduction

According to Aday and colleagues (1998), information produced for policy analysis must identify actual problem causes and consequences of policy alternatives, such as the asthma disease management program. Using the Behavior Model of Utilization (Phillips, et al., 1998; Aday, et al., 1998) as a backdrop, this research explored the context within which pediatric asthma-related health care utilization occurred for one urban, regional managed care company and measured the relative contribution of patient-related factors and contextual factors to asthma utilization behaviors (Figure 1). Specifically, linkages between patient-related factors, provider-related factors and environment-related factors influencing pediatric asthma health services use were tested.

Conceptual Framework

This research used the Behavior Model of Utilization (Phillips, et al., 1998; Aday, et al., 1998) to explore the relative contribution of patient-related factors and contextual factors to pediatric asthma health services utilization behaviors for one urban, regional managed care company. The conceptual framework employs a systems perspective to integrate population-related factors (patient-related factors and provider-related factors), environment-related factors (health care environment and external environment) and health behavior factors (personal health choice and health services use).

Specific variables associated with constructs of the model were not provided by Phillips and colleagues (1998) since variable definitions depend on the type of health behavior utilization under investigation. Therefore, review of pertinent empirical studies

for pediatric asthma health care as well as discussions with pediatric asthma health care practitioners were used to complete model variable definitions. Specifically, patient-related factors included predisposing characteristics (age and gender) and need (beta-agonist to anti-inflammatory medication ratio). Beta-agonist to anti-inflammatory medication ratio was used as proxy for illness severity. Provider-related factors included individual enabling variables (copay and insurance benefits) and provider enabling variables (primary care provider gender, primary care provider specialty, and primary care provider referral).

Environment-related factors included health care environment and external environment. Health care environment variables included availability (presence of primary care provider offices in neighborhoods and whether primary care provider offices, located in the neighborhood, offered late hours) and organization (asthma management program). External environment variables included community enabling (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence). Neighborhood ethnicity and neighborhood affluence were used as proxy for participant ethnicity and participant affluence, respectively. Health behavior factors included health services use (hospital admissions, emergency department services, primary care provider services, specialists services, home health services, and cost).

Neither health care environment variables related to financing nor health behavior factors related to personal health choice were tested in this research since reliable data were not available. These factors need to be considered in a full Behavior Model of Utilization but were beyond the scope of this study.

The Behavior Model Of Utilization

A computerized search of the Science Citation Index (SCI), the Social Science Citation Index (SSCI), PubMed, and MedLine by this author, failed to identify empirical studies employing the Behavior Model of Utilization in pediatric asthma health care for urban managed care companies. Instead, most empirical studies reported in the literature focused on components of asthma care delivery. For example, several empirical studies explored cost effectiveness of asthma-related health strategies such as disease management programs (Hanchak, Murray, Arkans, McHugh, McDermott, & Schlackman, 1996; Greineder, Loane, & Parks, 1998; Lahdensuo, Haahtela, Herrala, Kava, Kiviranta, Kuusise, Peramaki, Poussa, Saarelainen, & Sahn, 1996) or the cost effectiveness of clinical guidelines designed to manage acute episodes of asthma care within the disease management framework (Rohl, Meyer, & Lung, 1994; Greineder, 1996; Seid, Quinn, & Kurtin, 1997). Only one empirical study (Zoratti, Havstad, Rodriguez, Robens-Paradise, Lafata, & McCarthy, 1998) implied use of the Behavior Model of Utilization to explore health services use in a managed care setting.

Behavioral Model Of Utilization For Pediatric Asthma In Managed Care Companies

Research conducted by Zoratti and colleagues (1998) is discussed initially as the study included both provider-related and environment-related factors involved in asthma health care management. Interestingly, these authors failed to evaluate the relative contribution of provider-related factors, such as physician gender and physician referral, or environment-related factors, such as asthma disease management strategies, to asthma health care utilization behaviors. Second, additional empirical studies examining

components of asthma health care are discussed. These studies are organized around pertinent constructs of the Behavior Model of Utilization for pediatric asthma health care use.

Zoratti and Colleagues

Zoratti and colleagues (1998) used an observational, cross-sectional design to evaluate medication use and health care facility use for African-Americans (n=464) and Caucasians (n=1,609) enrolled in a large metropolitan health maintenance organization. Study measures included location of care (e.g. hospital, emergency department, or physician office), physician specialty, medication type and number of prescriptions. Prescriptions filled were estimated to be a one month supply of medications intended for continual use. Demographic measures included age, gender, marital status and income. Geocoding software was used to map subjects' street address to neighborhoods and estimate median household income and average household size. Subjects' socioeconomic status was determined by dividing average median household income by average household size for each neighborhood. Low-income was established as a single-person household with an annual income less than or equal to $10,450 per occupant (150% of the established poverty guideline).

Resource Use. Study results revealed a statistically significant difference in emergency department use rate between African-Americans and Caucasians (Zoratti, Havstad, Rodriguez, Robens-Paradise, Lafata, & McCarthy, 1998). Annual emergency department use rate for African-Americans was 0.71 compared to 0.28 for Caucasians (p=0.001). African-Americans also incurred more hospital admissions (p=0.002) and

less asthma specialists visits (p=0.002). Interestingly, annual use rates for primary care physician visits were similar for both groups (African-Americans 1.24 and Caucasians 1.21, p=0.81). These results did not change when demographic variables (age, gender, marital status and income) were entered as covariates in the regression model.

The influence of low socioeconomic status on resource utilization was also examined (Zoratti, et al., 1998). African-Americans, in the low-income subgroup, experienced more emergency department visits than Caucasians (p <0.001), after adjusting for age, marital status, income and gender. Specialist visits were similar between the two groups and inpatient admissions were borderline significant (p=0.07). The authors concluded that ethnic differences may be confounded by socioeconomic status.

Medication Use. Zoratti and colleagues (1998) indicated African-Americans were more likely to use oral corticosteroids (p <0.0001) than Caucasians but less likely to use inhaled corticosteroids (p=0.038). Use of other drug classes demonstrated similar results between groups. Within the low socioeconomic group, no differences were noted in medication use except a minimal increase in use of anticholinergics by African-Americans compared to Caucasians (p=0.04). The slight increase in use of inhaled corticosteroids by Caucasians (p=0.050) disappeared in the low-income subgroup (p=0.055) analysis indicating ethnic differences may be confounded by poverty. Likewise, the significant increase (p=0.026) in oral corticosteroid use noted for African-Americans disappeared in the low-income group analysis (p=0.64). However, the authors noted use of oral corticosteroids and low income remained statistically

significant throughout the study population (p=0.032). Increased anticholinergic use was statistically associated with Caucasian ethnicity (p=0.016), low income (p=0.009), and advanced age (p <0.001).

Conclusions. Zoratti and colleagues (1998) concluded that differences in asthma health care remained evident despite limited financial barriers provided by the health maintenance organization. These differences were only partly explained by ethnicity and socioeconomic status. Differences noted in emergency department services use may indicate asthma was less controlled for in African-American participants compared to Caucasian participants. Interestingly, emergency department visits and hospital admissions did not trigger specialists visits. Finally, ethnic and sociodemographic groups which experienced higher use of inhaled beta-agonists or oral corticosteroids, emergency department visits and hospital admissions also demonstrated lower use of asthma specialists.

Other Empirical Studies

Empirical studies presented in this section explored patient-related factors, provider-related factors or environment-related factors believed to influence asthma health utilization behaviors. As with the study conducted by Zoratti, et al., (1998), relative contributions of contextual factors to use of asthma health services use were not reported. To facilitate discussion, these studies are organized under pertinent constructs of the Behavior Model of Utilization (Figure 1).

Population-Related Factors

Phillips and colleagues (1998) indicated that population-related factors include patient-related factors and provider-related factors. Patient-related factors include predisposing characteristics and need. Provider-related factors include individual enabling and provider enabling.

Patient-Related Factors

Most empirical studies used age or gender as measures of predisposing characteristics. Generally, beta-agonist to anti-inflammatory medication ratio was used to measure patient need for asthma health services. In most empirical studies, beta-agonist to anti-inflammatory medication ratio was used as a proxy for illness severity.

Predisposing Characteristics: Age and Gender. A cross-sectional study conducted by the National Heart, Lung and Blood Institute (1995), indicated the prevalence of asthma has increased significantly in all age groups: less than 18 years; 18 years to 44 years; and 45+ years. Many asthma experts agreed that asthma is the most prevalent chronic disease in children (Gergen & Weiss, 1990; Weiss, Gergen, & Crain, 1992). Predisposing characteristics included inherent variables such as age, gender, and ethnicity. For example, between 1950 and 1978, mortality related to asthma declined. Interestingly, mortality was higher in males than in females during the same time frame (National Heart, Lung, and Blood Institute, 1995). Since 1978, the gap in asthma mortality has widened between African-Americans and Caucasians. In 1995, the National Heart, Lung and Blood Institute (1995) reported asthma mortality was nearly three times higher in African-American males than in Caucasian males and 2.5 times higher in

African-American females compared to Caucasian females. Mortality was 30 percent higher in females compared to males within both ethnic groups. Dr. Michael Weiss, Co-director of the Asthma Clinic, Cook County Hospital, Chicago, Illinois suggested the cause of ethnic tendencies evident in asthma are unclear (Weiss & Budetti, 1993; McDermott, et al., 1997).

Over the past decade, children under five years of age have experienced the fastest increase in asthma-related hospitalizations (Weiss and Budetti, 1993). Gergen and Weiss (1990) used the National Hospital Discharge Survey to evaluate trends in hospitalizations among children. In this study, medical records data were extracted for a randomized sample of 227,000 hospital discharges. Only children and youths were included in the study. Measures included principle discharge diagnosis, reimbursement, sociodemographic data, and surgical procedures. Individuals may have represented more than one admission as the unit of analysis was hospital discharges. Length of stay and need for endotracheal intubation or cardiopulmonary resuscitation were used as proxies for severity of illness.

Primary data analysis was employed in this study (Gergen & Weiss, 1990). Specifically, linear regression techniques were used to evaluate absolute rate changes in hospitalization rate per 1,000 population per year. Annual data were grouped into two periods (1979 to 1983 and 1984 to 1987) to evaluate trends in illness severity and payer source. Study results revealed asthma-related hospital rates were increasing disproportionately across age and ethnic groups. For example, the annual percentage change per year for asthma-related hospitalizations was 4.5 percent for children age 0

years to 17 years (p=0.05). Children under five years of age experienced the largest increase (5.0% annually) compared to other age groups (2.9% annually). African-American children, in the under five age group, were more likely to be admitted for asthma (p=0.05). They experienced 1.8 times the number of hospital admissions compared to Caucasian children in the same age group.

Need: Beta-agonist To Anti-inflammatory Medication Ratio. Most health care providers accept the notion that asthma management strategies, designed to reduce asthma-related morbidity, should target high-risk patients (Li, Xakellis, Edell, & Angstman, 1995; Balkrishnan, Norwook, & Anderson, 1998). Li and colleagues (1995) conducted a retrospective, observational study to determine direct care costs associated with asthma and the distribution of costs among asthma risk groups. A total of 2,213 patients with asthma submitted resource claims to the managed care company during the two year study period. Study results indicated 44 percent of asthma patients were classified as severe. Health care costs for the severe group were five times greater than asthma patients classified as mild; $1,579 and $298, respectively. Analysis of Medicaid claims submitted for all asthma patients indicated higher annual direct care costs for African-American children ($436) compared to Caucasian children ($350). The authors concluded that direct medical costs were concentrated in a small group of high-risk asthma patients. Methods used to classify asthma patients as mild, moderate or severe were not discussed by the authors.

Underutilization of inhaled corticosteroid (anti-inflammatory medications) and improper follow-up of asthma medication therapy may increase mortality and morbidity

associated with asthma (Kelso, Shala, Arheart, & Portner, 1996; Balkrishnan, Norwook, & Anderson, 1998; Donahue, Weiss, Livingston, Goetsch, Greineder, & Platt, 1997; Holzer, Engelhart, Crown, L'Herrou, & Kennedy, 1997). In 1995, a non-randomized control trial with a two year intervention in African-Americans with asthma was conducted to determine if a comprehensive long-term asthma management program, stressing the importance of inhaled corticosteroid and education, would improve outcomes (Kelso, Shala, Arheart, & Portner, 1996). Study participants were volunteers with a control group identified through chart review. Results indicated that the case group (n=21) experienced a significant reduction in emergency room visits (p=0.0001). Both groups experienced reductions in asthma-related hospitalizations with the greatest reduction noted for the case group. The authors concluded that the long-term management program improved outcomes in African-Americans with asthma.

A retrospective, case control study, obtained data from prescription and health care services claims submitted to the North Carolina Medicaid department between 1993 and 1996, to explore the impact of inhaled corticosteroid (anti-inflammatory) medications on health and cost outcomes (Balkrishnan, Norwood, & Anderson, 1998). Given the operational inclusion definition, 157 children out of a total of 1,415 were included in the study. Eighty-five children constituted the case group with 72 children as controls. Utilization data for case group members were analyzed one year before and one year after the introduction of inhaled corticosteroid medications. Utilization data for control group members were analyzed for two continuous years without introduction of inhaled corticosteroid medication. Children with incomplete records or who were taking

corticosteroid medications for reasons other than asthma were excluded from the study population.

Paired *t*-tests were used to evaluate differences in health care services use between the two groups. Empirical evidence indicated that introduction of prophylactic inhaled anti-inflammatory medications improved clinical and economic outcomes for patients with asthma. Specifically, reductions in hospitalizations (50%), physician visits (26%) and outpatient facility visits (15%) were reported for a cohort of North Carolina Medicaid patients, less than 12 years of age, following introduction of inhaled corticosteroid therapy to manage asthma-related symptoms. Collectively, reductions in hospital admissions ($p < 0.0001$) and physician visits ($p < 0.005$) demonstrated a statistically significant difference in utilization following introduction of inhaled corticosteroid medications in the case group. In the control group, increases in outpatient facility utilization were statistically significant.

A population based study of asthma members insured by a large health maintenance organization indicated inhaled corticosteroid medication, after adjusting for beta-agonist use, provided significant protection against exacerbations of asthma resulting in hospitalizations (Donahue, Weiss, Livingston, Goetsch, Greineder, & Platt, 1997). In this study, effectiveness of anti-inflammatory treatment, such as corticosteroid medications, was examined under conditions of actual use among a large, diverse population with asthma. Collectively, 16,941 members with asthma were eligible for the study, with 742 (4.4%) admitted to the hospital for asthma-related health care. Lack of pharmacy prescription data was the most common reason for exclusion from the study.

Sociodemographic measures included age. Ethnicity was not included as a measure since data were not available on all subjects. In this study the first hospitalization was considered the outcome of interest with exposure to inhaled corticosteroid medication the treatment of interest.

Study results revealed no differences between eligible and noneligible groups with respect to age and gender (Donahue, Weiss, Livingston, Goetsch, Greineder, & Platt, 1997). Gender distribution was similar between age groups with males predominantly among children (58%) and females (65%) among adults. Beta-agonists were the most frequently dispensed asthma medication, particularly in children, with inhaled corticosteroids second. Participants in the study group experienced a total of 2,245 emergency department visits and 742 hospital admissions during the study period.

Unadjusted analysis revealed asthma drug use was strongly correlated with the risk of hospitalization for asthma (Donahue, Weiss, Livingston, Goetsch, Greineder, & Platt, 1997). The authors indicated the relationship between hospitalization and inhaled corticosteroid use was more complex. For example, members with no corticosteroids dispensed were at greater risk of asthma hospitalization (4.7%) compared to members with up to one dispensing per person per year (1.8%). Interestingly, the risk increased with increasing dispensing rates to a maximum of 12 percent when members were dispensed more than eight prescriptions per person per year. The same phenomenon was noted for beta-agonists prescription patterns. This relationship changed after adjusting for age, gender, beta-agonist dispensing and ambulatory care. Adjusted analysis revealed inhaled corticosteroids were related to a 50 percent decrease in risk of asthma

hospitalization compared to members who were not receiving inhaled corticosteroids. Conversely, increases in beta-agonist prescriptions were positively correlated with risk of asthma hospitalization.

Provider-Related Factors

Phillips and colleagues (1998) indicated that provider-related factors include individual enabling and provider enabling. Review of pertinent empirical studies revealed that individual enabling variables include copay and insurance benefits. Provider enabling variables include primary care provider gender, primary care provider specialty, and primary care provider referral.

Individual Enabling Variables: Copay. Copay (cost-sharing) may present major obstacles to effective asthma care delivery in the primary setting as medical care expenses consume a much larger percentage of total family income for low-income individuals compared to high-income individuals (Aday, et al., 1998). Results of the RAND Health Insurance Experiment (Aday, et al., 1998) provided insight into the effects of cost-sharing on resource consumption. Study findings revealed an inverse correlation between cost-sharing and resource consumption. Specifically, the more patients had to pay out-of-pocket for services, the less medical care they consumed. Of particular importance to this study, were office visit rates. Study findings revealed office visit rates were lower, particularly for children, in cost-sharing plans compared to no cost-sharing plans. Negative health outcomes resulting from cost-sharing were reported as minimal. However, when negative health outcomes were evident, they occurred among low-income, chronically ill individuals. Study conclusions indicated that the economic and

health effects, associated with increased cost-sharing strategies, will most likely impact the poorest and sickest segments of the population.

Zoratti and colleagues (1998) used a cross-sectional design to evaluate the influence of copay on health service use for African Americans (n=464) and Caucasians (n=1,609) with asthma in a managed care setting (Zoratti, Havstad, Rodriguez, Robens-Paradise, Lafata, & McCarthy, 1998). Specifically, the relationship between copay groups (patient contribution for health services) and prescription fill/refill rate was explored. Low copay was considered $2 to $3 per prescription with high copay defined as $8 to $10 per prescription. No statistically significant differences were noted except: a) oral beta-agonist use was higher in the low copay group compared to the high copay group (0.81 and 0.18, respectively, p=0.017); and b) oral corticosteroid use was higher in the low copay group compared to the high copay group (0.80 and 0.20, respectively, p=0.017). The authors concluded that the amount of copay may present more significant barriers for low socioeconomic groups than demonstrated in this study because cumulative out-of-pocket cost (resulting from copays) was not evaluated.

Individual Enabling: Insurance Benefits. Traditionally, managed care companies offer multiple comprehensive, prepaid insurance benefit packages to a voluntary enrolled asthma population (Aday et al., 1998). Commercial health maintenance and preferred provider organizations contract services at a discounted rate that offers health care providers a large network of enrolled asthma populations. Health plan enrollees have a wider choice of providers (Aday et al., 1998). However, the scope of services offered may be restricted or out-of-pocket expenses increased to maintain the

managed care company's financial viability. The point of service product offers partial reimbursement for services consumed by enrollees from health care providers outside the managed care company's network. Seeking services outside the network increases out-of-pocket expense which may negatively influence patient satisfaction with the health care delivery system. Patients with clinically active asthma incur large out-of-pocket expenses (Weiss & Budetti, 1993). Additionally, they have a high degree of dependency on employer-based health insurance benefits.

A historical cohort study, using Medicaid claims data, was conducted to evaluate whether African-American children with asthma use emergency department and inpatient services more frequently than Caucasian children with similar insurance benefits and household income (Lozano, Connell, & Koepsell, 1995). Data were obtained from the Washington State Medicaid Management Information System. This administrative database contained all medical claims submitted for Medicaid enrollees. The unit of analysis was the child instead of the claim.

Study subjects were children, between the age of 3 years and 17 years, receiving assistance through the Aid to Families with Dependent Children (AFDC) program (Lozano, Connell, & Koepsell, 1995). During the study time frame, 204,968 children met inclusion criteria for the study. Collectively, three percent of the study population were Caucasian and four percent were African-American. Other ethnic groups were excluded from the study. This study was restricted to the Seattle-Tacoma metropolitan area which housed 85 percent of the state's African-American population. The study cohort, meeting all inclusion criteria, totaled 1,945. The Medicaid community service

office where subjects enrolled for AFDC services was used as a proxy for residence. Additional covariates included age, gender, office visit type (asthma or well-baby visit), and person-years contributed to the study.

Outcome measures evaluated in this study included type and frequency of medical service use (Lozano, Connell, & Koepsell, 1995). Payments for services rendered were also explored. All medical claims submitted for asthma-related health care or well-baby services were reviewed. Five categories of health care utilization were identified. Asthma-related categories included emergency department visits, hospital admissions, office visits and outpatient asthma prescriptions. The fifth category described well-baby services. Total amount paid for services included the four asthma-related categories.

Study results revealed African-American children were more likely to incur emergency department visits or be hospitalized compared to Caucasian children (Lozano, Connell, & Koepsell, 1995). Odds ratios reported were 1.70 for emergency department visits and 1.42 for hospitalizations. No differences were noted in the likelihood of having prescriptions filled or well-baby visits. African-American children experienced higher per capita expense compared to Caucasian children ($436 and $350, respectively).

The authors concluded that higher emergency department use for asthma among African-Americans, insured by Medicaid, was not fully explained by poverty or inadequate health care insurance (Lozano, Connell, & Koepsell, 1995). Second, African-American children experienced disproportionately less asthma-related office visits. This finding suggested suboptimal use of preventive services for asthma by African-

Americans.

Individual Enabling: Regular Source of Health Care. McDermott and colleagues (1997) argued that asthma patients may continue to seek care in the emergency department even when their asthma is being managed by primary care providers in the outpatient setting (McDermott, Marden, Shannon, Weiss, Sonenthal, & Donald, 1997). Often, patients lose confidence in primary care physicians who do not appreciate the asthma crisis or perceive a lack of effectiveness when the primary care physician addresses other non-asthma related health issues during the visit. Some patients reported quicker and more effective asthma care in the emergency department or believed emergency room care results in less frequent or less acute asthma attacks. According to McDermott and colleagues (1997), patients may satisfy a self-fulfilling prophecy by continuing to seek care in the emergency department instead of outpatient settings.

A recent study (Blixen, Tilley, Havstad, & Zoratti, 1997), supported by the Agency for Health Care Policy and Research in three Detroit-area emergency departments, demonstrated this notion. In this study, a structured interview process was used to query African-Americans, age 18 years to 50 years, about regular sources of health care. Study results indicated that seventy-one percent of patients receiving asthma care in the emergency department reported having a regular physician treating their asthma. Interestingly, about one-third of the patients seen in the emergency department had several asthma-related hospital admissions in the previous three months with extended lengths of stay. When data from the previous three months were reviewed,

about 63 percent of the patients had one to three asthma-related emergency department visits. Approximately 21 percent had used the emergency department four to six times and eight percent had six or more visits. Interestingly, 54 percent of these patients had not interacted with their physician or nurse in the previous three months. Forty-six percent of these patients had not been seen by their physician. Review of pharmaceutical data indicated 46 percent of the patients were using anti-inflammatory medications regularly to prevent complications. The authors concluded that regular sources of health care alone may not be enough to reduce the burden of asthma for African-Americans seen in the emergency department.

Provider Enabling Variables: Primary Care Provider Gender. A computerized search of the Science Citation Index (SCI), the Social Science Citation Index (SSCI), PubMed, and MedLine by this author, failed to identify empirical studies which explored the influence of physician gender on pediatric asthma utilization behavior.

Provider Enabling: Primary Care Provider Referral and Primary Care Provider Specialty. Reluctance of primary care providers to refer patients has been identified as a major factor in achieving equity since patients must navigate both structural and financial barriers to acquire appropriate health services (Weiss & Budetti, 1993; Todd, 1995; Szabo, 1997; Seid, Quinn, & Kurtin, 1997). Vollmer and colleagues (1997) indicated that two-thirds of patients with asthma are managed by primary care physicians. The most common referral pattern, reported by primary care physicians in a recent survey, was no routine referral (Blancquaert, Zvagulis, Gray-Donald, & Pless,

(1992).

Much debate in the literature surrounds the management of patients with asthma by primary care providers versus asthma specialists (Szabo, 1997). Study results reported by Lovelace Healthcare Innovations indicated primary care physicians were more effective managers of patients with asthma (Lawrence, 1998). In this study, a free standing asthma clinic employed primary care physicians, instead of specialists, to manage patients with asthma. Program evaluation results revealed reductions in pediatric hospital admissions (60%), emergency room department visits (82%), and urgent care visits (60%). Lost time from work was reduced 82 percent along with an 84 percent reduction in lost school time.

A retrospective, two group comparison study, exploring the role of hospital based specialists (hospitalists) and pediatric primary care physicians, supported the findings of Lovelace Healthcare Innovations in that asthma patients were managed more effectively by pediatric primary care providers (Seid, Quinn, & Kurtin, 1997; Lawrence, 1998). The purpose of this study was to explore outcomes for patients with asthma (n=722), residing in California, managed by five hospital-based physicians (hospitalists) and 65 pediatric primary care providers (Seid, Quinn & Kurtin, 1997). Most of the patients (n=462) in the study were managed by hospitalists. Payer class was used as a proxy for lack of primary access, cultural differences and degree of poverty experienced by patients. The authors believed these factors contributed to illness burden creating problems with patient management. Interestingly, hospitalists reported 60 percent of their patient population were insured by MediCal (Medicaid program in California) compared to 45 percent

reported by pediatric primary care providers. Mann Whitney rank sum test revealed no significant differences in illness burden between the two groups. Likewise, an independent sample t-test revealed no significant differences in financial or clinical outcomes. The authors concluded that further empirical study of the merits associated with the hospitalist model is needed to support the notion that specialists are more effective managers of patients with asthma than pediatric primary care providers.

Vollmer and colleagues (1997) conducted a cross-sectional analysis of patients with asthma in a large health maintenance organization to examine the role of physician specialty (Vollmer, O'Hollaren, Ettinger, Stibolt, Wilkins, Buist, Linton, & Osborne, 1997). Study subjects included patients (n=392) diagnosed with asthma between 15 years and 55 years of age. Other inclusion criteria were: 1) taking anti-asthma medications; 2) reporting current asthma symptoms; and 3) receiving health care from a generalist or allergist. Outcome measures evaluated in the study included characteristics of asthma, resource utilization, and quality of life.

Study results revealed patients managed by allergists had more severe asthma ($p < 0.01$) and tended to be older ($p < 0.01$) than patients managed by primary care providers (Vollmer, O'Hollaren, Ettinger, Stibolt, Wilkins, Buist, Linton, & Osborne, 1997). The likelihood of patients using inhaled anti-inflammatory medications ($p < 0.01$), oral steroids ($p < 0.01$), or regular breathing medications to control symptoms ($p < 0.01$) was higher for patients managed by allergists. Allergists were more likely to manage exacerbations of asthma symptoms in the outpatient setting ($p < 0.01$) compared to emergency department settings. Finally, asthma patients managed by allergists reported

higher quality of life than patients managed by primary care providers ($p < 0.05$). Given these findings, the authors concluded that the use of specialists to manage patients with asthma was both beneficial to patients and the organization.

Environment-Related Factors

Phillips and colleagues (1998) indicated that environment-related factors influencing health utilization behavior include the health care environment (availability, organization or financing) and the external environment (community enabling). Experts in asthma management indicated availability of primary care offices in neighborhoods or availability of primary care offices with late office hours in neighborhoods may influence asthma health services use. Review of pertinent empirical studies revealed organization variables include asthma management strategies. Community enabling variables include neighborhood urbanicity, neighborhood ethnicity, or neighborhood affluence.

Health Care Environment: Availability. Traditionally, managed care companies contracted with more primary care providers and fewer specialists compared to fee-for-service delivery models (Aday et al., 1998). These imbalances may worsen when managed care companies employ non-physicians to provide primary care services. Health care systems may produce too many or too few services relative to expected health improvements (Evans & Stoddart, 1990; Aday, Begley, Lairson, & Slater, 1998). Currently, some health care experts believe allocation of health-related goods and services is inefficient in that increases in health care spending have produced a decline in the overall health of populations. For example, limited resources have been diverted

from non-medical determinants of health, such as education, housing and environment management to health care services. Large variations in medical practice and conflictual evidence about effectiveness of some medical procedures provide additional evidence of allocation inefficiency. For this reason, health care professionals have demonstrated a renewed interest in disease management programs as a vehicle to improve health of individuals and communities and control rising health care costs associated with chronic illness.

Health care professionals have expressed concern that available resources are being spent on treatment for individuals for whom health improvement or survival is remote instead of prevention strategies (Aday et al., 1998). Misallocation of resources to technical procedures away from services that improve patients' understanding of their health problems and strategies they can employ to avoid health problems in the future represent allocation inefficiency. Primary health policy decisions that reflect concern with allocation efficiency include medical versus non-medical alternatives, availability of preventive services and mix or type of treatment. For example, non-medical strategies, such as improving air or water quality and education, may achieve greater health benefits than diverting resources to medical strategies. Recent growth in managed care organizations has resulted in shifts from treatment to prevention services. Since most chronic diseases have a strong behavioral component, one of the most potentially advantageous aspects of patient care is being neglected when focus shifts from patient education and counseling to treatments and procedures. Several studies reported in the literature demonstrate the shift from acute medical intervention toward prevention

services.

Greineder (1996) conducted a retrospective, observational pre-test/post-test study to explore the impact of a disease management program, designed to offer prevention strategies, on resource utilization in adults and children diagnosed with asthma. In this study, adults were 27 percent ($p < 0.001$) less likely to have an emergency department visit and 25 percent ($p < 0.001$) less likely to be admitted to the hospital for asthma-related conditions after participating in the Health Centers Division Asthma Program. Likewise, children were 24 percent ($p < 0.001$) less likely to return to the emergency department and 39 percent ($p < 0.001$) less likely to be admitted following enrollment. Interestingly, adults and children were more likely to incur office visits after the prevention strategies were implemented (4%, $p < 0.01$; 7%, $p < 0.001$, respectively). The authors concluded increased office visits were desirable because care was shifted from the expensive, acute care arena to a more appropriate, ongoing care and preventive outpatient arena. Health care costs associated with providing the care were not explored in this study.

Rohl and colleagues (1994) maintained that asthma is a heterogeneous disease relative to therapeutic response, symptom perception, and psychologic effect on the patient and family (Rohl, Meyer, & Lung, 1994). The authors argued that true success lies in the ability to develop an asthma program tailored to the individual's disease and living situation. A retrospective, observational pre-test/post-test research design was used to explore resource utilization for 36 adult patients with severe asthma enrolled in the *Time Out Program*. Study participants were used as their own controls. Study

findings revealed hospital admissions declined 83 percent, emergency department visits declined 45 percent and hospital days declined 82 percent one year following participation in the program compared to one year prior to enrollment.

The authors concluded that the asthma disease management program was best applied to patients with severe asthma who experience two or more hospitalizations or more than three emergency department visits annually (Rohl, Meyer, & Lung 1994). Specific outcomes to achieve program goals were not discussed. Empirical evidence to demonstrate the influence of the asthma disease management program on health improvement for this subpopulation were not presented.

Health Care Environment: Organization. Health care professionals accept the notion that asthma disease management provides a comprehensive, coordinated system of care that manages a disease state rather than an acute episode (Todd, 1995). However, a standardized definition of asthma disease management remains elusive. Review of pertinent literature revealed a substantial body of literature supporting professional opinion that asthma-related education improves clinical outcomes. Interestingly, there is little consensus concerning program content.

Dr. John Shannon, Co-Director for the Asthma Clinic, Cook County Hospital, Chicago, Illinois indicated patients need education to participate effectively in their own care (McDermott, Marder, Shannon, Weiss, Sonenthal & McDonald, 1997). However, educational resources do not substitute for face-to-face education between patient and health care providers. Competencies needed for adequate asthma management are difficult to develop in written form. Generally, the best way to educate patients with

asthma is one-on-one interaction with health care providers who are well versed in asthma management and understand patient misconceptions of the disease.

British researchers argued self-management is the key to asthma disease management (Lahdensuo, A., Haahtela, T., Herrala, J., Kava T., Kiviranta, K., Kuusise, P., Peramaki, E., Poussa, T., Saarelainen, S., & Svahn, T., 1996). The authors conducted a prospective, randomized, controlled clinical trial over a 12 month period to explore the relationship between self-management and quality of care. In this study, patients (n=115) with mild to moderate asthma were randomly assigned to an asthma self-management group or a traditional asthma management group. Patients in the self-management group received asthma-related education and adjustment of anti-inflammatory treatment based on peak expiratory measurements. The authors failed to describe asthma management strategies for the traditional management group.

Study results indicated that patients participating in the asthma self-management group had fewer unscheduled admissions to hospitals and experienced fewer emergency department visits compared to the traditional management group (Lahdensuo, et al., 1996). Additionally, patients in the treatment group experienced less lost days from work and medication use. Further, patients in the treatment group had better lung function and scored higher on quality of life indicators. The authors concluded that self-management, as an asthma management strategy, reduced asthma-related incidents and improved quality of care.

The Managed Health Care Association, representing more than 80 Fortune 500 companies, queried 15 managed care organizations concerning their asthma-related

health policies (Szabo, 1997). The purpose of the study was to determine if patterns of asthma care contributed to different patient outcomes. Study results revealed the importance of practice guidelines in that better patient outcomes were achieved when health plans adhered to asthma guidelines that defined standard treatment regimens. Additionally, patients with considerable knowledge about self-management practices experienced better outcomes than those less educated.

Outcome analysis of a summer asthma camp project demonstrated similar results (Kelly, Shield, Gowen, Jaganjac, Anderson, & Strope, 1998). Forty children, with moderate to severe asthma enrolled in an asthma camp, participated in asthma-related education, athletic events and social activities. Outcome measures were reported pre-camp and post-camp participation. The measures included changes in: 1) performance in peak flow meter and metered-dose inhaler techniques; 2) the number of emergency room visits and inpatient admissions; and 3) missed days from school. Study findings revealed improvement in patient outcomes following participation in the camp. For example, emergency department visits decreased by 59 percent with an 85 percent reduction in hospital admissions. Missed days from school declined from 266 days to 188 days. Significant improvement ($p < 0.0001$) was noted in peak flow meter and metered-dose inhaler techniques.

Hanchak and colleagues (1996) conducted a retrospective observational, pre-test/post-test study to explore resource consumption and cost for patients with asthma insured by U.S. Healthcare, Inc. The company was a large, independent practice model health maintenance organization which insured two million members in 13 states and the

District of Columbia. Plan administrators believed the *Pediatric Asthma Patient Management Program* would improve the quality of ambulatory medical care for enrollees. Participants in the study included members from southern New Jersey and southeastern Pennsylvania. Inclusion criteria consisted of: 1) age 1 year to 17 years; 2) previous hospitalization for asthma or an asthma related condition; 3) two emergency department visits; or 4) five or more urgent care visits for asthma. One year after the study, selection criteria was broadened to include physician referrals. Collectively, 500 children participated in the study.

Clinical outcomes included hospital admissions, hospital days, total fee-for-service costs; including home health visits and emergency department visits (Hanchak, et al., 1996). Participants served as their own control group in that resource utilization pre-intervention was compared with resource utilization post-intervention. Data from the 30-day pre-enrollment period (event month) was excluded to prevent bias in the pre-program cost data for each participant. The Friedman's test, a non-parametric analysis of variance for dependent groups, was used to test differences in resource utilization between pre-intervention and post-intervention periods (Hanchak et al., 1996). Each participant was used as a blocking factor in the analysis since severity of each participant was not assumed to be equal. Blocking allowed researchers to control for differences among patients and to more accurately assess program impact.

Participants were divided into two groups: 1) 60 participants with at least one year of history both pre-intervention and post-intervention and 2) all patients (n=260) with at least a three month history pre-intervention and post-intervention (Hanchak et al.,

1996). Data analysis revealed a statistically significant difference in clinical outcomes for the group of 60 participants with at least one year of history pre-intervention and post-intervention. Specifically, hospital days decreased 73 percent, hospital admissions decreased 56 percent, and emergency department visits decreased 57 percent. Fee-for-service costs declined 48 percent which represented a cost savings of $2,200 annually for each participant. Similar reductions, but of a lesser magnitude, were noted for the group of 260 participants. This group included the 60 participants with at least a year of history pre-intervention and post-intervention along with participants with at least a three month history.

The authors concluded that the *Pediatric Asthma Patient Management Program* improved clinical outcomes as well as generated cost savings for the overall care provided to program participants (Hanchak et al., 1996). The findings were most relevant to children with asthma for whom there was a previous emergency department and/or inpatient admission. The authors warned against generalization of study findings to a broader population of patients with asthma.

The effects of control groups should be considered when assessing effectiveness of asthma disease management programs (Greineder, Loane and Parks, 1998). A prospective, observational pre-test/post-test design with a control group was used in this study to determine if identification of high risk asthma among patients with asthma would result in decreased resource utilization if patients did not participate in the intervention (Greineder, Loane and Parks, 1998). The control group was recruited before the health maintenance organization established a formal asthma education and

case management program for high risk asthma. Control group members were referred to their pediatricians for usual care (n=32).

Emergency department and hospitalization lists for patients admitted with asthma were reviewed to identify potential study group subjects. Clinical outcomes for 65 pediatric patients, age 1 year to 14 years, were reviewed. Patients admitted to the emergency department or hospital with wheezing for the first time or with bronchopulmonary dysplasia were excluded. Once selected, study group participants were enrolled in the *Asthma Outreach Program* (n=33).

Sociodemographic factors between the two groups were similar in that most participants in both groups were male (57% control group and 60% study group). Most participants were African-American (55% control group and 52% study group) followed by Caucasian (29% control group and 28% study group) and Hispanic (16% control group and 20% study group). Mean average age for the control group was 5.6 years compared to 4.6 years for the study group.

A small, statistically insignificant reduction in resource utilization was noted for the control group while the study group demonstrated larger and highly statistically significant reductions in emergency department visits, hospital admissions and outpatient utilizations: 60 percent, p=0.001; 74 percent, p=0.008; 72 percent, p=0.004, respectively (Greineder et al., 1998). Interestingly, mean resource utilization for the two groups before enrollment in the study was similar. Chi-square analysis revealed statistically significant differences in clinical outcome measures. Specifically, the study group experienced 48 percent less emergency department visits than the control group

($p < 0.05$), 64 percent less hospital admissions ($p < 0.05$) and 54 percent less outpatient utilization ($p < 0.01$).

The small, uniform reduction in resource utilization in the control group helped estimate the effect of identification of high risk on subsequent resource utilization (Greineder et al., 1998). These findings suggested there may be a tendency toward a reduction in utilization among patients identified as high risk by their pediatricians. However, this small effect may be enhanced by participation in asthma disease management strategies such as the *Asthma Outreach Program.* Assessments of program effect must take into consideration the reductions in utilization demonstrated by the control group in this study. Specifically, a proportion of the reductions noted with the *Asthma Outreach Program* may be the result of a Hawthorn effect associated with patient identification as high risk or spontaneous decrease in resource utilization associated with the natural history of asthma (statistical regression to the mean). Net program effect was determined as the study group findings minus the control group findings. Following completion of this study, failure to offer appropriate asthma education to patients identified as high risk was deemed inappropriate clinical practice. The institutional review board insisted recruitment be closed and the study redesigned to provide control group patients with appropriate asthma education.

Community Enabling Variables

Community enabling variables discussed in the literature included neighborhood urbanicity (Evans, 1992; Gottlieb, Beiser & Conner, 1995; Shukla & Pestian, 1996; Carr, Zental & Weiss, 1992; Wissow, Gittlesoh, & Szklo, 1998), neighborhood ethnicity

(Blixen, Tilley, Havstad & Zoratti, 1997), or neighborhood affluence (Blixen, Tilley, Havstad & Zoratti, 1997; Blendon, Scheck, Donelan, Hill, Smith, Beatrice, & Altman, 1995; Gottlieb, Beiset, O'Connor, 1995).

Neighborhood Urbanicity. Results of several small area analyses indicated asthma morbidity and mortality are concentrated in urban, inner-city neighborhoods which are characterized by poverty and large minority populations (Evans, 1992; Gottlieb, Beiser & Conner, 1995; Shukla & Pestian, 1996). Several empirical studies indicated that asthma-related hospitalizations vary by geographic location (Carr, Zental & Weiss, 1992; Wissow, Gittlesoh, & Szklo, 1998; Shukla & Pestian, 1996). For example, the relative risk of asthma-related hospitalizations for children was 3.8 times higher for children in Boston, Massachusetts than for children in Rochester, New York (Wissow, Gittlesoh, & Szklo, 1998). In New Haven, Connecticut children experienced hospital admissions for asthma-related events two to three times more frequently than children in Rochester, New York (Carr, Zental & Weiss, 1992). Reasons for large variation in utilization by geographic location is uncertain. Small area analysis, such as the one reported by Shukla and Pestian (1996) indicated the variation may be influenced by individuals, community factors or the health care system.

Shukla and Pestian (1996) used a descriptive analysis approach to explore sentinel events occurring in Virginia during 1994. Sentinel events were defined as "discharges from hospital stays associated with ambulatory-sensitive conditions that may be managed successfully with out-patient treatment" (Shukla and Pestian, 1996, p. 1). The authors indicated that high occurrences of sentinel events may be indicative of

problems in the primary delivery system within the geographic region.

Data analysis revealed there were 728,477 discharges in Virginia during the study period (Shukla and Pestian, 1996). Approximately 3 percent (n=20,411) of the discharges were classified as sentinel events. Chronic illness related to asthma, uncontrolled hypertension and uncontrolled diabetes accounted for 96 percent of all sentinel event discharges noted. Collectively, these three chronic illnesses contributed $136 million (76.5%) to the total gross charges related to sentinel event discharges. Discharge rates per 1,000 population for asthma was 1.76 (Shukla and Pestian, 1996). Interestingly, 29 percent of the asthma-related discharges affected children under 10 years of age. Study results indicated that discharge rates varied significantly by payer group. For example, Medicare recipients demonstrated higher rates for hypertension and uncontrolled diabetes. Discharge rates related to asthma were higher for individuals receiving Medicaid benefits.

Sentinel event rates also varied significantly by locality (Shukla and Pestian, 1996). Sentinel event rates, defined as actual to expected sentinel events, ranged from 0.05 to 3.54. In this study, four major metropolitan areas demonstrated higher than expected sentinel event rates: Portsmouth, Richmond, Norfolk and Chesapeake. Interestingly, all of the metropolitan areas listed are within the service delivery area of the subject managed care company. According to the authors, these findings indicated that the primary care system functions efficiently in some localities and perhaps less efficiently in others. The authors concluded that the majority of the sentinel events occurred in urban areas where most people had health insurance and easy access to

primary care services (Shukla and Pestian, 1996). These findings suggested that economic access and geographic access were not primary barriers to reducing sentinel events in Virginia.

Neighborhood Ethnicity or Neighborhood Affluence. Asthma appears to impact African-Americans disproportionately in that the mortality rate is three to fives times greater compared to other ethnic groups (Blixen, Tilley, Havstad & Zoratti, 1997). According to Blixen and colleagues (1997), it is unclear whether poor asthma outcomes are associated with ethnicity or social class (affluence). These authors used a structured interview process to explore sociodemographic, health status, quality of life, and resource use as a basis to target interventions designed to improve morbidity and mortality for urban African-Americans. Study subjects (n=30) included African-Americans seeking care in three urban emergency departments. Most of the subjects reported duration of asthma symptoms for 8.45 years. Wide variation in income was noted in that one-third of the subjects reported incomes below $10,000 while one-half reported incomes between $20,000 and $39,000. Only two subjects reported incomes above $50,000. Fifty percent of the subjects reported insurance with a health maintenance organization with 21.7 percent insured through Medicaid.

Study results revealed 45 percent of the subjects regularly used anti-inflammatory medications while 75 percent managed their asthma daily with inhaled beta-agonists (Blixen, Tilley, Havstad & Zoratti, 1997). Most of the subjects (62.5%) reported one to three emergency department visits in the last three months. About 8.4 percent indicated they incurred more than six emergency department visits during the same time frame.

Overall scores reported by African-American participants on the Asthma Quality of Life questionnaire were lower than scores reported by Caucasian participants in other studies. The authors indicated low scores may indicate African-American participants perceived asthma as an acute versus a chronic inflammatory disease.

Retrospective review of data, drawn from a national household survey of Americans conducted by the Harvard/NORC/Kaiser group between February and June 1992, was used to examine health and social welfare problems, with special emphasis on problems among low-income Americans (Blendon, Scheck, Donelan, Hill, Smith, Beatrice, & Altman, 1995). The sampling frame used by the NORC survey provided each American household an equal opportunity to be included in the study. Selection procedures allowed each adult occupant in the home equal opportunity of being interviewed. Over sampling of low-income households ($20,000 or less) were included in the sampling design. A total of 4,660 households were screened for income eligibility. The NORC also contacted 1,623 households for inclusion as a cross section. NORC completed interviews for 1,987 households, including 1,337 deemed low-income households. Most of the interviews (n=1,497) were completed in person. Overall response rate reported for the study was 67 percent.

Study results revealed 33 percent of African-Americans surveyed reported fair or poor health compared to 14 percent of Caucasian subjects (Blendon, Scheck, Donelan, Hill, Smith, Beatrice, & Altman, 1995). Significant racial disparities persisted after adjusting for income. Interestingly, disparities in perception of health disappeared when adjusting for other measures of illness burden (disability; presence of emotional, mental

health or substance abuse; or reported experience of personal violence). Overall, the proportion of African-American adults lacking health insurance was higher than the proportion of Caucasian adults (18% and 9%, respectively). The authors indicated differences in health insurance coverage only partially explained disparity between ethnic groups. For example, one in six Americans indicated difficulty paying physician and hospital bills while 10 percent reported difficulty paying for prescriptions. Conversely, about 25 percent of African-Americans reported difficulty affording these services in the past twelve months.

The authors concluded that the day-to-day lives of African-Americans differ from Caucasians (Blendon, Scheck, Donelan, Hill, Smith, Beatrice, & Altman, 1995). Specific disparities were noted in perceptions of ability to access appropriate medical care and perceptions of health status. Many African-Americans also faced more financial difficulty than Caucasians in acquiring basic necessities of life as well as paying for medical expenses. Finally, study results provided some explanation for African-American perceptions that medical institutions performed fairly or poorly for both individuals and families. Further, these disparities not only reflect ethnicity but the burdens of living with low-income levels.

A small area analysis, conducted in Boston, indicated asthma hospitalization rates were highest in poor inner city neighborhoods (Gottlieb, Beiset, O'Connor, 1995). In this study, zip code boundaries were used to define 22 small areas within the Boston urban area. Six inner city areas with small populations were combined to form a single small area. These areas were homogenous with respect to ethnicity, income, and asthma

hospitalization rates minimizing between group variance. Mean population for these 22 areas was 25,578. Additionally, zip code boundaries were used to identify four small suburban areas contiguous with Boston. Information related to homogeneity for these suburban areas were not presented.

Study results revealed the asthma hospitalization rate for Boston (4.2/1,000 persons) was twice the age and gender adjusted rate for Massachusetts: 2.1/1,000 persons (Gottlieb, Beiset, O'Connor, 1995). Wide variation was noted in age and gender adjusted hospitalization rates between the small areas. Rates varied from 0.7/1,000 to a high of 9.8/1,000 persons. Six areas with the highest asthma hospitalization rates were significantly higher than the city-wide rate ($p < 0.001$).

Small-area rates for citizens age 5 to 34 years were highly correlated with rates for persons of all ages ($r=0.95$, $p < 0.001$) for urban areas. Asthma hospitalization rates were highest for the 0 years to 4 years age group but declined progressively through ages 15 to 24 years. Hospitalization rates were higher for males compared to females below age 15 years. Interestingly, rates were higher for females compared to males for the above 15 years group. Areas with higher asthma hospitalization rates also had a greater proportion of African-Americans and Hispanics. Additionally, a strong correlation was noted between the percentage of nonwhite population and asthma hospitalization rate ($r=0.84$, $p < 0.001$) and the percentage of Hispanic population ($r=0.48$, $p=0.024$). Population areas with lower socioeconomic status exhibited higher asthma hospitalization rates. A strong, positive correlation was noted between the percentage of people living in poverty and asthma hospitalization rates ($r=0.68$, $p < 0.001$). Finally,

asthma hospitalization rates were inversely correlated with the ratio of inhaled anti-inflammatory to beta-agonist medication use ($r=0.55$, $p=0.008$).

Gottlieb and colleagues (1995) concluded that asthma hospitalization rates were highest in poor, inner city neighborhoods of Boston. High hospitalization rates, noted in this study, affected both genders and all age groups. Excess hospitalization rates may have been related to under use of inhaled anti-inflammatory medications.

Limitations of Previous Research

Empirical studies designed to test the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in urban, managed care companies have not been reported. Instead, most empirical studies have explored cost-effectiveness of asthma-related health strategies, such as disease management programs. Additionally, empirical studies designed to evaluate the influence of physician gender or total out-of-pocket cost on utilization behavior have not been reported.

The Behavior Model of Utilization (Figure 1) offers opportunities to evaluate the relative contribution of contextual factors, such as provider-related factors and environment-related factors, as they relate to use of asthma health care services in urban managed care companies (Phillips, et al., 1998; Aday et al., 1998). Contextual factors have important, but poorly understood, influence on health care utilization. Understanding the relationship between contextual factors and utilization behaviors is critical as policy makers, administrators, and clinicians seek to formulate pediatric asthma health policy and programs, promote appropriate asthma health care behaviors, and control health care costs. Therefore, they are addressed in this research.

As noted in Table 1 through Table 3, a number of empirical studies examined provider-related factors or environment-related factors influencing utilization behavior. Only one study (Zoratti, et al., 1998) explored both contextual factors. However, Zoratti and colleagues (1998) failed to evaluate critical linkages between contextual factors and asthma health services use. Specifically, provider-related factors, such as primary care provider gender, primary care provider referral, or total out-of-pocket cost, were not explored. Additionally, linkages between environment-related factors, such as asthma disease management strategies, and provider-related factors were not examined.

In summary, this study addresses three limitations of previous research by: 1) testing the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in urban managed care companies; 2) measuring the context within which pediatric asthma health services occurred; and 3) measuring the relative contribution of patient-related factors, provider-related factors and environment-related factors to pediatric asthma health services use.

Table 1

Summary of Previous Research Findings: Population-Related Factors
Specifically, Patient-Related Factors: Predisposing Characteristics and Need

Variable/Finding	Research	Utilization Behavior	n	Page
Patient-Related Factors: Predisposing Characteristics				
*Asthma is more prevalent in children and African-American groups	National Heart Blood & Lung Institute (1995)	*Children under 5 years admitted more frequently *Mortality rate higher in African-American males		28
*Hospital admission rates increase disproportionately across age groups and ethnic groups	Gergen & Weiss (1990)	*African-Americans admitted 1.8 time more frequently than whites	227,000	29
Patient-Related Factors: Need				
*Strategies should target high-risk people with asthma	Li, et al., 1995	*44% of patients have severe asthma *Health care costs are 5 times higher in severe asthma groups *Annual direct cost is higher for African-Americans	2,213	30
*Underutilization of anti-inflammatory medications increase mortality and morbidity	Kelso, et al., 1996	*Inhaled corticosteroid use improved asthma outcomes	21	31
	Balkrishnan, et al., 1998	*Prophylactic anti-inflammatory medications reduced use of health care services	157	31
	Zoratti, et al., 1998		2,057	25
	Donahue, et al., 1997	*Inhaled corticosteroids reduce risk of asthma-related hospital admissions	742	32

Table 2

Summary of Previous Research Findings: Population-Related Factors
Specifically, Provider-Related Factors: Individual Enabling and Provider Enabling

Variable/Finding	Research	Utilization Behavior	n	Page
Provider-Related Factors: Individual Enabling				
Copay may present significant barriers for low-income groups	Zoratti, et al., 1998	*Oral beta-agonist use was higher in low copay group *Oral corticosteroid use was higher in low copay group	2,057	35
Copay inversely correlated with health services use	Aday, et al, 1998	*Health services use decreases as copay increases		35
Insurance Benefits: Higher emergency department use by African-Americans, insured by Medicaid, was not fully explained by poverty or inadequate *insurance benefits*	Lozano, et al., 1995	*African-Americans more likely to be admitted and use the emergency department *African-Americans have higher per capita cost *African-Americans have fewer office visits	1,945	36
Regular Source of Health Care may not be enough to reduce burden of asthma for African-Americans seen in the emergency department	Blixen, et al., 1997	*African-Americans : - used emergency department for asthma care - had a regular source of care which was not used on a regular basis - used anti-inflammatory medications regularly	30	38
Provider-Related Factors: Provider Enabling				
*Primary care providers manage asthma patients more efficiently	Lawrence, 1998	*Most common referral pattern is no referral	356	40
*Reluctance to refer patients to specialists creates structural and financial barriers to care	Seid, et al., 1997	*Asthma patients managed by specialist have more illness burden *No differences in financial or health outcomes	722	40
*Specialists manage asthma patients more efficiently	Vollmer et al., 1997	*Asthma patients managed by allergist have more illness burden *Increased use of anti-inflammatory medications *Report better quality of life *Exacerbations of asthma managed in outpatient setting	392	41

Table 3

Summary of Previous Research Findings: Environment-Related Factors
Specifically, Health Care Environment and External Environment

Variable/Finding	Research	Utilization Behavior	n	Page
Health Care Environment: Availability				
*Shift of available resources to prevention services decrease use of asthma health care services in the acute setting and increase use of outpatient services	Greineder, 1996 Rohl, et al., 1994	*Emergency department visits and inpatient admission decreased *Inpatient hospital days declined *Primary care provider and/or specialists visits increased	36	44 44
Health Care Environment: Organization				
*Asthma disease management programs decrease use of asthma health care services in the acute setting and increase use of outpatient services	*Lahdensuo, et al., 1996 Szabo, 1997 Kelley, et al., 1998 Hanchak, et al., 1996 Greineder, et al., 1996	*Emergency department visits and inpatient admission decreased *Inpatient hospital days declined *Primary care provider and/or specialists visits increased *Less lost days from work *Less medication use *Decline in total cost of asthma-related health care	115 15 40 500 65	46 47 47 47 49
External Environment: Community Enabling				
*Asthma mortality and morbidity are concentrated in urban, inner cities	Shukla & Pestian, 1996	*Asthma admission rates vary geographically *Higher sentinel events occur in urban, inner city areas	728,477	52
*Mortality disproportionately higher in African-Americans	Blixen, et al., 1997	*Mortality rates 3 to 5 times higher	30	54
*Day-to-day lives of African-Americans differ from other ethnic groups	Blendon et al., 1995	*African-Americans reported poor to fair health *Proportion of African-Americans lacking insurance higher *Financial difficulty in paying for medical expenses	1,987	55
*Asthma admission rates higher in poor, urban inner cities	Gottlieb, et al., 1995	*Asthma hospitalization rate in Boston twice age and gender adjusted rate for the state	25,578	56

CHAPTER III: METHODS

Introduction

Chapter III identifies specific research hypotheses tested in this study. Research hypotheses were based on the broad research questions discussed in Chapter I. Additionally, research methods used in this study are described through a discussion of data collection and sources of data, study variables, operational definitions, the health care setting, and study population. Finally, statistical techniques used to test the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in an urban, regional managed care company are discussed.

Research Design

A non-experimental, observational, longitudinal historical research design with three independent groups was used to test the explanatory power of the Behavior Model of Utilization (Figure 1) for pediatric asthma health services use for one urban, regional managed care company. The non-experimental design allowed investigation of variables not amenable to experimental control but of theoretical and practical interest (Polit, 1996). In this research, random selection of pediatric asthma participants was not possible since intact groups were studied. Random assignment of pediatric asthma participants was not possible since data were collected without experimental manipulation of variables.

The longitudinal research design offered a research methodology that was both practical and economical. Detecting changes and trends over time was possible since data were examined over a 24 month period. Data for case group participants (members

enrolled in the asthma management program), collected 12 months before enrollment in the asthma management program, were considered the pre-test year. Data collected from the date of enrollment to 12 months following enrollment in the asthma management program were considered the post-test year. Data for the two comparison groups were tracked for two contiguous 12 month periods without introduction of the asthma management program. Data collected during the first 12 month period (July 1997 through June 1998) were considered the pre-test year. These data were used to test study group comparability. Data collected during the second 12 month period (July 1998 through June 1999) were considered the post-test year. These data were used to measure the context of pediatric asthma health services use and to test the explanatory power of the Behavior Model of Utilization (Figure 1).

Data Collection and Sources of Data

Sociodemographic data, pharmacy data, and health services use data were obtained from administrative and pharmacy databases maintained internally by the subject managed care company. Data related to participants' decisions to enroll in the asthma disease management program were obtained from internal databases managed by case managers employed by the managed care company. Neighborhood urbanicity, neighborhood ethnicity and neighborhood affluence data were obtained from the U.S. Census Bureau by census tract (GeoAccess, Inc., 1991-1998). These data were used to match individual participants' residence with their primary care provider office locations. Specifically, participant and primary care provider street addresses were mapped geographically to a census block group using GeoNetwork 4.6 (GeoAccess, Inc.,

1991-1998).

Study Variables

Variables used in this study included population-related factors (patient-related factors and provider-related factors), environment-related factors (health care environment and external environment), and health behavior factors (health services use). To facilitate discussion, study variables are organized under pertinent constructs of the Behavior Model of Utilization (Figure 1).

Population-Related Factors

Population-related factors measured in this research included patient-related factors and provider-related factors. Patient-related factors tested included predisposing characteristics (age and gender) and need (beta-agonist to anti-inflammatory medication ratio). Provider-related factors included individual enabling (copay and insurance benefits) and provider enabling factors (primary care provider gender, primary care provider specialty, and primary care provider referral).

Patient-Related Factors: Predisposing Characteristics. Predisposing characteristics were operationally defined as participant age and participant gender. Participant age referred to the age of pediatric asthma participants, recorded in the managed care company's member database, at the beginning of the post-test year. Participant age was also collapsed into a categorical variable with three potential values: 0 years to 4 years; 5 years to 11 years; or 12 years to 18 years. Participant gender referred to the participants' gender recorded in the managed care company's member database during the enrollment process.

Patient-Related Factors: Need. In this research, need was used as a proxy for illness severity (Li, et al., 1995; Balkrishnan, et al., 1998). Need was operationally defined as participants' beta-agonist to anti-inflammatory medication ratio. Specifically, the total number of beta-agonist prescriptions filled by participants were divided by the total number of anti-inflammatory prescriptions filled for the pre-test and post-test year separately (Zoratti, et al., 1998). The beta-agonist to anti-inflammatory medication ratio was calculated for the pre-test year and then again for the post-test year. Beta-agonist and anti-inflammatory medications were identified by unique National Drug Codes submitted for billing purposes to the managed care company. For this research, each prescription fill represented a one-month supply of medication intended for continuous use (Zoratti, et al., 1998). Beta-agonist to anti-inflammatory medication ratio was also collapsed into a categorical variable with two potential values: high (3:1 or greater) beta-agonist to anti-inflammatory medication ratio or low (less than 3:1) beta-agonist to anti-inflammatory medication ratio (National Committee for Quality Assurance, 1999).

Provider-Related Factors: Individual Enabling. Individual enabling variables included copay and insurance benefits. Copay was operationally defined as cost-sharing; the obligated amount of money paid by participants' guarantors to complete payments required for services consumed. Obligated amounts were contractual and defined by participants' insurance benefit package. This categorical variable had two potential values: low copay (less than or equal to $3) or high copay (greater than $3). This variable was constructed but not used in data analysis since copay did not vary substantially between participants.

Insurance benefits were operationally defined by the company's health maintenance organization licenses and health insurance company license. Insurance benefits were contractual between pediatric participants' guarantor and the managed care company. This categorical variable had two potential values: Medicaid or commercial.

Provider-Related Factors: Provider Enabling. Provider enabling variables included primary care provider gender, primary care provider specialty, and primary care provider referral. Primary care provider gender was operationally defined as the gender recorded during the credentialing process between the primary care provider and the managed care company.

Primary care provider specialty was operationally defined as the specialty in which the primary care provider was board certified and recorded during the credentialing process between the primary care provider and the managed care company. This categorical variable had two potential values: general practice or pediatrics.

Primary care provider referral was operationally defined as the physician order which permitted participants access to the asthma management program. This categorical variable had two potential values: yes (referred to the asthma management program) or no (not referred to the asthma management program).

Environment-Related Factors

Environment-related factors evaluated in this study included health care environment (availability and organization) and external environment (community enabling). Health care environment variables related to financing were not tested in this research.

Environment-Related Factors: Health Care Environment. Health care environment factors included availability and organization. Availability was operationalized as the presence of primary care provider offices located in the neighborhood in which participants resided. In this study, neighborhood was defined by zip code. Specifically, street addresses of primary care provider offices, that contracted with or were employed by the managed care company, were mapped geographically to a census block group and matched by zip code with participants' residence (Zoratti, et al., 1998). Two potential values for this categorical variable included: yes (office located in participant's neighborhood) or no (office not located in participant's neighborhood).

Availability was also measured by the presence of primary care provider offices, offering late office hours, located in the neighborhood in which participants resided. In this study, late office hours was defined as services offered in the physician office after 5:00 P.M. Neighborhood was defined by zip code. Street addresses of primary care provider offices that offered late hours were mapped geographically to a census block group and matched by zip code with participants' residence (Zoratti, et al., 1998). Two potential values for this categorical variable included: yes (office with late hours located in participant's neighborhood) or no (office with late hours not located in participant's neighborhood).

Organization was operationalized by enrollment of pediatric asthma participants in the asthma management program. Participant enrollment in the asthma management program required a physician order. Enrollment data were obtained from internal databases managed by case managers employed by the managed care company. This

categorical variable had three potential values: participant enrolled in the asthma management program (enrolled group); participant referred to the asthma management program by the primary care provider but participant declined enrollment (declined group); or participant not referred to the asthma management program by the primary care provider (not referred group). This variable was also collapsed into a two categorical variable describing enrollment status.

External Environment: Community Enabling Variables Community enabling variables included neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence. Neighborhood urbanicity was operationalized by census designated place (CDP) provided by the U.S. Census Bureau (GeoAccess, Inc., 1991-1995; U.S. Census Bureau, 1994; U.S. Census Bureau, 1995; GeoNetworks, Inc., 1999). Participant street address was mapped geographically to a census block group (Zoratti, et al., 1998). Zip code for that census block was matched with urban designation defined by the U.S. Census Bureau. There were three potential values for this categorical variable: urban, suburban, or rural.

In this study, urban neighborhoods (urbanized areas) were defined as continuous built up areas with a population equal to or greater than 50,000 people (U.S. Census Bureau, 1994; U.S. Census Bureau, 1995). Population density was at least 1,000 persons per square mile. Suburban neighborhoods were defined as any incorporated place or census designated place with at least 2,500 residents. According to the U.S. Census Bureau (1994), a census designated place is a densely populated area that has both a name and a community identity. Rural neighborhoods were defined as an incorporated

place or census designated place with fewer than 2,500 residents. According to the U.S. Census Bureau (1994), rural areas are located outside of urbanized areas. For purposes of data analysis, neighborhood urbanicity was collapsed into a categorical variable with two potential values: urban neighborhood or non-urban neighborhood.

Neighborhood ethnicity was operationalized using population data provided by the U.S. Census Bureau for census block groups (GeoAccess, Inc., 1991-1998; U.S. Census Bureau, 1994; U.S. Census Bureau, 1995; GeoNetworks, Inc., 1999). Participant street address was mapped geographically to a census block group (Zoratti, et al., 1998). For purposes of determining ethnic groups, the total number of residents within an ethnic group was divided by the total population for each census block. Ethnicity for each neighborhood was determined arbitrarily as the ethnic group representing the majority of the total population (equal to or greater than 60%) within each census block group. The neighborhood was deemed multi-cultural when a specific ethnic group did not account for at least 60 percent of the total population within each census block group. There were three potential values for this categorical variable: African-American, Caucasian, or multi-cultural. For purposes of data analysis, this variable was collapsed into a categorical variable with two values: Caucasian neighborhood or non-Caucasian neighborhood. African-American participants represented the majority (97%) of participants within the non-Caucasian neighborhood group. Only three percent of neighborhoods within the non-Caucasian group were classified as multi-cultural.

Participant street address was also used to operationalize neighborhood affluence. Specifically, participant street address was mapped geographically to a census block

group and median household income for a four person family unit with one related child under 18 years of age (GeoAccess, Inc., 1991-1998; U.S. Census Bureau, 1994; U.S. Census Bureau, 1995; U.S. Census Bureau, 1998; GeoNetworks, Inc., 1999). There were three potential values for this categorical variable: low-income, middle-income or high-income. For purposes of determining socioeconomic groups, median income designation for each participant's zip code was analyzed. Median income levels by zip code at or below the 25th percentile ($0-$30,999) were considered low-income neighborhoods. In this study, the 25th percentile level of income reflected 180% of the established 1998 poverty guideline for a four person family unit with one related child under 18 years of age (U.S. Census Bureau, 1998). Median income levels by zip code between the 25th percentile and 75th percentile ($31,000-$49,999) were considered middle-income neighborhoods. Median income levels by zip code equal to or greater than the 75th percentile ($50,000+) were considered high-income neighborhoods. For purposes of data analysis, this variable was collapsed into a categorical variable with two values: low-income neighborhood or non low-income neighborhood. Participants residing in middle-income neighborhoods represented the majority of participants within the non low-income neighborhood group.

Health Behavior Factors

Health behavior factors included use of asthma-related health services. Use of health services was defined as hospital admissions, emergency department services, primary care provider services, specialists services, home health services, and total health care cost. Additional variables included hospital days, primary care provider volume use

(low user or high user), health services cost, medication cost, and out-of-pocket cost. The integrated, administrative data base was used to retrieve resource data for health services use. Resource data were collected at the asthma health care encounter level as determined by an ICD9-CM principle diagnosis of asthma (493-493.91).

In this research, health services use data were collected for two contiguous 12 month time periods. Specifically, data for case group participants (members enrolled in the asthma management program) collected 12 months before enrollment in the asthma management program were considered the pre-test year. Data collected from the date of enrollment to 12 months following enrollment in the asthma management program were considered the post-test year.

Data for the two comparison groups were collected for two continuous years without introduction of the asthma management program. Data collected during the first 12 months (July 1997 through June 1998) were compared to the case group pre-test year to assess group comparability. Data collected during the second 12 months (July 1998 through June 1999) were compared to the case group post-test year to compare differences in pediatric asthma health services use. These data were used to measure patient-related and contextual factors in pediatric health services use. These data were also used to test the explanatory power of the Behavior Model of Utilization (Figure 1).

Hospital admissions (hospital services) were defined as an over-night stay in an acute care facility. Hospital days were defined as the number of days participants remained in the acute care hospital setting for admissions related to a principle diagnosis of asthma. Emergency department services (hospital services) were defined as use of

emergency services not requiring admission to an acute care facility. Primary care provider services, specialists services, and home health services were defined as ambulatory (out patient services) resource use. Hospital admissions, emergency department services, primary care provider services, specialists services and home health services were also collapsed into a two categorical variable with the following values: yes, the service was consumed or no the service was not consumed. Primary care provider services were also grouped based on volume with the following values: low user (less than six visits annually) or high user (six or more visits annually).

Services cost was defined as the total cost for both hospital and ambulatory asthma-related health services consumed by participants. For purposes of data analysis, services cost was collapsed into a categorical variable with two potential values: low cost (less than $2,592) or high cost (greater than or equal to $2,592). High cost was equal to or greater than the 80th percentile for study participants' service cost.

Total out-of-pocket cost was defined as the total obligated amount of cost-sharing incurred by participants' guarantors as a result of contractual arrangements associated with insurance benefits. Out-of-pocket cost was calculated by summing copay amounts for the study period. For purposes of data analysis, out-of-pocket cost was collapsed into a categorical variable with two potential values: low cost (less than $4) or high cost (greater than or equal to $4). High cost was equal to or greater than the 80th percentile for study participants' out-of-pocket cost.

Medication cost was defined as the total cost incurred for beta-agonist or anti-inflammatory medications, identified by unique National Drug Codes, by the managed

care company and participants' guarantors. For purposes of data analysis, medication cost was collapsed into a categorical variable with two potential values: low cost (less than $468) or high cost (greater than or equal to $468). High cost was equal to or greater than the 80th percentile for study participants' medication cost.

Total health care cost was defined as the sum of services cost, medication cost, out-of-pocket cost, and program cost (for participants enrolled in the asthma management program). For purposes of data analysis, total health care cost was collapsed into a categorical variable with two potential values: low cost (less than $3,060) or high cost (greater than or equal to $3,060). High cost was equal to or greater than the 80th percentile for study participants' health care cost.

Human Subjects

The study was conducted following approval from: 1) the Human Subjects Committee, Old Dominion University; 2) the senior medical director of the subject managed care company; and 3) the quality improvement director of the subject managed care company. The purpose and procedures used in this study were discussed with the senior medical director and quality improvement director for the subject managed care company. The subject managed care company did not require additional review by the health care company's Institutional Review Board. Weekly meetings to discuss progress and problem solve issues related to data collection were conducted with the senior medical director and quality improvement director.

In this research, direct contact with participants was not necessary since this study involved secondary analysis of existing administrative, clinical, and pharmacy databases.

Comparison group participants identified as high risk, through retrospective review of pharmacy claims data, were referred to the asthma disease management program director for assessment and appropriate asthma preventive care.

Confidentiality of individual participant records was assured as all identifying data were removed following extraction of records from administrative, pharmacy and case manager data bases. Instead, study participants were assigned a unique subject identification number to facilitate comparison of pre-test year and post-test year data. Internal and external regulatory requirements for access and use of member records were guaranteed by the researcher.

Results of data analysis were reported only in aggregate form by providing an abstract of study results to the subject managed care company and their designees. Any subsequent publication of study findings will not identify individual members or study settings. The researcher was available throughout data collection and analysis to answer questions about the study, data collection procedures or results reporting.

Research Procedures

Permission to conduct this study was granted by the senior medical director and quality improvement director for the subject managed care company following approval from the Human Subjects Committee of Old Dominion University. Participants in the case group and the first comparison group were previously identified as high risk by case managers employed by the subject managed care company. A retrospective review of pharmacy claims data was conducted to identify pediatric asthma participants for the

second comparison group; asthma members at risk for severe asthma, but not previously referred to the asthma management program. These participants were referred to the asthma disease management program director for assessment and appropriate asthma preventive care.

Records for members eligible for the study were selected from the automated administrative database and pharmacy database of the insurer. Data extracted from the administrative database included sociodemographic data, clinical data, hospital and ambulatory resource utilization, and health care costs. Data extracted from the pharmacy database included types of medications, quantity dispensed, total cost, and prescribing physician. Primary care provider data were extracted to analyze differences in health care practice patterns. Data files were converted from text-tab delimited files into SPSS (SPSS, 1997) compatible files for data analysis. Preparation of data included editing procedures to exclude invalid or unusable records.

Health Care Setting and Study Population

Data were obtained from the subject managed care company's automated administrative and pharmacy database. The integrated infrastructure of the data bases allowed capture of pediatric asthma health services use across the continuum of care at the participant and primary care provider transaction level. This structure enabled the researcher to link study participants with their primary care providers.

Health Care Setting Description

The subject managed care company is the managed care division of a not-for-profit, fully integrated health care company (Munsey, 1999). The health care company

network provides a full range of services including six hospitals, two out-patient centers, seven nursing homes, three assisted-living centers, 44 primary care provider practices, and the managed care company that covers over 300,000 members. The health care company also offers home health services, hospice services, durable medical services, rehabilitation services, as well as ground and air medical transport. The health care company has strong affiliations with a regional, tertiary care, pediatric facility and a medical school.

The managed care company has two health maintenance organization (HMO) licenses for the commercial and Medicaid products, and a health insurance company license for the point of service (POS) and preferred provider organization (PPO) products. The commercial HMO and POS/PPO products provide health care to approximately 144,000 members within a large metropolitan statistical area. The Medicaid product provides health care for approximately 62,000 members. Generally, members join the managed care company through employer-sponsored health plans or Medicaid-sponsored enrollment through state programs.

Health care for members is provided through a combination of direct contracting, PHOs, and group models with approximately 3,600 physicians including primary care and specialists. The concept of managed care is relatively new for the region, with the commercial products offered as early as 1984 and the Medicaid product initiating in 1995. Recently, the managed care company was awarded the highest quality rating, excellent, by the National Committee for Quality Assurance (NCQA) for the commercial HMO product. The Medicaid product also received the highest quality rating from

NCQA during the same time frame.

Study Sample Selection

In 1998, the pediatric asthma population accounted for 60 percent (n=8,183) of the total asthma population (n=13,638) enrolled by the managed care company; representing approximately 3.7 percent of total covered lives. Review of calendar year 1998 administrative data, by this researcher, identified 410 children within the pediatric population as high risk. These children represented approximately five percent of the total pediatric asthma population (n=8,183). Access for pediatric asthma members to the asthma management program required referrals from their primary care providers. Study group construction and data collection are presented in this section.

This research employed three distinct groups; one case group (treatment group) and two comparison groups (Table 4). In this research, the case group (n=203) is referred to as the "enrolled" group. The first comparison group (n=68) is referred to as the "declined" group. The second group (n=70) is referred to as the "not referred" group. Health services use data, for the three study groups, were explored during the 12 month pre-test year to evaluate group comparability. Additionally, data collected during the 12 month post-test (Table 5) year were used to measure the context of pediatric health services use and to test the explanatory power of the Behavior Model of Utilization. Overall, 83.2 percent of the eligible population were included in this study.

Enrolled Group

The "enrolled" group was an intact group since participants were currently enrolled in the asthma management program (Table 4). The enrolled group (n=203)

represented 80.8 percent of the eligible population (n=251). Health services use data for the enrolled group were divided into two 12 month periods (Table 5). Data collected during the 12 months prior to enrollment in the asthma management program were considered the pre-test year. Data collected from the date of enrollment to 12 months following enrollment in the asthma management program were considered the post-test year.

Declined Group

The "declined" group was an intact group and included pediatric members (n=68) who were previously referred by their primary care providers to the asthma management program but declined to enroll in the program (Table 4). The declined group (n=68) represented 93.1 percent of the eligible population (n=73). Health services use data for the declined group were collected for two contiguous 12 month periods (Table 5) without introduction of the asthma management program. Data collected during the first 12 months were considered the pre-test year. Data collected during the second 12 months were considered the post-test year.

Not Referred Group

The "not referred" group (n=70) included pediatric asthma members, selected from the general pediatric asthma population by this researcher (Table 4). Participants in this group were identified as high risk for severe asthma but had not been previously referred to the asthma management program by their primary care provider. In this study, high risk was defined as a beta-agonist to anti-inflammatory medication ratio greater than or equal to 3:1 (National Committee for Quality Assurance, 1999). The not

referred group (n=70) represented 81.4 percent of the total eligible population (n=86) identified using the high risk selection criteria (Table 4).

Selection Of Participants Eligible For The Not Referred Group. The not referred group was selected by querying the managed care company's pharmacy database to determine the number of asthma-related prescriptions filled between July 1997 and June 1998 (pre-test year). Specifically, the number of beta-agonist prescriptions filled were compared to the number of anti-inflammatory prescriptions filled. Asthma members with a beta-agonist to anti-inflammatory medication ratio of 3:1 or greater were considered high risk (National Committee for Quality Assurance, 1999) and eligible for inclusion in the study. High risk members, identified through this selection process, were referred to the asthma management program director for assessment and appropriate preventive care. Referral of participants for follow up care did not effect study results given the retrospective nature of this study design.

Data Collection. Health services use data for the not referred group were collected for two contiguous 12 month periods (Table 5) without introduction of the asthma management program. Data collected during the first 12 months were considered the pre-test year. Data collected during the second 12 months were considered the post-test year.

Table 4

Pediatric Asthma Population
Eligible Population, Sample Population, and Inclusion Rate

Pediatric Asthma Population	Declined Group	Enrolled Group	Not Referred Group	Total
Eligible For Study Pediatric Participants	73	251	86	410
Sample Population Pediatric Participants	68	203	70	341
Inclusion Rate Pediatric Participants	93.1%	80.8%	81.4%	83.2%

Table 5
Pediatric Asthma Study Population: Study Group Design

Study Groups	Pre-Test Year	Asthma Management Program	Post-Test Year
Enrolled (n=203)	O_1	X	O_2
Declined (n=68)	O_1		O_2
Not Referred (n=70)	O_1		O_2

Exclusion Criteria

In this research, children with asthma were excluded if they changed health insurance companies during the study period or were not continuously enrolled for 24 months (Table 6). Children were also excluded if the administrative data base or pharmacy data base lacked sociodemographic data, resource utilization data, clinical data, primary care provider data, or cost data. Participant service claims, failing to have asthma (ICD9-CM diagnosis codes 493-493.91) recorded in the primary discharge diagnosis position were also excluded. This exclusion criteria eliminated health service

claims for which services were consumed by participants for reasons other than asthma. Collectively, 14.1 percent of the eligible population failed to meet the 24 month continuously enrolled inclusion criteria. Approximately three percent of eligible children were excluded because of missing data (Table 6).

Table 6

Analysis of Children With Asthma Excluded From Study Population

Group	Pediatrics
Declined Program	
Principle Diagnosis Other Than Asthma (493-493.91)	0
Continuously Enrolled Less Than 24 Months	0
Medicare and Medicaid Recipient	0
Changed Insurance Company	0
Missing Data	4
Program	
Principle Diagnosis Other Than Asthma (493-493.91)	0
Continuously Enrolled Less Than 24 Months	49
Medicare and Medicaid Recipient	0
Changed Insurance Company	0
Missing Data	0
Not Offered Program	
Principle Diagnosis Other Than Asthma (493-493.91)	0
Continuously Enrolled Less Than 24 Months	9
Medicare and Medicaid Recipient	0
Changed Insurance Company	0
Missing Data	7
Total	
Principle Diagnosis Other Than Asthma (493-493.91)	0
Continuously Enrolled Less Than 24 Months	58
Medicare and Medicaid Recipient	0
Changed Insurance Company	0
Missing Data	11

The study population was selected because the managed care company collected sociodemographic data, resource utilization data and pharmacy data at the transaction level. Data were collected across the continuum of care, facilitating exploration of chronological order of events. Additionally, data were available for all product lines

insured by the managed care company. Finally, rigorous quality control mechanisms were in place to manage incorrect and/or missing data and edit checks were conducted on a routine basis by information system engineers to ensure data integrity.

Study Population Description For The Post-Test Year

Population-related factors: patient-related factors (Table 7) measured in this research included predisposing characteristics (age and gender) and need (beta-agonist to anti-inflammatory medication ratio). In this study, about half (46.3%) of the participants were between four and twelve years of age. The mean age was 8.4 years with a standard deviation of 4.8 years. Sixty-three percent of the children were male. Approximately sixty-three percent (63.6%) had a low beta-agonist to anti-inflammatory medication ratio (average 2.8; standard deviation 3.2).

Table 7

Descriptive Statistics For Post-Test Year
Population-Related Factors: Patient-Related Factors

Research Factor	Variable	n	Percent	Mean	SD
Population-Related Factors: Patient-Related Factors					
Predisposing Characteristics	Age	341	100%	8.4	4.8
	0 Years to 4 Years	90	26.4%		
	5 Years to 11 Years	158	46.3%		
	12 Years to 18 Years	93	27.3%		
	Gender	341	100%	N/A	N/A
	Male	215	63.0%		
	Female	126	37.0%		
Need	Beta-agonist to Anti-inflammatory Ratio	341	100%	2.8	3.2
	High Ratio (3:1 or >)	124	36.4%		
	Low Ratio (<3:1)	217	63.6%		

Population-Related Factors: Provider-Related Factors

Provider-related factors (Table 8) included in this research were individual enabling and provider enabling. Individual enabling variables measured included insurance benefits and copay. In this study, most (78.3%) of the participants were insured through the Medicaid insurance benefit plan. Most (85.3%) of the participants' guarantors paid low copay for asthma health care services used. Contractual copay was not required for approximately 80 percent of the study population. As a result, copay was not considered a variable in this study.

Provider enabling variables measured in this research included primary care provider gender, primary care provider specialty, and primary care provider referral to the asthma management program (Table 8). Health care services, for about 65 percent of the study population, were managed by male primary care providers. Approximately 87 percent of the children were managed by board-certified pediatricians versus general practitioners. Interestingly, most (79.5%) of the children had been referred to the asthma management program by their primary care provider.

Table 8

Descriptive Statistics For Post-Test Year
Population-Related Factors: Provider-Related Factors

Research Factor	Variable	n	Percent
Population-Related Factors: Provider-Related Factors			
Individual Enabling	Insurance Benefits		
	Medicaid	267	78.3%
	Commercial	74	21.7%
Provider Enabling	PCP Gender		
	Male	224	65.7%
	Female	117	34.3%
	PCP Specialty		
	General Practice	44	12.9%
	Pediatrics	297	87.1%
	PCP Referral to Asthma Management Program		
	Referred	271	79.5%
	Not Referred	70	20.5%

Environment-Related Factors: Health Care Environment

Health care environment factors (Table 9) measured in this research included availability (primary care provider office in the neighborhood and primary care provider office in the neighborhood with late office hours) and organization (asthma management program). In this study, most (85.3%) of the participants did not have a primary care provider office located in their neighborhood. Only seven percent of study participants had primary care provider offices with late office hours located in their neighborhood. Collectively, about 60 percent of the children were currently enrolled in the asthma management program. Almost 20 percent of the study population had declined to enroll

in the program and 20.5 percent had not been referred to the program by their primary care provider.

Environment-Related Factors: External Environment

External environment factors measured in this research included neighborhood urbanicity, neighborhood ethnicity and neighborhood affluence (Table 9). In this study, most (71.0%) participants resided in urban neighborhoods. Of those residing in non-urban neighborhoods, 14.4 percent (n=49) resided in suburban neighborhoods and 12.9 percent (n=44) resided in rural neighborhoods. For purposes of data analysis, neighborhood urbanicity was collapsed into a dichotomous variable with the following values: urban neighborhood or non-urban neighborhood. Within neighborhoods classified as "non-urban neighborhoods", suburban represented the predominant neighborhood urbanicity group.

Approximately 58 percent of study participants resided in predominately Caucasian neighborhoods (Table 9) followed by African-American neighborhoods (37.8%) and multi-cultural neighborhoods (3.2%). For purposes of data analysis, neighborhood ethnicity was collapsed into a dichotomous variable with the following values: predominately Caucasian neighborhood or non-Caucasian neighborhood. Within neighborhoods classified as "non-Caucasian neighborhoods", African-Americans represented the predominant neighborhood ethnic group.

In this study, approximately 26 percent of the children resided in low-income neighborhoods, 54.8 percent resided in middle-income neighborhoods, and 18.8 percent resided in high-income neighborhoods (Table 9). For purposes of data analysis,

neighborhood affluence was collapsed into a dichotomous variable with the following values: low-income neighborhood or non low-income neighborhood. Within neighborhoods classified as "non low-income neighborhoods", middle-income represented the predominant neighborhood affluence group.

Table 9

Descriptive Statistics For Post-Test Year
Environment-Related Factors: Health Care Environment and External Environment

Research Factor	Variable	n	Percent
Environment-Related Factors: Health Care Environment			
Availability	PCP Office In Neighborhood		
	Yes	50	14.7%
	No	291	85.3%
	PCP Office In Neighborhood With Late Hours		
	Yes	25	7.3%
	No	316	92.7%
Organization	Asthma Management Program		
	Enrolled Group	203	59.5%
	Declined Group	68	19.9%
	Not Referred Group	70	20.5%
Environment-Related Factors: External Environment			
Community Enabling	Neighborhood Urbanicity		
	Urban	242	71.0%
	Suburban	49	14.4%
	Rural	44	12.9%
	Neighborhood Ethnicity		
	African-American	129	37.8%
	Caucasian	200	58.8%
	Multi-cultural	11	3.2%
	Neighborhood Affluence		
	Low-income	90	26.4%
	Middle-income	187	54.8%
	High-income	64	18.8%

Comparability of Study Groups For Pre-Test Year

Population-related factors, environment-related factors, and health services use were examined, for the pre-test year, to determine comparability of study groups. Specifically, the chi-square test for independence was used to test differences between study groups. Direct comparison between study groups was possible when the chi-square produced a 2 x 2 contingency table (Polit, 1996). When contingency tables were larger than 2 x 2, post-hoc tests, using multiple chi-squares, were used to determine significantly different groups. The overall alpha level was adjusted by the Bonferroni inequality when multiple chi-square tests were used, minimizing the risk of a Type I error (Hair, Anderson, Tatham, & Black, 1995). Specifically, the adjusted alpha level for any separate chi-square test was defined by dividing the overall alpha by the number of tests in the analysis. In this research, the adjusted alpha for separate chi-square tests was calculated at 0.017 (overall alpha, 0.05/3 separate chi-square tests).

Population-Related Factors: Pre-Test Year

Sociodemographic differences between the three study groups were examined for the pre-test year. As shown in Table 10, differences noted in age categories between study groups were statistically significant ($\chi^2 = 29.908$, $p = 0.000$). Participants in the not referred group were significantly older than participants in the enrolled group ($\chi^2 = 29.527$, $p=0.000$). Age categories were comparable between participants in the enrolled group and participants in the declined group ($\chi^2=6.499$, $p=0.039$). Age categories were also comparable between participants in the declined group and participants in the not referred group ($\chi^2=6.011$, $p=0.050$). Participant gender was comparable across all three

study groups (χ^2=0.102, p=0.951).

Need (beta-agonist to anti-inflammatory medication ratio) was used to test comparability of severity of illness between the three study groups. As shown in Table 10, the percentage of participants with a high beta-agonist to anti-inflammatory medication ratio was similar across all three groups. Chi-square analysis revealed that differences noted were not statistically significant indicating severity of illness was comparable for all three groups (χ^2 =3.481, p=0.175).

Environment-Related Factors: Pre-Test Year

As shown in Table 10, differences in neighborhood urbanicity between the three study groups were statistically significant (χ^2=10.728, p=0.005). Participants in the declined group were significantly less likely to reside in urban neighborhoods compared to participants in the enrolled group (χ^2 =9.891, p=0.002) or participants in the not referred group (χ^2 =5.976, p=0.015). The likelihood of residing in urban neighborhoods was comparable between participants in the enrolled group and participants in the not referred group (χ^2 =0.000, p=0.984). Neighborhood ethnicity and neighborhood affluence was comparable across all study groups (χ^2 =3.243, p=0.198; χ^2 =3.888, p=0.143, respectively).

Table 10

Comparability Of Study Groups: Pre-Test Year
Population-Related And Environment-Related Factors

Health Services Use Outcomes[1]	Total (n=341)	Enrolled Group (n=203)	Declined Group (n=68)	Not Referred Group (n=70)	χ^2	p	Power[a]
Age Group							
0 Years to 4 Years	26.4%	31.0%	26.5%	12.9%			
5 Years to 11 Years	46.3%	51.2%	41.2%	37.1%			
12 Years to 18 Years	27.3%	17.7%	32.4%	50.0%	29.908	.000	0.72
Gender							
Female	37.0%	36.5%	36.8%	38.6%			
Male	63.0%	63.5%	63.2%	61.4%	0.102	.951	0.42
BA Ratio[b]							
High BA Ratio	48.7%	45.8%	48.5%	58.6%			
Low BA Ratio	51.3%	54.2%	52.9%	41.4%	3.481	.175	0.37
Neighborhood Urbanicity							
Non-Urban	27.3%	23.8%	43.9%	23.9%			
Urban	71.0%	76.2%	56.1%	76.1%	10.728	.005	0.72
Neighborhood Ethnicity							
Non-Caucasian	41.1%	42.9%	45.6%	31.9%			
Caucasian	58.7%	57.1%	54.4%	68.1%	3.243	.198	NC[c]
Neighborhood Affluence							
Non Low-Income	73.6%	70.0%	76.5%	81.4%			
Low-Income	26.4%	30.0%	23.5%	18.6%	3.888	.143	0.42

[a]Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b]BA Ratio - Beta-agonist to anti-inflammatory medication ratio
[c]NC - Statistical power not calculated since Cramer's V statistic was <0.10

[1]Chi-square test of independence

Health Services Use: Pre-Test Year

Health services use measures tested in this research included the likelihood of being admitted to the hospital, using emergency department (ED) services, using primary care provider (PCP) services, using specialist services, or using home health services.

Primary care provider services were also grouped based on volume (PCP Services Volume) with the following values: low user (less than six visits annually) or high user (six or more visits annually). Differences in pediatric asthma health services use was examined for the three study groups for the pre-test year. Research findings are presented in Table 11.

Hospital Admission. Overall, approximately 29 percent (n=100) of study participants were admitted to the hospital in the pre-test year. Of those who were admitted, the average number of hospital admissions was 2.07 (s.d.=1.6 admissions). Inpatient days per participant averaged 4.7 days (s.d. = 4.3 days). Differences noted, between study groups, in the likelihood of being admitted to the hospital were statistically significant (χ^2 =21.960, p=0.000). Participants in the declined group were significantly more likely to be admitted to the hospital compared to participants in the enrolled group (χ^2 =11.537, p=0.001) or participants in the not referred group (χ^2 =20.258, p=0.0000). The likelihood of being admitted to the hospital was comparable between participants in the enrolled group and participants in the not referred group (χ^2 =5.023, p=0.025).

Emergency Department Services. Overall, approximately 43 percent (n=148) of study participants used emergency department services in the pre-test year. Of those who used services, the average number of emergency department visits was 2.4 (s.d. = 1.7 visits). Differences noted, between study groups, in the likelihood of using emergency department services were statistically significant (χ^2 =22.337, p=0.000). Participants in the enrolled group were significantly less likely to use emergency

department services compared to participants in the declined group (χ^2 =6.983, p=0.008) or participants in the not referred group (χ^2 =20.339, p=0.000). The likelihood of using emergency department services was comparable between participants in the declined group and participants in the not referred group (χ^2 =2.325, p=0.127).

Primary Care Provider Services. Overall, approximately 98 percent (n=335) of study participants used primary care provider services in the pre-test year. Of those who used services, the average number of primary care provider visits was 4.3 (s.d. = 5.6 visits). The likelihood of using primary care provider services in the pre-test year did not vary for participants in the enrolled group (100%). The likelihood of using primary care provider services was comparable between participants in the declined group and participants in the not referred group (χ^2 =0.001, p=0.971).

Primary Care Provider Services Volume. Overall, only 23.2% of study participants were classified as primary care provider high users in the pre-test year. Differences noted, between study groups, in the likelihood of being classified primary care provider high user were statistically significant (χ^2 =48.419, p=0.000). Participants in the enrolled group were significantly less likely to be classified primary care provider high user compared to participants in the declined group (χ^2 =48.790, p=0.000) or participants in the not referred group (χ^2 =13.420, p=0.000). Participants in the not referred group were significantly less likely to be classified primary care provider high user compared to participants in the declined group (χ^2 =6.594, p=0.010).

Specialist Services. Overall, approximately 55 percent (n=189) of study participants used specialist services in the pre-test year. Of those who used services, the

average number of specialist visits was 5.2 (s.d. = 6.7 visits). Differences noted, between study groups, in the likelihood of using specialist services were statistically significant (χ^2 =29.973, p=0.000). Participants in the enrolled group were significantly less likely to use specialist services compared to participants in the declined group (χ^2 =15.117, p=0.000) or participants in the not referred group (χ^2 =21.832, p=0.000). The likelihood of using specialist services was comparable between participants in the declined group and participants in the not referred group (χ^2 =0.462, p=0.497).

Home Health Services. Overall, 5.6 percent (n=19) of study participants used home health services in the pre-test year. Of those who used services, the average number of home health visits was 1.7 (s.d. = 1.08 visits). Differences noted, between study groups, in the likelihood of using home health services were statistically significant (χ^2 =37.000, p=0.000). Participants in the declined group were significantly more likely to use home health services compared to participants in the enrolled group (χ^2 =25.668, p=0.000) or participants in the not referred group (χ^2 =16.039, p=0.000). The likelihood of using home health services was comparable between participants in the enrolled group and participants in the not referred group (χ^2 =1.756, p=0.185).

Table 11

Comparability Of Study Groups: Pre-Test Year
Health Services Use

Health Services Use Outcomes[1]	Total (n=341)	Enrolled Group (n=203)	Declined Group (n=68)	Not Referred Group (n=70)	χ^2	p	Power[a]
Hospital Admissions							
Admitted	29.3%	27.6%	50.0%	14.3%			
Not Admitted	70.7%	72.4%	50.0%	85.7%	21.960	.000	0.93
ED Services							
Services Used	43.4%	33.5%	51.5%	64.3%			
Services Not Used	56.6%	66.5%	48.5%	35.7%	22.337	.000	0.93
PCP Services Volume							
High User	23.2%	11.3%	51.5%	30.0%			
Low User	76.8%	88.7%	48.5%	70.0%	48.419	.000	0.99
Specialist Services							
Services Used	55.4%	43.3%	70.6%	75.7%			
Services Not Used	44.6%	56.7%	29.4%	24.3%	29.973	.000	0.99
Home Health Services							
Services Used	5.6%	2.5%	20.6%	0%			
Services Not Used	94.4%	97.5%	79.4%	100%	37.000	.000	0.99

[a]Cramer's V statistic used to calculate statistical power (Cohen, 1988)

[1]Chi-square test of independence

Health Services Cost: Pre-Test Year

Differences in pediatric asthma health services costs were examined for the three study groups for the pre-test year. Health services cost measures included the likelihood of being classified high services cost, high medication cost, high out-of-pocket cost, or high total health care cost. Research findings are presented in Table 12.

Services Cost. Overall, approximately 20 percent (n=69) of study participants were classified high services cost for the pre-test year. Of those who used services, average service cost was $1,761 per participant (s.d. = $3,368) with a median cost of

$444. Differences noted, between study groups, in the likelihood of being classified high services cost were statistically significant (χ^2 =16.562, p=0.000). Participants in the declined group were significantly more likely to be classified high services cost compared to participants in the enrolled group (χ^2 =9.921, p=0.000) or participants in the not referred group (χ^2=13.873, p=0.000). The likelihood of being classified high services cost was comparable between participants in the enrolled group and participants in the not referred group (χ^2 =2.606, p= 0.106).

Medication Cost. Overall, approximately 20 percent (n=69) of study participants were classified high medication cost for the pre-test year. Of those who used services, medication cost per participant averaged $395 (s.d. =$619) with a median cost of $171. Differences noted, between study groups, in medication cost were not statistically significant (χ^2 = 5.114, p =0.078).

Out-Of-Pocket Cost. About 18 percent (n=69) of study participants were classified high out-of-pocket cost for the pre-test year. Of those who used services, out-of-pocket cost per participant averaged $22 (s.d. = $77) with a median cost of $0. Differences noted, between study groups, in out-of-pocket cost were not statistically significant (χ^2 =2.217, p=0.330).

Total Health Care Cost. Overall, approximately 20 percent (n=69) of study participants were classified high total health care cost for the pre-test year. Of those who used services, total health care cost per participant averaged $2,179 (s.d. = $3,599) with a median cost of $950. Differences noted, between study groups, in the likelihood of being classified high total health care cost were statistically significant (χ^2 =8.175, p=0.017).

Participants in the declined group were significantly more likely to be classified high total health care cost compared to participants in the not referred group (χ^2 =7.864, p=0.005). The likelihood of being classified high total health care cost was comparable between participants in the enrolled group and participants in the declined group (χ^2 =3.649, p=0.56) or participants in the not referred group (χ^2 =2.460, p=0.117).

Table 12

Comparability Of Study Groups: Pre-Test Year
Health Services Cost

Health Services Use Outcomes[1]	Total (n=341)	Enrolled Group (n=203)	Declined Group (n=68)	Not Referred Group (n=70)	χ^2	p	Power[a]
Services Cost							
High Cost	20.2%	18.2%	36.8%	10.0%			
Low Cost	79.8%	81.8%	63.2%	90.0%	16.562	.000	0.90
Medication Cost							
High Cost	20.2%	19.7%	13.2%	28.6%			
Low Cost	79.8%	80.3%	86.8%	71.4%	5.114	.078	0.32
Out-of-Pocket Cost							
High Cost	18.2%	16.7%	16.2%	24.3%			
Low Cost	81.8%	83.3%	83.8%	75.7%	2.217	.330	NC[b]
Total Health Care Cost							
High Cost	20.2%	19.7%	30.9%	11.4%			
Low Cost	79.8%	80.3%	69.1%	88.6%	8.175	.017	0.68

[a]Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b]NC - Statistical power not calculated since Cramer's V statistic was <0.10

[1]Chi-square test of independence

Study Group Comparability For The Pre-Test Year

The three study groups were not comparable for the pre-test year in terms of health services use or cost. Statistically significant differences noted, between study groups, in the likelihood of using pediatric health services were evident across all service

categories. Likewise, statistically significant differences, between study groups, in the likelihood of being classified high cost were noted for the service cost and total health care cost categories. It was interesting to note these differences given the comparability of illness intensity (beta-agonist to anti-inflammatory medication ratio) between study groups for the pre-test year.

Controlling For Differences In The Pre-Test Year

Given the significant differences noted between study groups for the pre-test year, the McNemar test was used to explore differences between the pre-test year and post-test year for each study group. Specifically, this 2 x 2 within subjects design tested differences in proportions for dependent groups (Shott, 1990; Polit, 1996). Second, pre-test year health services use or cost variables were entered as covariates in the logistic regression models, used to test the explanatory power of the Behavior Model of Utilization, to control for pre-test differences and to more accurately test program effect for the post-test year. These research results are discussed in detail in Chapter IV.

Research Hypotheses

In this research, the Behavior Model of Utilization (Phillips, et al., 1998; Aday, et al., 1998) was employed to measure the context in which pediatric asthma health services use occurred for one urban, regional managed care company. Specifically, population-related factors (patient-related factors and provider-related factors) and environment-related factors were examined. Additionally, the explanatory power of the Behavior Model of Utilization related to these factors was tested.

Both bivariate and multivariate hypotheses were tested in this study. Bivariate hypotheses examined individual relationships between population-related factors, environment-related factors, and health services use/cost. Multivariate hypotheses tested the relative contribution of patient-related and contextual factors (provider-related factors and environment-related factors) to pediatric asthma health services use/cost.

Bivariate Hypotheses

Specific bivariate hypotheses evaluated in this research included: 1) hypotheses A.1. through A.4. state expected relationships between population-related factors; 2) hypotheses B.1.a. and B.1.d. state expected relationships between environment-related factors; 3) hypotheses C.1.a. through C.1.b. state expected relationships between population-related factors and environment-related factors; 4) hypotheses D.1.a. through D.5.f. state expected relationships between population-related factors and health services use/cost; and 5) hypotheses E.1.a. through E.5.f. state expected relationships between environment-related factors and health services use/cost.

A. Hypotheses A.1. through A.4. state expected relationships between population-related factors: 1) patient-related factors; and 2) provider-related factors. Patient-related factors included predisposing characteristics and need. Provider-related factors included individual enabling and provider enabling.

Relationships Between Population-Related Factors (Specifically Patient-Related Factors: Predisposing Characteristics and Need).

Hypothesis A.1. states expected relationship between predisposing characteristics (age) and need.

A.1. Participants age four years or younger will be more likely to be classified high beta-agonist to anti-inflammatory medication ratio than participants in other age groups.

Relationships Between Population-Related Factors (Specifically Patient-Related Factors: Predisposing Characteristics and Provider-Related Factors: Individual Enabling).

Hypotheses A.2. states expected relationship between predisposing characteristics (age) and individual enabling factors (insurance benefits).

A.2. Participants four years of age or younger will be more likely to be insured by Medicaid than participants in other age groups.

Relationships Between Population-Related Factors (Specifically Patient-Related Factors: Predisposing Characteristics and Provider-Related Factors: Provider Enabling).

Hypotheses A.3. states expected relationship between predisposing characteristics (age) and provider enabling factors (primary care provider specialty).

A.3. Participants four years of age or younger will be more likely to be managed by pediatric primary care providers than participants in other age groups.

Relationship Between Population-Related Factors (Specifically Provider-related Factors: Individual Enabling and Provider Enabling).

Hypothesis A.4. states expected relationship between provider enabling factors (primary care specialty).

A.4. Pediatric primary care providers will be more likely to refer participants to the asthma management program than general practice primary care providers.

B. Hypotheses B.1.a. through B.1.d. state expected relationships between environment-related factors: 1) health care environment; and 2) external environment. Health care environment factors included availability (primary care provider office located in the neighborhood and primary care provider with late office hours located in the neighborhood). External environment included community enabling (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence).

Relationships Between Environment-Related Factors (Specifically Health Care Environment: Availability and External Environment: Community Enabling: Neighborhood Urbanicity).

Hypotheses B.1.a. and B.1.b. state expected relationships between availability (primary care provider office located in the neighborhood and primary care provider with late office hours located in the neighborhood) and community enabling factors (neighborhood urbanicity).

B.1.a. Primary care provider offices will be more likely to be located in non-urban neighborhoods than urban neighborhoods.

B.1.b. Primary care provider offices with late office hours will be more likely to be located in non-urban neighborhoods than urban neighborhoods.

Hypotheses B.1.c. and B.1.d. state expected relationships between availability (primary care provider office in the neighborhood and primary care provider with late office hours in the neighborhood) and community enabling factors (neighborhood ethnicity).

B.1.c. Primary care provider offices will be more likely to be located in predominately non-Caucasian neighborhoods than Caucasian neighborhoods.

B.1.d. Primary care provider offices with late office hours will be more likely to be located in predominately non-Caucasian neighborhoods than Caucasian neighborhoods.

C. Hypotheses C.1.a. and C.1.b. state expected relationships between population-related factors (provider-related factors) and environment-related factors (health care environment). Population-related factors included provider enabling factors (primary care provider gender and primary care provider specialty). Health care environment included organization (asthma management program).

Relationships Between Population-Related Factors (Specifically Provider-Related Factors: Primary Care Provider Gender and Primary Care Provider Specialty) and Environment-Related Factors (Specifically Health Care Environment: Asthma Management Program).

Hypothesis C.1.a. states expected relationship between primary care provider gender and the asthma management program.

C.1.a. Participants managed by female primary care providers will be more likely to enroll in the asthma management program than participants managed by male primary care providers.

Hypothesis C.1.b. states expected relationship between primary care provider specialty and the asthma management program.

C.1.b. Participants managed by pediatric primary care providers will be more likely to enroll in the asthma management program than participants managed by general practice primary care providers.

D. Hypotheses D.1.a through D.5.f. state expected relationships between population-related factors (patient-related factors and provider-related factors) and health behavior factors (health services use/cost). Patient-related factors included predisposing characteristics and need. Provider-related factors included individual enabling and provider enabling. Health services use included hospital admissions, emergency department services, primary care provider services, primary care provider high user, specialists services, and total health care cost.

Relationship Between Population-Related Factors (Specifically Patient-related Factors and Health Behavior Factors (Specifically Health Services Use).

Hypotheses D.1.a. through D.2.f. explored the relationship between patient-related factors and health services use/cost. Predisposing characteristics included age. Need included beta-agonist to anti-inflammatory medication ratio.

Relationship Between Population-Related Factors (Specifically Patient-Related Factors: Predisposing Characteristics) and Health Behavior Factors (Specifically Health Services Use).

Hypothesis D.1.a. through D.1.f. state expected relationships between predisposing factors (age) and health services use/cost.

D.1.a. Participants four years of age or younger will be more likely to be admitted to the hospital than participants in other age groups.

D.1.b. Participants four years of age or younger will be more likely to use emergency department services than participants in other age groups.

D.1.c. Participants four years of age or younger will be less likely to use primary care provider services than participants in other age groups.

D.1.d. Participants four years of age or younger will be less likely to be classified primary care provider high users than participants in other age groups.

D.1.e. Participants four years of age or younger will be less likely to use specialist services compared to participants in other age groups.

D.1.f. Participants four years of age or younger will be more likely to be classified high total health care cost than participants in other age groups.

Relationship Between Population-Related Factors (Specifically Patient-Related Factors: Need) and Health Behavior Factors (Specifically Health Services Use.

Hypotheses D.2.a. through D.2.f. state expected relationships between need (beta-agonist to anti-inflammatory medication ratio) and health services use/cost.

D.2.a. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to be admitted to the hospital than participants with a low beta-agonist to anti-inflammatory medication ratio.

D.2.b. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to use emergency department services than participants with a low beta-agonist to anti-inflammatory medication ratio.

D.2.c. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to use primary care services than participants with a low beta-agonist to anti-inflammatory medication ratio.

D.2.d. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to be classified primary care provider high users than participants with a low beta-agonist to anti-inflammatory medication ratio.

D.2.e. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to use specialist services than participants with

a low beta-agonist to anti-inflammatory medication ratio.

D.2.f. Participants with a high beta-agonist to anti-inflammatory ratio will be more likely to be classified high total health care cost than participants with a low beta-agonist to anti-inflammatory medication ratio.

Relationship Between Population-Related Factors (Specifically Provider-related Factors) and Health Behavior Factors (Specifically Health Services Use).

Hypotheses D.3.a. through D.5.f. state expected relationships between provider-related factors (individual enabling and provider enabling) and health services use/cost. Individual enabling included insurance benefits. Provider enabling included primary care provider gender and primary care provider specialty.

Relationship Between Population-Related Factors (Specifically Provider-related Factors: Individual Enabling) and Health Behavior Factors (Specifically Health Services Use).

Hypotheses D.3.a. through D.3.f. state expected relationships between individual enabling factors (insurance benefits) and health services use/cost.

D.3.a. Participants insured by Medicaid will be more likely to be admitted to the hospital than participants insured by commercial products.

D.3.b. Participants insured by Medicaid will be more likely to use emergency department services than participants insured by commercial products.

D.3.c. Participants insured by Medicaid will be less likely to use primary care provider services than participants insured by commercial products.

D.3.d. Participants insured by Medicaid will be less likely to be classified primary care provider high users than participants insured by commercial products.

D.3.e. Participants insured by Medicaid will be less likely to use specialist services than participants insured by commercial products.

D.3.f. Participants insured by Medicaid will be more likely to be classified high total health care cost than participants insured by commercial products.

Relationship Between Population-Related Factors (Specifically Provider-related Factors: Provider Enabling) and Health Behavior Factors (Specifically Health Services Use).

Hypotheses D.4.a. through D.5.f. state expected relationships between provider enabling factors (primary care provider gender and primary care provider specialty) and health services use/cost.

D.4.a. There will be no difference in the likelihood of being admitted to the hospital between participants managed by female primary care providers or participants managed by male primary care providers.

D.4.b. There will be no difference in the likelihood of using emergency department services between participants managed by female primary care providers or participants managed by male primary care providers.

D.4.c. There will be no difference in the likelihood of using primary care provider services between participants managed by female primary care providers or participants managed by male primary care providers.

D.4.d. There will be no difference in the likelihood of being classified primary care provider high user between participants managed by female primary care providers or participants managed by male primary care providers.

D.4.e. There will be no difference in the likelihood of using specialist services between participants managed by female primary care providers or participants managed by male primary care providers.

D.4.f. There will be no difference in the likelihood of being classified high total health care cost between participants managed by female primary care providers or participants managed by male primary care providers.

D.5.a. There will be no difference in the likelihood of being admitted to the hospital between participants managed by pediatric primary care providers or participants managed by general practice primary

care providers.

D.5.b. There will be no difference in the likelihood of using emergency department services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.

D.5.c. There will be no difference in the likelihood of using primary care provider services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.

D.5.d. There will be no difference in the likelihood of being classified primary care provider high users between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.

D.5.e. There will be no difference in the likelihood of using specialist services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.

D.5.f. There will be no difference in the likelihood of being classified high total health care cost between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.

E. Hypotheses E.1.a. through E.6.f. state expected relationships between environment-related factors (health care environment and external environment) and health behavior factors (health services use/cost). Health care environment included availability (primary care office located in the neighborhood and primary care office with late office hours located in the neighborhood) and organization (asthma management program). External environment included community enabling factors (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence).

Relationship Between Environment-Related Factors (Specifically Health Care Environment: Availability) and Health Behavior Factors: (Specifically Health Services Use).

Hypotheses E.1.a. through E.2.f. state expected relationships between health care environment (availability) and health services use/cost.

E.1.a. Participants will be more likely to be admitted to the hospital when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.

E.1.b. Participants will be more likely to use emergency department services when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.

E.1.c. Participants will be more likely to use primary care provider services when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.

E.1.d. Participants will be more likely to be classified primary care provider high users when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.

E.1.e. There will be no difference in the likelihood of using specialist services between participants with their primary care provider office located in their neighborhood or participants without their primary care provider office located in their neighborhood.

E.1.f. Participants will be more likely to be classified high total health cost than when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.

E.2.a. Participants will be more likely to be admitted to the hospital when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.

E.2.b. Participants will be more likely to use emergency department services when their primary care provider office, offering late hours, is located in their neighborhood compared to other

participants.

E.2.c. Participants will be more likely to use primary care provider services when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.

E.2.d. Participants will be more likely to be classified primary care provider high users when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.

E.2.e. There will be no difference in the likelihood of using specialist services between participants with their primary care provider offices, offering late office hours, located in their neighborhood compared to other participants.

E.2.f. Participants will be more likely to be classified high total health care cost when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.

Relationship Between Environment-Related Factors (Specifically Health Care Environment: Organization) and Health Behavior Factors: (Specifically Health Services Use).

Hypotheses E.3.a. through E.3.f. state expected relationships between health care environment (organization) and health services use/cost. Organization

included the asthma management program.

E.3.a. Participants enrolled in the asthma management program will be less likely to be admitted to the hospital than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

E.3.b. Participants enrolled in the asthma management program will be less likely to use emergency department services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

E.3.c. Participants enrolled in the asthma management program will be less likely to use primary care provider services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

E.3.d. Participants enrolled in the asthma management program will be less likely to be classified primary care provider high users than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

E.3.e. Participants enrolled in the asthma management program will be less likely to use specialist services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

E.3.f. Participants enrolled in the asthma management program will be less likely to be classified high total health care cost than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.

Relationship Between Environment-Related Factors (Specifically External Environment) and Health Behavior Factors (Specifically Health Services Use).

Hypotheses E.4.a. through E.6.f. state expected relationships between external environment factors (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence) and health services use/cost.

E.4.a. Participants residing in urban neighborhoods will be more likely to be admitted to the hospital than participants residing in non-urban neighborhoods.

E.4.b. Participants residing in urban neighborhoods will be more likely to use emergency department services than participants residing in non-urban neighborhoods.

E.4.c. Participants residing in urban neighborhoods will be less likely to use primary care provider services than participants residing in non-urban neighborhoods.

E.4.d. Participants residing in urban neighborhoods will be less likely to be classified primary care provider high users than participants residing in non-urban neighborhoods.

E.4.e. Participants residing in urban neighborhoods will be less likely to use specialist services than participants residing in non-urban neighborhoods.

E.4.f. Participants residing in urban neighborhoods will be more likely to be classified high total health care cost than participants residing in non-urban neighborhoods.

E.5.a. Participants residing in predominately non-Caucasian neighborhoods will be more likely to be admitted to the hospital than participants residing in predominately Caucasian neighborhoods.

E.5.b. Participants residing in predominately non-Caucasian neighborhoods will be more likely to use emergency department services than participants residing in predominately Caucasian neighborhoods.

E.5.c. Participants residing in predominately non-Caucasian neighborhoods will be less likely to use primary care provider services than participants residing in predominately Caucasian neighborhoods.

E.5.d. Participants residing in predominately non-Caucasian neighborhoods will be less likely to be classified primary care provider high users than participants residing in predominately Caucasian neighborhoods.

E.5.e. Participants residing in predominately non-Caucasian neighborhoods will be less likely to use specialist services than participants residing in predominately Caucasian neighborhoods.

E.5.f. Participants residing in predominately non-Caucasian neighborhoods will be more likely to be classified high total health care cost than participants residing in predominately Caucasian neighborhoods.

E.6.a. Participants residing in low-income neighborhoods will be more likely to be admitted to the hospital than participants residing in non low-income neighborhoods.

E.6.b. Participants residing in low-income neighborhoods will be more likely to use emergency department services than participants residing in non low-income neighborhoods.

E.6.c. Participants residing in low-income neighborhoods will be less likely to use primary care provider services than participants residing in non low-income neighborhoods.

E.6.d. Participants residing in low-income neighborhoods will be less likely to be classified primary care provider high users than participants residing in non low-income neighborhoods.

E.6.e. Participants residing in low-income neighborhoods will be less likely to use specialist services than participants residing in non low-income neighborhoods.

E.6.f. Participants residing in low-income neighborhoods will be more likely to be classified high total health care cost than participants residing in non low-income neighborhoods.

Multivariate Hypotheses

Specific multivariate hypotheses tested in this research included: 1) hypotheses F.1. through F.2.a. state expected relationships between patient-related factors and health services use/cost; 2) hypotheses G.1. through G.2.a. state expected relationships between population-related factors and health services use/cost; 3) hypotheses H.1. through H.2.a. state expected relationships between population-related factors, external environment factors, and health services use/cost; and 4) hypotheses I.1. through I.2.a. state expected relationships between population-related factors, environment-related factors, and health services use/cost.

F. Patient-related factors are expected to interact to influence health services use. Hypotheses F.1. through F.2.a. state expected relationship between patient-related factors and health services use/cost (health services use/cost = age + gender + need + pre-test year measure).

F.1. When patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory medication ratio will be predictive of health services use, when controlling for pre-test year health services use.

F.1.a. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be

more likely to be admitted to the hospital, when controlling for pre-test year hospital admission.

F.1.b. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.

F.1.c. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.

F.1.d. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.

F.1.e. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use specialist services, when controlling for pre-test year specialist services use.

F.2. When patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory medication ratio will be predictive of health services cost, when controlling for pre-test year total health care cost.

F.2.a. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.

G. Population-related factors are expected to interact to influence health services use. Hypotheses G.1. through G.2.a. state expected relationship between patient-related factors, provider-related factors and health services use/cost (health services use/cost = age + participant gender + need + insurance benefit + primary care provider gender + primary care provider specialty + pre-test year measure).

G.1. When patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, and primary care provider specialty will all be predictive of health services use, when controlling for pre-test year health services use.

G.1.a. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admissions.

G.1.b. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to

use emergency department services, when controlling for pre-test year emergency department services use.

G.1.c. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.

G.1.d. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.

G.1.e. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to use specialist services, when controlling for pre-test year specialist services use.

G.2. When patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, and primary care provider specialty will all be predictive of health services cost, when controlling for pre-test year total health care cost.

G.2.a. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.

H. Population-related factors and environment-related factors (external environment) are expected to interact to influence health services use/cost. Hypotheses H.1. through H.2.a. state expected relationships between population-related factors, external environment, and health services use/cost (health services use/cost = age + participant gender + need + insurance benefit + primary care provider gender + primary care provider specialty + neighborhood urbanicity + neighborhood ethnicity + neighborhood affluence + pre-test year measure).

H.1. When population-related factors and external environment factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test year health services use.

H.1.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods will be more likely to be admitted to the hospital, when controlling for pre-test year hospital

admission.

H.1.b. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.

H.1.c. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.

H.1.d. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.

H.1.e. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in

predominately urban neighborhoods will be more likely to use specialist services, when controlling for pre-test year specialist services use.

H.2. When population-related factors and external environment factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of health services cost, when controlling for pre-test year total health care cost.

H.2.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.

I. Population-related factors and environment-related factors are expected to interact to influence health services use/cost. Hypotheses I.1. through I.2.a. state expected relationships between population-related factors, environment-related factors, and health services use/cost (health services use/cost = age + gender + need + insurance benefit + primary care provider gender + primary care specialty + availability + asthma management program + neighborhood urbanicity + neighborhood ethnicity + neighborhood affluence + pre-test year measure).

I.1. When population-related factors and environment-related factors are considered together in one model, participant age, beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, asthma management program, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test year health services use.

I.1.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admissions.

I.1.b. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.

I.1.c. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the

asthma management program and/or reside in urban neighborhoods will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.

I.1.d. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.

I.1.e. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to use specialist services, when controlling for pre-test year specialist services use.

I.2. When population-related factors and environment-related factors are considered together in one model, participant age, beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, asthma management program and neighborhood urbanicity will all be predictive of health services cost, when controlling for pre-test year total health care

cost.

I.2.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be classified high total health care cost, when controlling for pre-test year total heath care cost.

Statistical Tests

In this research, descriptive and inferential statistics were calculated for the sample population with respect to population-related factors, environment-related factors, and behavior-related factors. Population-related factors included patient-related factors and provider-related factors. Environment-related factors included health care environment and external environment. Health behavior factors included health services use.

Hypotheses of Difference

Differences in health services use between the pre-test year and the post-test year for each study group were tested. Additionally, differences in health services use between study groups were tested for the post-test year. In this research, neither health services use nor health services cost data were normally distributed. To minimize risks associated with Type I errors, non-parametric techniques were used to test hypotheses of difference (Shott, 1990; Polio, 1996). By definition, non-parametric tests do not make assumptions about the sampled population (Daniel, 1983). Consequently, they are often

referred to as distribution-free procedures.

McNemar Test. The McNemar test was used to test differences in health services use between the pre-test year and the post-test year for each of the study groups (enrolled group, declined group, or not referred group). Specifically, this 2 x 2 within-subjects design tested differences in proportions for dependent groups (Shott, 1990; Polit, 1996). The null hypothesis tested the notion that pre-test year to post-test year differences in health services use or cost were not statistically significant. The continuity corrected chi-square distribution was used when the sample size was large. The binomial distribution was used when the sample size was small. There was one degree of freedom when using the McNemar test.

Chi-square Test Of Independence. The chi-square test of independence was used to test hypotheses of difference between study groups for both 12 month time periods: 1) the pre-test year; and 2) the post-test year (Shott, 1990; Polit, 1996). Chi-square tests contrast the observed frequencies in each contingency table cell with the expected frequencies. Observed frequencies are the frequencies observed within the actual data set. Expected frequencies are the number of cases that would be found in each contingency table cell if the null hypothesis were true; that is, if the two categorical variables were unrelated.

The chi-square test of independence was used to test between group differences when both the independent and dependent variables were measured on a nominal scale (Shott, 1990; Polit, 1996). Each study participant qualified for only one cell of the contingency table. The chi-square test does not make assumptions about the shape of the

distribution or homogeneity of variance. However, the expected frequency of each cell must be greater than 0. With 2 x 2 contingency tables, the expected cell frequency should be at least five. In this study, the strength of the relationship was measured with the phi coefficient in a 2 x 2 table. The phi coefficient, ranging from 0 to 1, is interpreted as a Pearson r. Specifically, the larger the value, the stronger the relationship between the two variables. The Cramer's V statistic was calculated when the contingency table was larger than 2 x 2. The Cramer's V statistic was also used to estimate effect size.

Direct comparison of groups is possible when the chi-square produces a 2 x 2 contingency table. When contingency tables are greater than 2 x 2, post-hoc tests, using multiple chi-square tests, must be used to determine which groups differ significantly. In this research, the overall alpha was adjusted by the Bonferroni inequality when multiple chi-squares were used, to minimize the risk of Type I errors. Specifically, the overall alpha level was adjusted for the number of tests in the analysis. In this study, the adjusted alpha (0.017) for each separate chi-square was calculated as the overall alpha (0.05) divided by the number of tests (3).

Power tables, specific to chi-square analysis, were used to determine statistical power for each test. According to Cohen (1988), statistical power for the chi-square can be determined when the overall sample size is specified together with the degrees of freedom, the alpha level, and the effect size. Once these four factors are known, the tables yield the power value. Degrees of freedom are calculated by multiplying the number of rows minus one times the number of columns minus 1 ($[R_{ow}-1][C_{olumn}-1]$).

Effect size is determined by the Cramer's V statistic calculated for the sample.

Hypotheses of Association

In this study, hypotheses of association were tested using non-parametric procedures. Specifically, logistic regression procedures were used to test hypotheses of association because the dependent variables were dichotomous (Shott, 1990; Polit, 1996; Hair et al., 1995). Logistic regression is similar to multiple regression in that relationships between multiple independent variables and a single dependent variable are analyzed to yield a prediction equation. Logistic regression is based on an estimation procedure that has less restrictive assumptions than multiple linear regression and does not assume multivariate normality. According to Polit (1996), logistic regression is generally a more statistically appropriate method since multivariate normality is usually unrealistic.

Logit analysis assumes a relationship between the independent variable and the dependent variable that resembles an S curve (Hair, et al., 1995). The dependent variable can be any value between 0 and 1, with the predicted value bounded to fall between 0 and 1. The probability approaches 0 at very low levels of the independent variable but does not exceed 0. The probability increases up the curve as the independent variable increases. However, the slope decreases so that the probability does not exceed 1, at any level of the independent variable.

In this research, the enter method for variable selection was used for each logistic regression model (Polit, 1996). Specifically, all selected variables were entered in the model in a single step. Tolerance, or multicollinearity, constituted the entry criteria.

Tolerance was used to determine the degree to which independent variables were linearly related to one another. Multicollinearity was also assessed prior to model construction using chi-square analysis. Pre-test year variables were entered in the model to control for study group differences, given the lack of group comparability in health services use/cost noted for the pre-test year.

Logistic regression predicts the estimate of the probability that the event will occur or will not occur from the dependent, dichotomous variable. In this research, logistic regression techniques were used to estimate parameters based on the maximum likelihood method; the ones that are most likely to generate the observed data (Shott, 1990; Polit, 1996; Hair et al., 1995). The regression generates models for estimating the probability that an event occurred and transforms the probability into its odds. The odds of an event occurring are defined as a ratio: the probability of the event occurring to the probability of the event not occurring. The dependent variable is transformed to be the natural log of the odds (logit). Finally, the maximum likelihood is used to estimate the coefficients of the independent variables with the logit as a continuous dependent variable.

In this research, the estimate coefficients were used to measure changes in the ratio of probabilities or the odds ratio (Hair, et al., 1995). Estimated coefficients were expressed in logarithms and transformed back (antilog) to more easily assess their relative effect on the probabilities. A positive coefficient increased the odds ratio while a negative coefficient decreased the predicted probability. For example, the odds ratio increases when the estimated coefficient is positive because the transformation, or

antilog, will be greater than 1. The odds ratio decreases when the estimated coefficient is negative since the antilog will be less than 1. There is no change in the odds ratio when the estimated coefficient is equal to zero.

The estimated coefficients represent a nonlinear relationship among independent and dependent variables (Hair et al., 1995). The transformation process (taking the logarithm) provides linearization of the relationship. However, the coefficients represent different slopes in the relationship across values of the independent variable. As a result, the S-shaped distribution is estimated. Logit analysis tests the hypothesis that the estimated coefficient is not zero by calculating the Wald statistic. Statistical significance is provided for each estimated coefficient to enable hypothesis testing.

Logit regression maximizes the likelihood of an event occurring to test the goodness-of-fit for the estimated model (Hair et al., 1995). The likelihood value is the overall measure of how well the model fits the data. This measure is referred to as -2LL (-2 times the log of the likelihood value). Small values for -2LL are indicative of a well-fit model. Specifically, a perfect fit has a likelihood of 1 with a -2LL of zero. The chi-square test is used to test for the reduction of the log likelihood value.

Model fit can also be assessed by creating a classification matrix with respect to the dependent variable (Polit, 1996). Specifically, each participant's probability is computed using the regression equation. Actual events (occurring or not) are compared to predicted events (occurring or not) to determine how may events were predicted correctly as well as where incorrect predictions occurred. Probabilities of classification must be specified when creating a classification matrix (Hair et al., 1995). Specifically,

it must be determined whether the observed group sizes reflect actual population proportions or should be assumed to be equal. The conservative assumption is one of equal probabilities. In this research, the assumption of equal probabilities (each event had an equal chance of occurring) was used to determine the cutting score. Specifically, the case was classified as positive when the probability of the event was greater than 0.50. The case was classified as negative when the probability of the event was less than 0.50. Use of equal probabilities may have under estimated the predictive accuracy of the model in this research. However, the assumption of equal probabilities was necessary since it was unknown whether the observed proportions in the sample were representative of the population proportions.

The R statistic, ranging from -1.00 to +1.00, is used to interpret the magnitude of contribution for individual predictor variables (Polit, 1996). This statistic is an index of the partial correlation between each predictor variable and the dependent variable. When the R statistic is greater than zero, increases in the variable increases the likelihood that the event will occur. When the R statistic is negative, increases in the variable decrease the likelihood that the event will occur. Larger contributions to the model are associated with larger absolute values of R.

Test Of Statistical Significance

A one-tailed test for statistical significance (alpha) was used to determine the probability distribution corresponding to rejection of the null hypothesis for directional hypotheses (Shott, 1990; Polit, 1996). Two-tailed test for statistical significance was used when non-directional hypotheses were tested. Alpha levels were established a

priori at 0.05. Risk of Type II errors were assessed using power analysis for each statistical procedure employed. In this research, statistical power was influenced by effect size, sample size, and the alpha level. According to Cohen (1988), power, criterion significance (alpha), effect size, and sample size are so related that one is a function of the other three. Therefore, when three of the components are fixed, the fourth can be determined. In this study, power tables were used to determine power values for the Chi-square test of independence. Cohen (1998) indicated that power tables find their major use after experiments have been conducted. Statistical power of 0.80 was preferred for each statistical technique used. Study results should be interpreted with caution when statistical power was less than 0.80.

CHAPTER IV: RESULTS

Introduction

Presentation of research results are organized under pertinent constructs of the Behavior Model for Utilization. Phillips and colleagues (1998) identified two broad categories of factors that impact the dependent variable, health services use: 1) population-related factors; and 2) environment-related factors. Population-related factors include patient-related factors (predisposing characteristics and need) and provider-related factors (individual enabling and provider enabling). Environment-related factors include health care environment (availability and organization) and external environment (neighborhood urbanicity, neighborhood ethnicity, and neighborhood affluence).

Following examination of the dependent variable, health services use/cost, the discussion focuses on the independent variables described by Phillips and colleagues (1998). Specifically, the bivariate and multivariate hypotheses identified in Chapter III are tested to determine if the research findings support them. First, relationships between each of the independent variables and dependent variable are explored. Second, relationships among the independent variables are examined.

Dependent Variable: Health Services Use/Cost

In this research, health services use was measured by the following variables: 1) the likelihood of being admitted to the hospital; 2) emergency department services use; 3) primary care provider services use; 4) provider care provider volume; 5) specialist services use; and 6) home health services use (Table 13). Health services cost was

measured by the likelihood of being classified high services cost, high medication cost, high out-of-pocket cost or high total health care cost (Table 14).

Health Services Use: Post-Test Year

Approximately 23 percent (n=79) of study participants were admitted to the hospital during the post-test year (Table 13). Of those who were admitted, the average number of hospital admissions was 1.8 (s.d.=1.6 admissions). Inpatient days per participant averaged 3.9 days (s.d. = 4.4 days). Approximately 40 percent (n=138) of study participants used emergency department services during the post-test year (Table 13). Of those who used services, the average number of emergency department visits was 1.8 (s.d. = 1.3 visits). Eighty-six percent (n=119) of study participants had two or less emergency department visits during the post-test year.

Approximately 70 percent (n=239) of study participants used primary care provider services during the post-test year (Table 13). Of those who used services, the average number of primary care provider visits was 5.2 (s.d. = 6.3 visits). About 90 percent of study participants used primary care provider services once during the post-test year. Overall, only 23.2% of study participants were classified as primary care provider high users during the post-test year.

Approximately 45 percent (n=155) of study participants used specialist services during the post-test year (Table 13). Of those who used services, the average number of specialist visits was 4.0 (s.d. = 4.5 visits). About 92 percent (n=143) of these participants used specialists services once during the post-test year. Approximately 42 percent of study participants used home health services during the post-test year. Of those who

used services, the average number of home health visits was 2.0 (s.d. = 1.8 visits). Over 90 percent (n=179) of these participants had three or less home health visits during the post-test year. In this study, analysis of home health services was used as a quality check for the asthma management program and was not included in subsequent analyses.

Table 13

Health Services Use: Post-Test Year

Health Services Use	n	Percent
Hospital Admissions		
Admitted	79	23.2%
Not Admitted	262	76.8%
ED Services		
Services Used	138	40.5%
Services Not Used	203	59.5%
PCP Services		
Services Used	239	70.1%
Services Not Used	102	29.9%
PCP Services Volume		
High Volume User	79	23.2%
Low Volume User	262	76.8%
Specialist Services		
Services Used	155	45.5%
Services Not Used	186	54.5%
Home Health Services		
Services Used	143	41.9%
Services Not Used	198	58.1%

Health Services Cost

Services cost averaged $1,897 (s.d.=$3,398) with a median cost of $821 (Table 14). The interquartile range for services cost was between $490 and $2,008. Medication cost averaged $328 (s.d.=$490) with a median cost of $136. The interquartile range for medication cost was between $50 and $376. Out-of-pocket cost averaged $45 (s.d.=$142)

with a median cost of $0. The interquartile range calculated for out-of-pocket cost was also $0.

In this study, total health care cost included both cost to the managed care company and participants' guarantors. Average total health care cost was $2,399 (s.d.=$5,069) with a median cost of $1,082. The interquartile range was between $589 and $2,560. Given the similarities noted in the cost categories (Table 14), total health care cost was used to determine if research findings support the bivariate and multivariate hypotheses.

Table 14

Health Services Cost: Post-Test Year

Health Services Cost	n	Percent
Services Cost		
High Cost	69	20.2%
Low Cost	272	79.8%
Medication Cost		
High Cost	68	19.9%
Low Cost	273	80.1%
Out-of-Pocket Cost		
High Cost	68	19.9%
Low Cost	273	80.1%
Total Health Care Cost		
High Cost	70	20.5%
Low Cost	271	79.5%

Research Hypotheses: Bivariate Relationships

In the following section, the bivariate research hypotheses identified in Chapter III are discussed. Bivariate hypotheses tested relationships between population-related factors, environment-related factors, and the dependent variable, health services use.

The chi-square test for independence was used to test differences between study groups (Polit, 1996). Direct comparison between study groups was possible when the chi-square produced a 2 x 2 contingency table. When contingency tables were greater than 2 x 2, post-hoc tests, using multiple chi-squares, were used to determine which groups differed significantly.

The overall alpha was adjusted by the Bonferroni inequality when multiple chi-square tests were used, minimizing the risk of a Type I error (Hair, et al., 1995). Specifically, the adjusted alpha level for each separate chi-square test was defined as the overall alpha divided by the number of tests in the analysis. In this research, the adjusted alpha (0.017) for each separate chi-square test was determined by dividing the overall alpha (0.05) by the number of tests (3) in the analysis. To minimize the risk of a Type II error, statistical power was calculated for each bivariate analysis using the Cramer's V statistic (Polit, 1996; Cohen, 1988).

Population-Related Factors

Bivariate relationships between the seven population-related variables were tested using chi-square tests of independence. Research results for hypotheses A.1. through A.3. are presented in Table 15.

Hypothesis A.1. A statistically significant difference in beta-agonist to anti-inflammatory medication ratio was noted between participant age groups (χ^2=9.397, p= .009). Participants in the 5 years to 11 years age group were significantly less likely to be classified high beta-agonist to anti-inflammatory medication ratio compared to participants 12 years of age or older (χ^2=7.791, p=.005). The likelihood of being

classified high beta-agonist to anti-inflammatory medication ratio was comparable between participants four years of age or younger and participants in the 5 years to 11 years age group (χ^2=5.353, p=0.021) or participants 12 years of age or older (χ^2=0.161, p =0.689). It was hypothesized that participants four years of age or younger would be more likely to be classified high beta-agonist to anti-inflammatory medication ratio. *This research does not support the hypothesis.*

Hypothesis A.2. A statistically significant difference was noted when testing the relationship between participant age group and insurance benefit (χ^2=9.156, p=.010). Participants four years of age or younger were significantly more likely to be insured by Medicaid compared to participants in the 5 years to 11 years age group (χ^2=5.654, p=0.017) or participants 12 years of age or older (χ^2=9.107, p=0.003). Differences noted in insurance benefit between participants in the 5 years to 11 years age group and participants 12 years of age or older were not statistically significant (χ^2=0.971, p=0.324). It was hypothesized that participants four years of age or younger would be more likely to be insured by Medicaid than participants in other age groups. *This research supports the hypothesis.*

Hypothesis A.3. A statistically significant difference in primary care provider specialty was noted between participant age groups (χ^2=15.978, p=.000). Participants 12 years of age or older were significantly less like to be managed by pediatric primary care providers compared to participants four years of age or younger (χ^2=9.591, p=0.002) or participants in the 5 years to 11 years age group (χ^2=11.732, p=0.001). Differences noted in primary care provider specialty between participants four years of age or

younger and participants in the 5 years to 11 years age group were not statistically significant (χ^2=0.087, p=0.768). It was hypothesized that participants four years of age or younger would be managed by pediatric primary care providers more often than participants in other age groups. *This research does not support the hypothesis.*

Table 15

Relationships Between Population-Related Factors
(Specifically, Patient-Related Factors and Provider-Related Factors)

	Member Age Group					
Dependent Variable	0-4 Years (n=90)	5-11 Years (n=158)	12-18 Years (n=93)	χ^2	p	Power[a]
BA Ratio[b][1]						
High	42.2%	27.8%	45.2%			
Low	57.8%	72.2%	54.8%	9.397	.009	.92
Insurance Benefit[1]						
Commercial	11.1%	23.4%	29.0%			
Medicaid	88.9%	76.6%	71.0%	9.156	.010	.93
PCP Specialty[1]						
General Practice	7.8%	8.9%	24.7%			
Pediatrics	92.2%	91.1%	75.3%	15.978	.000	.96

[a] Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b] Beta-agonist to anti-inflammatory ratio

[1] Chi-square test of independence

Hypothesis A.4. A statistically significant difference in primary care provider referral was noted between primary care provider specialty groups (χ^2=3.947, p=.047). Participants managed by pediatric primary care providers were significantly more likely to be referred to the asthma management program compared to participants managed by general practice primary care providers. It was hypothesized that pediatric primary care providers would refer study participants to the asthma management program more often than general practice primary care providers. *This research supports the hypothesis.*

Environment-Related Factors

Study findings for hypotheses B.1.a. through B.1.d. are presented in Table 16.

Hypothesis B.1.a. A statistically significant difference in the likelihood of primary care provider offices located in the neighborhood was noted between urbanicity groups (χ^2=4.390, p=.036). Non-urban neighborhoods were significantly more likely to have primary care provider offices compared to urban neighborhoods. It was hypothesized that primary care provider offices would be located in non-urban neighborhoods more often than urban neighborhoods. *This research supports the hypothesis.*

Hypothesis B.1.b. Differences noted, between urbanicity groups, in the likelihood of primary care provider offices, with late office hours, located in the neighborhood were not statistically significant (χ^2=2.018, p=.155). It was hypothesized that primary care provider offices with late office hours would be located in non-urban neighborhoods more often than urban neighborhoods. *This research does not support the hypothesis.*

Hypothesis B.1.c. A statistically significant difference in the likelihood of primary care provider offices located in the neighborhood was noted between ethnicity groups (χ^2=6.850, p=.009). Non-Caucasian neighborhoods were significantly more likely to have primary care provider offices compared to Caucasian neighborhoods. It was hypothesized that primary care provider offices would be located in predominately non-Caucasian neighborhoods more often than Caucasian neighborhoods. *This research supports the hypothesis.*

Table 16

Relationships Between Environment-Related Factors
(Specifically, Health Care Environment and Community Enabling)

Dependent Variable	Neighborhood Urbanicity: Non-Urban (n=93)	Urban (n=242)	χ^2	p	Power[a]
PCP Located in Neighborhood[1]					
No	78.5%	87.6%			
Yes	21.5%	12.4%	4.390	.036	.46
Dependent Variable	**Neighborhood Ethnicity: Non-Caucasian (n=140)**	**Caucasian (n=200)**	**χ^2**	**p**	**Power[a]**
PCP Located in Neighborhood[1]					
No	79.3%	89.5%			
Yes	20.7%	10.5%	6.850	.009	.71

[a] Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b]NC - Statistical power not calculated since Cramer's V statistic was < 0.10

[1] Chi-square test of independence

Hypothesis B.1.d. Differences noted, between ethnicity groups, in the likelihood of primary care provider offices, with late office hours, located in the neighborhood were not statistically significant (χ^2=1.305, p=.253). It was hypothesized that primary care provider offices with late office hours would be located in non-Caucasian neighborhoods more often than Caucasian neighborhoods. *This research does not support the hypothesis.*

Population-Related Factors And Environment-Related Factors

Hypothesis C.1.a. A statistically significant difference in the likelihood of study participants being enrolled in the asthma management program was noted between primary care provider gender groups (χ^2=3.765, p=.050). Participants managed by

female primary care providers were significantly more likely to be enrolled in the asthma management program compared to participants managed by male primary care providers. It was hypothesized that study participants managed by female primary care providers would be more likely to enroll in the asthma management program than participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis C.1.b. Differences noted, between primary care provider specialty groups, in the percentage of study participants enrolled in the asthma management program were not statistically significant (χ^2=0.353, p=.552). It was hypothesized that participants managed by pediatric primary care providers would be more likely to enroll in the asthma management program than participants managed by general practice primary care providers. *This research does not support the hypothesis.*

Bivariate Relationships Between Population-Related Factors And The Dependent Variable

Patient-Related Factors: Age and Health Services Use/Cost

Study findings for hypotheses D.1.a. through D.1.f. are presented in Table 17.

Hypothesis D.1.a. A statistically significant difference in the likelihood of being admitted to the hospital was noted between participant age groups (χ^2=11.179, p=.004). Participants 12 years of age or older were significantly more likely to be admitted to the hospital compared to participants four years or younger (χ^2=8.370, p=0.004) or participants in the 5 years to 11 years age group (χ^2=7.755, p=0.005). Differences noted in the likelihood of being admitted to the hospital between participants four years of age or younger and participants in the 5 years to 11 years age group were not statistically

significant (χ^2=0.331, p=0.565). It was hypothesized that participants four years of age or younger would be more likely to be admitted to the hospital than participants in other age groups. *This research does not support the hypothesis.* The results indicate the opposite is true (e.g. older children were more likely to be admitted to the hospital than younger children).

Table 17

Relationships Between Patient-Related Factors:
Predisposing Characteristics (Age) and the Dependent Variable

Health Services Use Outcomes[1]	0 to 4 Years (n=90)	5 to 11 Years (n=158)	12 to 18 Years (n=93)	χ^2	p	Power[a]
Hospital Admissions						
Admitted	16.7%	19.6%	35.5%			
Not Admitted	83.3%	80.4%	64.5%	11.179	.004	0.84
ED Services						
Services Used	35.6%	36.1%	52.7%			
Services Not Used	64.4%	63.9%	47.3%	7.931	.019	0.71
PCP Services						
Services Used	65.6%	69.9%	75.3%			
Services Not Used	34.4%	30.4%	24.7%	2.089	.352	NC[b]
PCP Services Volume						
High User	14.4%	20.3%	36.6%			
Low User	85.6%	79.7%	63.4%	13.971	.001	0.96
Specialist Services						
Services Used	37.8%	42.4%	58.1%			
Services Not Used	62.2%	57.6%	41.9%	8.696	.013	0.72
Total Health Care Cost						
High Cost	11.1%	17.1%	35.5%			
Low Cost	88.9%	82.9%	64.5%	18.789	.000	0.99

[a]Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b]NC - Statistical power not calculated since Cramer's V statistic was <0.10

[1]Chi-square test of independence

Hypothesis D.1.b. A statistically significant difference in the likelihood of emergency department services use was noted between participant age groups (χ^2=7.931, p=.019). Participants 12 years of age or older were significantly more likely to use emergency department services than participants in the 5 years to 11 years age group (χ^2 =6.622, p=0.010). Differences noted in the likelihood of emergency department use between participants 12 years of age or older and participants four years of age or younger were not statistically significant (χ^2=5.442, p=0.020). Likewise differences in the likelihood of emergency department use between participants four years of age or younger and participants in the 5 years to 11 years age group were not statistically significant (χ^2=0.007, p=0.935). It was hypothesized that participants four years of age or younger would be more likely to use emergency department services than participants in other age groups. *This research does not support the hypothesis.* The results indicate the opposite is true (e.g. older children were more likely to use emergency department services than younger children).

Hypothesis D.1.c. Differences noted, between participant age groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=2.089, p=.352). It was hypothesized that participants four years of age or younger would be less likely to use primary care provider services. *This research does not support the hypothesis.*

Hypothesis D.1.d. A statistically significant difference in the likelihood of being classified primary care provider high user was noted between participant age groups (χ^2=13.971, p=.001). Participants 12 years of age or older were significantly more likely

to be classified primary care provider high users compared to participants four years of age or younger (χ^2=11.719, p=0.001) or participants in the 5 years to 11 years age group (χ^2=8.031, p=0.005). Differences in the likelihood of being classified primary care provider high users between participants four years of age or younger and participants in the 5 years to 11 years age group were not statistically significant (χ^2=1.303, p=0.254). It was hypothesized that participants four years of age or younger would be less likely to be classified primary care provider high users. *This research does not support the hypothesis.* The results indicate the opposite is true (e.g. older children were more likely to be classified primary care provider high user than younger children).

Hypothesis D.1.e. A statistically significant difference in the likelihood of using specialist services was noted between participant age groups (χ^2=8.696, p=.013). Participants 12 years of age or older were significantly more likely to use specialist services compared to participants four years of age or younger (χ^2=7.540, p=0.006) or participants in the 5 years to 11 years age group (χ^2=5.750, p=0.016). Differences noted in the likelihood of using specialist services between participants four years of age or younger and participants in the 5 years to 11 years age group were not statistically significant (χ^2=0.509, p=0.476). It was hypothesized that participants four years of age or younger would be less likely to use specialist services compared to other age groups. *This research does not support the hypothesis.* The results indicate the opposite is true (e.g. older children were more likely to use specialist services than younger children).

Hypothesis D.1.f. A statistically significant difference in the likelihood of being classified high total health care cost was noted between participant age groups

(χ^2=18.789, p=.000). Participants 12 years of age or older were significantly more likely to be classified high total health care cost compared to participants four years of age or younger (χ^2=15.114, p=0.000) or participants in the 5 years to 11 years age group (χ^2=10.890, p=0.001). Differences noted in the likelihood of being classified high total health care cost between participants four years of age or younger and participants in the 5 years to 11 years age group were not statistically significant (χ^2=1.614, p=0.204). It was hypothesized that participants four years of age or younger would be more likely to be classified high total health care cost compared to other age groups. *This research does not support the hypothesis.* The results indicate the opposite is true (e.g. older children were more likely to be classified high total health care cost than younger children).

Patient-Related Factors: Need and Health Services Use/Cost

Study findings for hypotheses D.2.a. through D.2.f. are presented in Table 18.

Hypothesis D.2.a. A statistically significant difference in the likelihood of being admitted to the hospital was noted between participant need groups (χ^2=9.047, p=.002). Participants with a high beta-agonist to anti-inflammatory medication ratio were significantly more likely to be admitted to the hospital than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory medication ratio would be more likely to be admitted to the hospital than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Hypothesis D.2.b. A statistically significant difference in the likelihood of using emergency department services was noted between participant need groups (χ^2=8.643, p=.002). Participants with a high beta-agonist to anti-inflammatory medication ratio were significantly more likely to use emergency department services than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory medication ratio would be more likely to use emergency department services than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Hypothesis D.2.c. A statistically significant difference in the likelihood of using primary care provider services was noted between participant need groups (χ^2=7.436, p=.006). Participants with a high beta-agonist to anti-inflammatory medication ratio were significantly more likely to use primary care provider services than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory medication ratio would be more likely to use primary care provider services than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Hypothesis D.2.d. A statistically significant difference in the likelihood of being classified primary care provider high users was noted between participant need groups (χ^2=6.122, p=.010). Participants with a high beta-agonist to anti-inflammatory medication ratio were significantly more likely to be classified primary care provider high users than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory

medication ratio would be more likely to be classified primary care provider high users than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Table 18

Relationships Between Patient Related Factors: Need (Beta-Agonist to Anti-inflammatory Medication Ratio) and the Dependent Variable

Health Services Use Outcomes[1]	Low BA Ratio[b] (n=217)	High BA Ratio[b] (n=124)	χ^2	p	Power[a]
Hospital Admissions					
Admitted	18.0%	32.3%			
Not Admitted	82.0%	67.7%	9.047	.002	0.72
ED Services					
Services Used	34.6%	50.8%			
Services Not Used	65.4%	49.2%	8.643	.002	0.71
PCP Services					
Services Used	65.0%	79.0%			
Services Not Used	35.0%	21.0%	7.436	.006	0.65
PCP Services Volume					
High User	18.9%	30.6%			
Low User	64.5%	69.4%	6.122	.010	0.57
Specialist Services					
Services Used	35.9%	62.1%			
Services Not Used	64.1%	37.9%	21.767	.000	0.99
Total Health Care Cost					
High Cost	17.5%	25.8%			
Low Cost	82.5%	74.2%	3.328	.047	0.41

[a]Cramer's V statistic used to calculate statistical power (Cohen, 1988)
[b]BA Ratio - Beta-agonist to anti-inflammatory medication ratio

[1]Chi-square test of independence

Hypothesis D.2.e. A statistically significant difference in the likelihood of using specialist services was noted between participant need groups (χ^2=21.767, p=.000). Participants with a high beta-agonist to anti-inflammatory medication ratio were

significantly more likely to use specialist services than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory medication ratio would be more likely to use specialist services than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Hypothesis D.2.f. A statistically significant difference in the likelihood of being classified high total health care cost was noted between participant need groups (χ^2=3.328, p=.047). Participants with a high beta-agonist to anti-inflammatory medication ratio were significantly more likely to be classified high total health care cost than participants with a low beta-agonist to anti-inflammatory medication ratio. It was hypothesized that participants with a high beta-agonist to anti-inflammatory medication ratio would be more likely to be classified high total health care cost than participants with a low beta-agonist to anti-inflammatory medication ratio. *This research supports the hypothesis.*

Provider-Related Factors: Insurance Benefit and Health Services Use/Cost

Hypothesis D.3.a. Differences noted, between participant insurance benefit groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=0.446, p=.309). It was hypothesized that participants with Medicaid insurance benefits would be more likely to be admitted to the hospital than participants insured by commercial products. *This research does not support the hypothesis.*

Hypothesis D.3.b. Differences noted, between participant insurance benefit groups, in the likelihood of using emergency department services were not statistically

significant (χ^2=0.272, p=.351). It was hypothesized that participants with Medicaid insurance benefits would be more likely to use emergency department services than participants insured by commercial products. *This research does not support the hypothesis.*

Hypothesis D.3.c. Differences noted, between participant insurance benefit groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=0.809, p=.368). It was hypothesized that participants with Medicaid insurance benefits would be less likely to use primary care provider services than participants insured by commercial products. *This research does not support the hypothesis.*

Hypothesis D.3.d. Differences noted, between participant insurance benefit groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=0.334, p=.332). It was hypothesized that participants with Medicaid insurance benefits would be less likely to be classified primary care provider high users than participants insured by commercial products. *This research does not support the hypothesis.*

Hypothesis D.3.e. Differences noted, between participant insurance benefit groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.009, p=.513). It was hypothesized that participants with Medicaid insurance benefits would be less likely to use specialist services than participants insured by commercial products. *This research does not support the hypothesis.*

Hypothesis D.3.f. Differences noted, between participant insurance benefit groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.004, p=.547). It was hypothesized that participants with Medicaid insurance benefits would be more likely to be classified high total health care cost than participants insured by commercial products. *This research does not support the hypothesis.*

Provider-Related Factors: Primary Care Provider Gender and Health Services Use/Cost

Hypothesis D.4.a. Differences noted, between primary care provider gender groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=0.058, p=.455). It was hypothesized that there would be no difference in the likelihood of being admitted to the hospital between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis D.4.b. Differences noted, between primary care provider gender groups, in the likelihood of using emergency department services were not statistically significant (χ^2=0.298, p=.334). It was hypothesized that there would be no difference in the likelihood of emergency department use between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis D.4.c. Differences noted, between primary care provider gender groups, in the likelihood of using primary care provider services were not statistically

significant (χ^2=0.062, p=.804). It was hypothesized that there would be no difference in the likelihood of primary care provider use between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis D.4.d. Differences noted, between primary care provider gender groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=0.001, p=.545). It was hypothesized that there would be no difference in the likelihood of being classified primary care provider high users between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis D.4.e. Differences noted, between primary care provider gender groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.531, p=.270). It was hypothesized that there would be no difference in the likelihood of specialist services use between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Hypothesis D.4.f. Differences noted, between primary care provider gender groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=313, p=.335). It was hypothesized that there would be no difference in the likelihood of being classified high total health care cost between participants managed by female primary care providers or participants managed by male primary care providers. *This research supports the hypothesis.*

Provider-Related Factors: Primary Care Provider Specialty and Health Services Use/Cost

Hypothesis D.5.a. Differences noted, between primary care provider specialty groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=0.209, p=.707). It was hypothesized that there would be no difference in the likelihood of being admitted to the hospital between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Hypothesis D.5.b. Differences noted, between primary care provider specialty groups, in the likelihood of using emergency department services were not statistically significant (χ^2=1.905, p=.168). It was hypothesized that there would be no difference in the likelihood of emergency department use between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Hypothesis D.5.c. Differences noted, between primary care provider specialty groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=0.003, p=.955). It was hypothesized that there would be no difference in the likelihood of primary care provider use between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Hypothesis D.5.d. Differences noted, between primary care provider specialty groups, in the likelihood of being classified primary care provider high users were not

statistically significant (χ^2=0.705, p=.401). It was hypothesized that there would be no difference in the likelihood of being classified primary care provider high users between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Hypothesis D.5.e. Differences noted, between primary care provider specialty groups, in the likelihood of using specialist services were not statistically significant (χ^2=1.684, p=.199). It was hypothesized that there would be no difference in the likelihood of specialist use between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Hypothesis D.5.f. Differences noted, between primary care provider specialty groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=1.363, p=.243). It was hypothesized that there would be no difference in the likelihood of being classified high total health care cost between participants managed by pediatric primary care providers or participants managed by general practice primary care providers. *This research supports the hypothesis.*

Bivariate Relationships Between

Environment-Related Factors and Dependent Variable

Health Care Environment: Primary Care Provider Office in the Neighborhood and Health Services Use/Cost

Hypothesis E.1.a. Differences noted, between primary care provider availability groups, in the likelihood of being admitted to the hospital were not statistically

significant (χ^2=2.568, p=.080). It was hypothesized that participants would be more likely to be admitted to the hospital when their primary care provider office was located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Hypothesis E.1.b. Differences noted, between primary care provider availability groups, in the likelihood of using emergency department services were not statistically significant (χ^2=1.018, p=.197). It was hypothesized that participants would be more likely to use emergency department services when their primary care provider office was located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Hypothesis E.1.c. Differences noted, between primary care provider availability groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=1.828, p=.176). It was hypothesized that participants would be more likely to use primary care provider services when their primary care provider office was located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Hypothesis E.1.d. Differences noted, between primary care provider availability groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=0.023, p=.880). It was hypothesized that participants would be more likely to be classified primary care provider high users when their primary care provider office was located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Hypothesis E.1.e. Differences noted, between primary care provider availability groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.153, p=.696). It was hypothesized that there would be no difference in the likelihood of using specialist services between participants with their primary care provider office located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research supports the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Hypothesis E.1.f. Differences noted, between primary care provider availability groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.078, p=.780). It was hypothesized that participants would be more likely to be classified high total health care cost when their primary care provider office was located in their neighborhood compared to participants without their primary care provider office located in their neighborhood. *This research does not*

support the hypothesis. Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices.

Health Care Environment: Primary Care Provider Office, Offering Late Hours, in the Neighborhood and Health Services Use/Cost

Hypothesis E.2.a. Differences noted, between primary care provider availability groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=2.568, p=.080). It was hypothesized that participants would be more likely to be admitted to the hospital when their primary care provider office, offering late hours, was located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Hypothesis E.2.b. Differences noted, between primary care provider availability groups, in the likelihood of using emergency department services were not statistically significant (χ^2=0.011, p=.542). It was hypothesized that participants would be more likely to use emergency department services when their primary care provider office, offering late hours, was located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Hypothesis E.2.c. Differences noted, between primary care provider availability groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=1.310, p=.252). It was hypothesized that participants would be more likely to use primary care provider services when their primary care provider office, offering late hours, was located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Hypothesis E.2.d. Differences noted, between primary care provider availability groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=1.890, p=.169). It was hypothesized that participants would be more likely to be classified primary care provider high users when their primary care provider office, offering late hours, was located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Hypothesis E.2.e. Differences noted, between primary care provider availability groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.324, p=.569). It was hypothesized that there would be no difference in the likelihood of using specialist services between participants with their primary care

provider office, offering late hours, located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research supports the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Hypothesis E.2.f. Differences noted, between primary care provider availability groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.005, p=.946). It was hypothesized that participants would be more likely to be classified high total health care cost when their primary care provider office, offering late hours, was located in their neighborhood compared to participants without their primary care provider office, offering late hours, located in their neighborhood. *This research does not support the hypothesis.* Conservative interpretation of this result is recommended given the limited number of neighborhoods with primary care provider offices offering late hours.

Comparison of Health Services Use/Cost For Asthma Management Program Groups Between Pre-Test Year and Post-Test Year

Analysis of pre-test year health services use and cost data revealed that the asthma management program groups (enrolled, declined, or not referred) were not comparable. Consequently, the McNemar test was used to explore differences between the pre-test year and post-test year for each study group. These analyses were reviewed prior to analyzing bivariate relationships between the asthma management program groups and health services use/cost for the post-test period.

The McNemar test employed a 2 x 2 within-subjects design to test differences in proportions for three dependent groups: 1) enrolled group; 2) declined group; or 3) not referred group. The continuity corrected chi-square distribution was used for the enrolled group since the sample size was large. The binomial distribution was used for the declined and not referred groups since the sample size was small. Following this discussion, study results for the bivariate analysis between the asthma management program groups and health services use for the post-test year are presented.

Enrolled Group. The enrolled group included participants who were enrolled in the asthma management program for the post-test year. Data collected during the 12 months prior to enrollment in the asthma management program were considered the pre-test year. Data collected from the date of enrollment to 12 months following enrollment in the asthma management program were considered the post-test year.

As shown in Table 19, differences in health services use between the pre-test year and the post-test year were statistically significant across all service categories. The percentage of participants admitted to the hospital decreased significantly between the pre-test year (27.6%) and post-test year (7.9%). Significant decreases were also noted between pre-test and post-test years related to use of emergency department services (33.5% and 25.1%, respectively), use of primary care provider services (100% and 55.2%, respectively), and use of specialist services (43.3% and 26.6%, respectively). The percentage of participants classified as primary care provider high users also declined significantly during the same time frame (11.3% and 5.9%, respectively). The percentage of participants classified as high total health care cost declined significantly

between the pre-test year and post-test year (19.7% and 7.4%, respectively).

Table 19

Comparison of Health Services Use And Cost Between Pre-Test Year And Post-Test Year for the Enrolled Group

Health Services Use Outcomes[1]	Pre-Test Year (n=203)	Post-Test Year (n=203)	Continuity Corrected χ^2	p
Hospital Admissions				
Admitted	27.6%	7.9%		
Not Admitted	72.4%	92.1%	30.420	.000
ED Services				
Services Used	33.5%	25.1%		
Services Not Used	66.5%	74.9%	4.339	.037
PCP Services				
Services Used	100%	55.2%		
Services Not Used	0%	44.8%	89.011	.000
PCP Services Volume[a]				
High User	11.3%	5.9%		
Low User	88.7%	94.1%		.043
Specialist Services				
Services Used	43.3%	26.6%		
Services Not Used	56.7%	73.4%	14.716	.000
Total Health Care Cost				
High Cost	19.7%	7.4%		
Low Cost	80.3%	92.6%	12.023	.001

[1]McNemar Test
[a]Binomial distribution used

Declined Group. The declined group included participants who were previously referred by their primary care provider to the asthma management program but declined to enroll in the program. Health services data were collected for the declined group for two contiguous 12 month periods without introduction of the asthma management program. Data collected during the first 12 month period (July 1997 through June 1998) were considered the pre-test year. Data collected during the second 12 month period (July 1998 through June 1999) were considered the post-test year. Differences in health

services use between the pre-test year and the post-test year were not statistically significant (Table 20). Differences in total health care cost were statistically significant. The percentage of participants classified high total health care cost increased significantly from 30.9 percent for the pre-test year to 42.6 percent for the post-test year.

Table 20

Comparison of Health Services Use And Cost Between Pre-Test Year And Post-Test Year for the Declined Group

Health Services Use Outcomes[1]	Pre-Test Year (n=68)	Post-Test Year (n=68)	p
Hospital Admissions[a]			
Admitted	50.0%	57.4%	
Not Admitted	50.0%	42.6%	.302
ED Services[a]			
Services Used	51.5%	42.6%	
Services Not Used	48.5%	57.4%	.263
PCP Services[a]			
Services Used	95.6%	88.2%	
Services Not Used	4.4%	11.8%	.063
PCP Services Volume[a]			
High User	48.5%	52.9%	
Low User	51.5%	47.1%	1.000
Specialist Services[a]			
Services Used	70.6%	63.2%	
Services Not Used	29.4%	36.8%	.359
Total Health Care Cost[a]			
High Cost	30.9%	42.6%	
Low Cost	69.1%	57.4%	.039

[1]McNemar Test
[a]Binomial distribution used

Not Referred Group. The not referred group included participants selected from the general pediatric asthma population. These participants had high beta-agonist to anti-inflammatory medication ratios (3:1 or greater) and had not been referred to the asthma

management program by their primary care provider. Health services data were collected for the not referred group for two contiguous 12 month periods without introduction of the asthma management program. Data collected during the first 12 month period (July 1997 through June 1998) were considered the pre-test year. Data collected during the second 12 month period (July 1998 through June 1999) were considered the post-test year. Differences in health services use between the pre-test year and the post-test year are presented in Table 21.

Table 21

Comparison of Health Services Use And Cost Between Pre-Test Year And Post-Test Year for the Not Referred Group

Health Services Use Outcomes[1]	Pre-Test Year (n=70)	Post-Test Year (n=70)	p
Hospital Admissions[a]			
Admitted	14.3%	34.3%	
Not Admitted	85.7%	65.7%	.001
ED Services[a]			
Services Used	64.3%	82.9%	
Services Not Used	35.7%	17.1%	.002
PCP Services[a]			
Services Used	95.7%	95.7%	
Services Not Used	4.3%	4.3%	1.000
PCP Services Volume[a]			
High User	30.0%	44.3%	
Low User	70.0%	55.7%	.031
Specialist Services[a]			
Services Used	75.7%	82.9%	
Services Not Used	24.3%	17.1%	.359
Total Health Care Cost[a]			
High Cost	11.4%	35.7%	
Low Cost	88.6%	64.3%	.000

[1]McNemar Test
[a]Binomial distribution used

As shown in Table 21, the percentage of participants admitted to the hospital increased significantly between the pre-test year and post-test year (14.3% and 34.3%, respectively). The percentage of participants using emergency department services also increased significantly between the pre-test year and post-test years (64.3% and 82.9%, respectively). A significant increase was noted during the same time frame for participants classified primary care provider high users (30.0% and 44.3%, respectively). The percentage of participants classified high total health care cost increased significantly from 11.4 percent for the pre-test year to 35.7 percent for the post-test year. Differences noted in primary care provider services use or specialist services use between the pre-test year and post-test year were not statistically significant.

Organization: Asthma Management Program And Health Services Use/Cost

Post-test year findings for hypotheses E.3.a. through E.3.f. are shown in Table 22.

Hypothesis E.3.a. A statistically significant difference in the likelihood of being admitted to the hospital was noted between participants enrolled in the asthma management program compared to participants who declined to enroll in the program or participants not referred to the program (χ^2=76.153, p=.000). Participants in the enrolled group were significantly less likely to be admitted to the hospital compared to participants in the declined group (χ^2=77.066, p=0.000) or participants in the not referred group (χ^2=29.019, p=0.000). Participants in the declined group were significantly more likely to be admitted to the hospital compared to participants in the not referred group (χ^2=7.397, p=0.000). It was hypothesized that participants enrolled in the asthma management program would be less likely to be admitted to the hospital than participants

who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Hypothesis E.3.b. A statistically significant difference in the likelihood of using emergency department services was noted between study groups (χ^2=72.183, p=.000). Participants in the enrolled group were significantly less likely to use emergency department services compared to participants in the declined group (χ^2=7.518, p=0.006) or participants in the not referred group (χ^2=72.335, p=0.000). Participants in the not referred group were significantly more likely to use emergency department services compared to participants in the declined group (χ^2=23.937, p=0.000). It was hypothesized that participants enrolled in the asthma management program would be less likely to use emergency department services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Hypothesis E.3.c. A statistically significant difference in the likelihood of using primary care provider services was noted between study groups (χ^2=54.151, p=0.000). Participants in the enrolled group were significantly less likely to use primary care provider services compared to participants in the declined group (χ^2=24.016, p=0.000) or participants in the not referred group (χ^2=37.895, p=0.000). Differences noted in the likelihood of using primary care provider services between participants in the declined group and participants in the not referred group were not statistically significant (χ^2=2.630, p=0.105). It was hypothesized that participants enrolled in the asthma management program would be less likely to use primary care provider services than

participants who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Table 22

Relationships Between Health Care Environment Organization (Asthma Management Program) And The Dependent Variable

Health Services Use Outcomes[1]	Enrolled Group (n=203)	Declined Group (n=68)	Not Referred Group (n=70)	χ^2	p	Power[2]
Hospital Admissions						
Admitted	7.9%	57.4%	34.3%			
Not Admitted	92.1%	42.6%	65.7%	76.153	.000	0.99
ED Services						
Services Used	25.1%	42.6%	82.9%			
Services Not Used	74.9%	27.4%	17.1%	72.183	.000	0.99
PCP Services						
Services Used	55.2%	88.2%	95.7%			
Services Not Used	44.8%	11.8%	4.3%	54.151	.000	0.99
PCP Services Volume						
High User	5.9%	52.9%	44.3%			
Low User	94.1%	47.1%	55.7%	85.364	.000	0.99
Specialist Services						
Services Used	26.6%	63.2%	82.9%			
Services Not Used	73.4%	36.8%	17.1%	77.272	.000	0.99
Total Health Care Cost						
High Cost	7.4%	42.6%	35.7%			
Low Cost	92.6%	57.4%	64.3%	52.309	.000	0.99

[2]Cramer's V statistic used to calculate statistical power (Cohen, 1988)

[1]Chi-square test of independence

Hypothesis E.3.d. A statistically significant difference in the likelihood of being classified primary care provider high users was noted between study groups (χ^2=85.364, p=.000). Participants in the enrolled group were significantly less likely to be classified primary care provider high user compared to participants in the declined group (χ^2=77.299, p=0.000) or participants in the not referred group (χ^2=37.895, p=0.000).

Differences noted in the likelihood of being classified primary care provider high user between participants in the declined group and participants in the not referred group were not statistically significant (χ^2=1.035, p=0.309). It was hypothesized that participants enrolled in the asthma management program would be less likely to be classified as primary care provider high user than participants who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Hypothesis E.3.e. A statistically significant difference in the likelihood of using specialist services was noted between study groups (χ^2=77.272, p=.000). Participants in the enrolled group were significantly less likely to use specialist services compared to participants in the declined group (χ^2=29.746, p=0.000) or participants in the not referred group (χ^2=68.085, p=0.000). Participants in the declined group were significantly less likely to use specialist services compared to participants in the not referred group (χ^2=6.768, p=0.000). It was hypothesized that participants enrolled in the asthma management program would be less likely to use specialist services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Hypothesis E.3.f. A statistically significant difference in the likelihood of being classified high total health care cost was noted between study groups (χ^2=52.309, p=.000). Participants in the enrolled group were significantly less likely to be classified high total health care cost compared to participants in the declined group (χ^2=44.457, p=0.000) or participants in the not referred group (χ^2=31.593, p=0.000). Differences

noted in the likelihood of being classified high total health care cost between participants in the declined group and participants in the not referred group were not statistically significant (χ^2=0.696, p=0.404). It was hypothesized that participants enrolled in the asthma management program would be less likely to be classified high total health care cost than participants who declined to enroll in the asthma management program or were not referred to the asthma management program. *This research supports the hypothesis.*

Environment-Related Factor: Neighborhood Urbanicity and Health Services Use/Cost

Hypothesis E.4.a. Differences noted, between neighborhood urbanicity groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=1.104, p=.293). It was hypothesized that participants residing in urban neighborhoods would be more likely to be admitted to the hospital than participants residing in non-urban neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.4.b. Differences noted, between neighborhood urbanicity groups, in the likelihood of using emergency department services were not statistically significant (χ^2=0.143, p=.705). It was hypothesized that participants residing in urban neighborhoods would be more likely to use emergency department services than participants residing in non-urban neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.4.c. Differences noted, between neighborhood urbanicity groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=1.310, p=.252). It was hypothesized that participants residing in urban

neighborhoods would be less likely to use primary care provider services than participants residing in non-urban neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.4.d. A statistically significant difference in the likelihood of being classified primary care provider high users was noted between neighborhood urbanicity groups, (χ^2=3.689, p=.040). Participants residing in urban neighborhoods were significantly less likely to be classified primary care provider high users. It was hypothesized that participants residing in urban neighborhoods would be less likely to be classified primary care provider high users than participants residing in non-urban neighborhoods. *This research supports the hypothesis.*

Hypothesis E.4.e. Differences noted, between neighborhood urbanicity groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.924, p=.201). It was hypothesized that participants residing in urban neighborhoods would be less likely to use specialist services than participants residing in non-urban neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.4.f. Differences noted, between neighborhood urbanicity groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.015, p=.507). It was hypothesized that participants residing in urban neighborhoods would be more likely to be classified high total health care cost than participants residing in non-urban neighborhoods. *This research does not support the hypothesis.*

Environment-Related Factor: Neighborhood Ethnicity and Health Services Use/Cost

Hypothesis E.5.a. Differences noted, between neighborhood ethnicity groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=0.053, p=.458). It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be more likely to be admitted to the hospital than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.5.b. A statistically significant difference was noted in the likelihood of using emergency department services between participants residing in predominately non-Caucasian neighborhoods and participants residing in predominately Caucasian neighborhoods (χ^2=4.471, p=.022). Participants residing in predominately Caucasian neighborhoods were significantly more likely to use emergency department services than other participants. It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be more likely to use emergency department services than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.5.c. Differences noted, between neighborhood ethnicity groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=0.520, p=.471). It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be less likely to use primary care provider services than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.5.d. Differences noted, between neighborhood ethnicity groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=0.308, p=.337). It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be less likely to be classified primary care provider high users than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.5.e. Differences noted, between neighborhood ethnicity groups, in the likelihood of using specialist services were not statistically significant (χ^2=0.285, p=.336). It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be less likely to use specialist services than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.5.f. Differences noted, between neighborhood ethnicity groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.437, p=.302). It was hypothesized that participants residing in predominately non-Caucasian neighborhoods would be more likely to be classified high total health care cost than participants residing in predominately Caucasian neighborhoods. *This research does not support the hypothesis.*

Environment-Related Factor: Neighborhood Affluence and Health Services Use/Cost

Hypothesis E.6.a. Differences noted, between neighborhood affluence groups, in the likelihood of being admitted to the hospital were not statistically significant (χ^2=0.290, p=.351). It was hypothesized that participants residing in predominately low-

income neighborhoods would be more likely to be admitted to the hospital than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.6.b. Differences noted, between neighborhood affluence groups, in the likelihood of using emergency department services were not statistically significant (χ^2=1.842, p=.109). It was hypothesized that participants residing in predominately low-income neighborhoods would be more likely to use emergency department services than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.6.c. Differences noted, between neighborhood affluence groups, in the likelihood of using primary care provider services were not statistically significant (χ^2=3.608, p=.057). It was hypothesized that participants residing in predominately low-income neighborhoods would be less likely to use primary care provider services than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.6.d. Differences noted, between neighborhood affluence groups, in the likelihood of being classified primary care provider high users were not statistically significant (χ^2=1.995, p=.101). It was hypothesized that participants residing in predominately low-income neighborhoods would be less likely to be classified primary care provider high users than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.6.e. Differences noted, between neighborhood affluence groups, in the likelihood of using specialist services were not statistically significant (χ^2=1.467, p=.138). It was hypothesized that participants residing in predominately low-income neighborhoods would be less likely to use specialist services than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Hypothesis E.6.f. Differences noted, between neighborhood affluence groups, in the likelihood of being classified high total health care cost were not statistically significant (χ^2=0.201, p=.338). It was hypothesized that participants residing in predominately low-income neighborhoods would be more likely to be classified high total health care cost than participants residing in non low-income neighborhoods. *This research does not support the hypothesis.*

Research Hypotheses: Multivariate Relationships

In the following section, the multivariate research hypotheses identified in Chapter III are discussed. Multivariate hypotheses tested the explanatory power of the Behavior Model of Utilization (Phillips, Morrison, Andersen, & Aday, 1998; Aday, Begley, Lairson, & Slater, 1998) for pediatric asthma health services use in one urban, regional managed care company. Independent variables included population-related factors and environment-related factors. The dependent variable included health services use/cost.

In this research, logistic regression procedures were used to test the probability of health services use/cost in the post-test year. The enter method for variable selection was used for each regression model, selected variables were entered in a single step.

Tolerance, or multicollinearity, was the entry criteria. Relationships between multiple independent variables and a single, dichotomous dependent variable were analyzed to yield a prediction equation. Parameters estimated were based on the maximum likelihood method; the ones that were most likely to generate the observed data. Pre-test year health services use or cost variables were entered as covariates in the logistic regression models to control for pre-test year differences and to more accurately assess program effect.

Model fit was assessed using the likelihood value (-2 log likelihood) and creating a classification matrix with respect to the dependent variable. Relative contribution of each predictor variable was assessed using the R statistic. These parameters are discussed in detail in Chapter 5 when the explanatory models, used in this research, are compared with one another.

Population-Related Factors: Patient-Related Factors

Study findings for hypotheses F.1. through F.2.a. are presented in Table 23 through Table 28.

Hypothesis F.1.

It was hypothesized that when patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory medication ratio will be predictive of health services use, when controlling for pre-test year health services use. *This research supports the hypothesis.*

Hypothesis F.1.a. It was hypothesized that the probability of being admitted to the hospital would be greater for participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test year hospital admission. *This research partially supports the hypothesis.* As shown in Table 23, the overall predictive model for hospital admission was statistically significant ($\chi^2 = 70.816$, p =.0000). Two of the predictor variables were significantly related to the likelihood of being admitted to the hospital: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of being admitted to the hospital was almost four times as great among participants who were age 12 years or older compared to participants age four years or younger (odds ratio = 3.6). The risk of being admitted to the hospital was over twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.5). The classification results indicate moderate success, with an overall rate of correct classification of 81.5% in the analysis sample.

Hypothesis F.1.b. It was hypothesized that the probability of using emergency department services would be greater for participants who are four years of age or younger and/or who have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test year emergency department services use. *This research partially supports the hypothesis.* As shown in Table 24, the overall predictive model for using emergency department services was statistically significant ($\chi^2 = 72.756$, p =.0000). Two of the predictor variables were significantly related to the likelihood of

using emergency department services: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of using emergency department services was over twice as great among participants who were age 12 years or older compared to participants age four years or younger (odds ratio = 2.4). The risk of using emergency department services was almost twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.7). The classification results indicate high success, with an overall rate of correct classification of 70.1% in the analysis sample.

Table 23
Results Of Logistic Regression Model For Hospital Admission
Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Hospital Admission	2.0779	47.2103***	7.9874	4.4156	14.4483
Dummy Variable Age 5 Years to 11 Years	.5234	1.7989	1.6877	.7855	3.6264
Dummy Variable Age 12 Years or older	1.2942	9.9075***	3.6482	1.6296	8.1674
Participant Gender	.0292	.0093	1.0296	.5690	1.8628
Beta-agonist to Anti-inflammatory Ratio	.8949	8.7225***	2.4472	1.3513	4.4320
Constant	-3.0483	42.2997***			
-2 Log Likelihood	298.343				
Model Chi-square (*df* = 5)	70.816				
p Value	.0000				
Overall Rate of Correct Classification	81.5%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Table 24

Results Of Logistic Regression Model For Emergency Department Services Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year ED[#] Services Use	1.8294	52.2938***	6.2301	3.7945	10.2289
Dummy Variable Age 5 Years to 11 Years	.4756	2.2750	1.6090	.8672	2.9853
Dummy Variable Age 12 Years or older	.8549	6.2247*	2.3512	1.2012	4.6021
Participant Gender	-.0065	.0006	.9936	.5980	1.6508
Beta-agonist to Anti-inflammatory Ratio	.5013	3.7849*	1.6509	1.0167	2.7357
Constant	-1.8922	26.5564***			
-2 Log Likelihood	387.504				
Model Chi-square (*df* = 5)	72.756				
p Value	.0000				
Overall Rate of Correct Classification	70.1%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[#]ED - Emergency Department
*p < .05 **p < .01 ***p < .005

Hypothesis F.1.c. It was hypothesized that the probability of using primary care provider services would be greater for participants who are four years of age or younger and/or who have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test year primary care provider services use. *This research partially supports the hypothesis.* As shown in Table 25, the overall predictive model for primary care provider services use was statistically significant ($\chi^2 = 15.384$, p =.0088). Beta-agonist to anti-inflammatory medication ratio was the only predictor variable significantly related to the likelihood of using primary care provider services. The risk of using primary care provider services was over twice as great among participants with a

high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.2). The classification results indicate moderate success, with an overall rate of correct classification of 70.7% in the analysis sample. Conservative interpretation of study results is recommended given the wide confidence interval noted for the pre-test year predictor variable (1.011, 36.2466).

Table 25

Results Of Logistic Regression Model For Primary Care Provider Services Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[#] Services Use	1.8007	3.8888*	6.0537	1.0111	36.2466
Dummy Variable Age 5 Years to 11 Years	.2410	.6847	1.2725	.7190	2.2522
Dummy Variable Age 12 Years or older	.3946	1.3609	1.4837	.7646	2.8790
Participant Gender	-.2818	1.1911	.7544	.4548	1.2514
Beta-agonist to Anti-inflammatory Ratio	.7737	8.0710***	2.1677	1.2712	3.6967
Constant	-1.1999	1.5627			
-2 Log Likelihood	400.715				
Model Chi-square (*df* = 5)	15.384				
p Value	.0088				
Overall Rate of Correct Classification	70.7%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[#]PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Hypothesis F.1.d. It was hypothesized that the probability of being classified primary care provider high users would be greater for participants who are four years of age or younger and/or who have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test year primary care provider high users. *This research*

partially supports the hypothesis. As shown in Table 26, the overall predictive model for primary care provider high user was statistically significant ($\chi^2 = 95.478$, p =.0000). Two of the predictor variables were significantly related to the likelihood of being classified primary care provider high users: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of being classified primary care provider high users was over four times as great among participants age 12 years or older compared to participants age four years of age or younger (odds ratio = 4.5). The risk of being classified primary care provider high users was almost twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.9). The classification results indicate high success, with an overall rate of correct classification of 82.9% in the analysis sample. Conservative interpretation of study results is recommended given the wide confidence interval noted for the pre-test year predictor variable (7.4054, 26.1946).

Hypothesis F.1.e. It was hypothesized that the probability of using specialist services would be greater for participants who are four years of age or younger and/or who have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test year specialist services use. *This research partially supports the hypothesis.* As shown in Table 27, the overall predictive model for using specialist services was statistically significant ($\chi^2 = 67.897$, p =.0000). Two of the predictor variables were significantly related to the likelihood of using specialist services: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of

using specialist services was over twice as great among participants age 12 years or older compared to participants four years of age or younger (odds ratio = 2.3). The risk of using specialist services was almost three times as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.8). Although the model was statistically significant, the classification results indicate only moderate success, with an overall rate of correct classification of 67.5% in the analysis sample.

Table 26

Results Of Logistic Regression Model For Primary Care Provider High User Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[5]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[4] High User	2.6339	66.7889***	13.9277	7.4054	26.1946
Dummy Variable Age 5 Years to 11 Years	.7625	3.1705	2.1436	.9261	4.9616
Dummy Variable Age 12 Years or older	1.4958	11.2607***	4.4629	1.8629	10.6915
Participant Gender	-.0683	.0455	.9340	.4988	1.7488
Beta-agonist to Anti-inflammatory Ratio	.6802	4.5635*	1.9743	1.0577	3.6850
Constant	-3.1434	41.3802***			
-2 Log Likelihood	273.680				
Model Chi-square (*df* = 5)	95.478				
p Value	.0000				
Overall Rate of Correct Classification	82.9%				
n	341				

[1]Logistic Regression
[4]PCP - Primary care provider
[5]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis F.2.

It was hypothesized that when patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory

medication ratio will be predictive of health services cost, when controlling for pre-test year total health care cost. *This research supports the hypothesis.*

Table 27

Results Of Logistic Regression Model For Specialist Services Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Specialist Services Use	1.4874	35.5481***	4.4254	2.7140	7.2160
Dummy Variable Age 5 Years to 11 Years	.5291	3.0857	1.6974	.9406	3.0631
Dummy Variable Age 12 Years or older	.8173	5.9182*	2.2645	1.1722	4.3748
Participant Gender	.0840	.1103	1.0876	.6626	1.7854
Beta-agonist to Anti-inflammatory Ratio	1.0391	16.6851***	2.8267	1.7169	4.6540
Constant	-1.9454	28.2861***			
-2 Log Likelihood	402.008				
Model Chi-square (*df* = 5)	67.897				
p Value	.0000				
Overall Rate of Correct Classification	67.5%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis F.2.a. It was hypothesized that the probability of being classified high total health care cost would be greater for participants who are four years of age or younger and/or who have a high beta-agonist to anti-inflammatory medication ratio, when controlling for pre-test total health care cost. *This research partially supports the hypothesis.* As shown in Table 28, the overall predictive model for being classified high total health care cost was statistically significant ($\chi^2 = 54.563$, p =.0000). Two of the predictor variables were significantly related to the likelihood of being classified high

total health care cost: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of being classified high total health care cost was 4.5 times as great for participants age 12 years or older compared to participants four years of age or younger (odds ratio = 4.5). The risk of being classified high total health care cost was almost twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.8). The classification results indicate high success, with an overall rate of correct classification of 83.3% in the analysis sample.

Table 28

Results Of Logistic Regression Model For High Total Health Care Cost Excluding Provider-Related Factors and Environment-Related Factors

Predictor Variable[1]	*b*[2]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Total Health Care Cost	1.8446	33.3137***	6.3255	3.3811	11.8339
Dummy Variable Age 5 Years to 11 Years	.6485	2.3339	1.9127	.8324	4.3954
Dummy Variable Age 12 Years or older	1.5106	12.2071***	4.5293	1.9410	10.5692
Participant Gender	-.0771	.0635	.9258	.5083	1.6862
Beta-agonist to Anti-inflammatory Ratio	.6058	3.7992*	1.8327	1.0014	3.3701
Constant	-2.8631	37.0176***			
-2 Log Likelihood	291.643				
Model Chi-square (*df* = 5)	54.563				
p Value	.0000				
Overall Rate of Correct Classification	83.3%				
n	341				

[1]Logistic Regression
[2]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Population Related Factors: Patient-Related Factors And Provider-Related Factors

Study findings for hypotheses G.1. through G.2.a. are presented in Table 29 through Table 34.

Hypothesis G.1.

It was hypothesized that when patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio and primary care provider specialty will all be predictive of health services use, when controlling for pre-test year health services use. *This research supports the hypothesis.*

Hypothesis G.1.a. It was hypothesized that the probability of being admitted to the hospital would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test year hospital admission. *This research partially supports the hypothesis.* As shown in Table 29, the overall predictive model for hospital admission was statistically significant ($\chi^2 = 72.272$, $p = .0000$). Two predictor variables were significantly related to the likelihood of being admitted to the hospital: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of hospital admission was four times as great among participants age 12 years or older compared to participants age four years or younger (odds ratio = 4.0). The risk of hospital admission was over twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory ratio (odds ratio = 2.5). The

classification results indicate high success, with an overall rate of correct classification of 81.2% in the analysis sample.

Table 29

Results Of Logistic Regression Model For Hospital Admission Excluding Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Hospital Admission	2.0680	46.1529***	7.9090	4.3552	14.3625
Dummy Variable Age 5 Years to 11 Years	.5273	1.8111	1.6944	.7861	3.6520
Dummy Variable Age 12 Years or older	1.3874	10.7223***	4.0046	1.7454	9.1879
Participant Gender	.0125	.0017	1.0126	.5579	1.8378
Beta-agonist to Anti-inflammatory Ratio	.9143	8.9695***	2.4951	1.3716	4.5390
Primary Care Provider Gender	.0731	.0546	1.0759	.5826	1.9867
Primary Care Provider Specialty	.4699	1.0110	1.5998	.6401	3.9984
Participant Insurance Benefit	.1782	.2376	1.1951	.5837	2.4470
Constant	-4.3027	12.9357***			
-2 Log Likelihood	296.887				
Model Chi-square (*df* = 8)	72.272				
p Value	.0000				
Overall Rate of Correct Classification	81.2%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis G.1.b. It was hypothesized that the probability of using emergency department services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test emergency department use. *This research partially supports the hypothesis.* As shown

in Table 30, the overall predictive model for using emergency department services was statistically significant ($\chi^2 = 75.458$, p =.0000). Two predictor variables were significantly related to the likelihood of being admitted to the hospital: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The risk of using emergency department services was over two times as great among participants age 12 years or older compared to participants age four years or younger (odds ratio = 2.3). The risk of using emergency department services was almost twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory ratio (odds ratio = 1.7). The classification results indicate moderate success, with an overall rate of correct classification of 72.4% in the analysis sample.

Hypothesis G.1.c. It was hypothesized that the probability of using primary care provider services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test year primary care provider services use. *This research partially supports the hypothesis.* As shown in Table 31, the overall predictive model for using primary care provider services was statistically significant ($\chi^2 = 16.319$, p =.0380). Beta-agonist to anti-inflammatory medication ratio was the only predictor variable significantly related to the likelihood of using primary care provider services. The risk of using primary care provider services was over twice as great among participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory

medication ratio (odds ratio = 2.2). The classification results indicate moderate success, with an overall rate of correct classification of 70.7% in the analysis sample. Conservative interpretation of study results is recommended given the wide confidence interval noted for the pre-test year predictor variable (1.0311, 38.2338).

Table 30
Results Of Logistic Regression Model For Emergency Department Services Excluding Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year ED[a] Services Use	1.8571	52.7722***	6.4050	3.8808	10.5711
Dummy Variable Age 5 Years to 11 Years	.4921	2.3904	1.6357	.8766	3.0523
Dummy Variable Age 12 Years or older	.8287	5.4627*	2.2904	1.1431	4.5892
Participant Gender	-.0149	.0033	.9852	.5901	1.6448
Beta-agonist to Anti-inflammatory Ratio	.5101	3.8798*	1.6655	1.0025	2.7670
Primary Care Provider Gender	.2749	1.0524	1.3164	.7785	2.2260
Primary Care Provider Specialty	-.3441	.7744	.7089	.3294	1.5254
Participant Insurance Benefit	.3501	1.2369	1.4193	.7657	2.6306
Constant	-2.0666	4.4295*			
-2 Log Likelihood	384.803				
Model Chi-square (*df* = 8)	75.458				
p Value	.0000				
Overall Rate of Correct Classification	72.4%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[a]ED - Emergency Department
*p < .05 **p < .01 ***p < .005

Table 31

Results Of Logistic Regression Model For Primary Care Provider Services Excluding Environment-Related Factors

Predictor Variable[1]	*b*[2]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[3] Services Use	1.8372	3.9728*	6.2787	1.0311	38.2338
Dummy Variable Age 5 Years to 11 Years	.2106	.5128	1.2345	.6936	2.1971
Dummy Variable Age 12 Years or older	.3821	1.2096	1.4654	.7417	2.8955
Participant Gender	-.2941	1.2808	.7452	.4478	1.2402
Beta-agonist to Anti-inflammatory Ratio	.7830	8.2034***	2.1880	1.2804	3.7388
Primary Care Provider Gender	.0106	.0016	1.0106	.6071	1.6824
Primary Care Provider Specialty	.2132	.3226	1.2377	.5930	2.5833
Participant Insurance Benefit	-.2614	.7105	.7699	.4192	1.4140
Constant	-1.1510	.7524			
-2 Log Likelihood	399.781				
Model Chi-square (*df* = 8)	16.319				
p Value	.0380				
Overall Rate of Correct Classification	70.7%				
n	341				

[1]Logistic Regression
[2]Unstandardized logistic regression coefficient
[3]PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Hypothesis G.1.d. It was hypothesized that the probability of being classified primary care provider high users would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test year primary care provider high users. *This research partially supports the hypothesis.* As shown in Table 32, the overall predictive model for being classified primary care provider high users was statistically significant ($\chi^2 = 97.138$, p =.0000). Two predictor

variables were significantly related to the likelihood of being classified primary care provider high users: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The likelihood of being classified primary care provider high users was over five times as great for participants age 12 years or older compared to participants age four years or younger (odds ratio = 5.1). The likelihood of being classified primary care provider high users was almost twice as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.9). The classification results indicate high success, with an overall rate of correct classification of 83.9% in the analysis sample.

Hypothesis G.1.e. It was hypothesized that the probability of using specialist services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test year specialist services use. *This research partially supports the hypothesis.* As shown in Table 33, the overall predictive model for using specialist services was statistically significant ($\chi^2 = 69.057$, $p = .0000$). Two predictor variables were significantly related to the likelihood of using specialist services: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. The likelihood of using specialist services was twice as great for participants age 12 years or older compared to participants age four years or younger (odds ratio = 2.1). The likelihood of using specialist services was almost three times greater for participants with a high beta-agonist to anti-inflammatory medication

ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.9). The classification results indicate moderate success, with an overall rate of correct classification of 66.9% in the analysis sample.

Table 32

Results Of Logistic Regression Model For Primary Care Provider High User Excluding Environment-Related Factors

Predictor Variable[1]	*b*[$]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP* High User	2.6798	64.0671***	14.5815	7.5653	28.1048
Dummy Variable Age 5 Years to 11 Years	.8196	3.5848	2.2697	.9716	5.3023
Dummy Variable Age 12 Years or older	1.6384	12.4401***	5.1471	2.0709	12.7930
Participant Gender	-.0820	.0649	.9213	.4902	1.7315
Beta-agonist to Anti-inflammatory Ratio	.6903	4.6521*	1.9943	1.0650	3.7344
Primary Care Provider Gender	.0048	.0002	1.0048	.5218	1.9350
Primary Care Provider Specialty	.2601	.2720	1.2971	.4880	3.4476
Participant Insurance Benefit	.4132	1.1478	1.5116	.7098	3.2190
Constant	-4.4521	12.4417***			
-2 Log Likelihood	272.021				
Model Chi-square (*df* = 8)	97.138				
p Value	.0000				
Overall Rate of Correct Classification	83.9%				
n	341				

[1]Logistic Regression
[$]Unstandardized logistic regression coefficient
*PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Table 33

Results Of Logistic Regression Model For
Specialist Services Excluding Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Specialist Services Use	1.4926	35.4758***	4.4485	2.7221	7.2697
Dummy Variable Age 5 Years to 11 Years	.5196	2.9195	1.6814	.9264	3.0518
Dummy Variable Age 12 Years or older	.7518	4.7159*	2.1208	1.0760	4.1802
Participant Gender	.0854	.1127	1.0891	.6617	1.7927
Beta-agonist to Anti-inflammatory Ratio	1.0511	16.8896***	2.8609	1.7330	4.7230
Primary Care Provider Gender	.1599	.3790	1.1734	.7053	1.9521
Primary Care Provider Specialty	-.3486	.8339	.7056	.3339	1.4913
Participant Insurance Benefit	.0264	.0075	1.0268	.5658	1.8634
Constant	-1.4305	2.3339			
-2 Log Likelihood	400.847				
Model Chi-square (*df* = 8)	69.057				
p Value	.0000				
Overall Rate of Correct Classification	66.9%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis G.2.

It was hypothesized that when patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio and primary care provider specialty will all be predictive of health services cost, when controlling for pre-test year health services . *This research supports the hypothesis.*

Hypothesis G.2.a. It was hypothesized that the probability of being classified high total health care cost would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers, when controlling for pre-test year total health care cost. *This research partially supports the hypothesis.* As shown in Table 34, the overall predictive model for being classified high total health care cost was statistically significant (χ^2 =60.245, p =.000). Three predictor variables were significantly related to the likelihood of being classified high total health care cost: 1) age dummy variable, 12 years or older; 2) participant beta-agonist to anti-inflammatory medication ratio; and 3) primary care provider specialty. The likelihood of being classified high total health care cost was over five times greater for participants 12 years of age or older compared to participants age four years or younger (odds ratio = 5.5). The likelihood of being classified high total health care cost was almost two times as great for participants with a high beta-agonist to anti-inflammatory medication ratio compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.9). The likelihood of being classified high total health care cost was three times as great for participants managed by pediatric primary care providers compared to participants managed by general practice primary care providers (odds ratio = 3.0). The classification results indicate high success, with an overall rate of correct classification of 83.6% in the analysis sample.

Table 34

Results Of Logistic Regression Model For High Total Health Care Cost Excluding Environment-Related Factors

Predictor Variable[1]	$b^{\S}$	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Total Health Care Cost	1.8662	32.5820***	6.4635	3.4055	12.2674
Dummy Variable Age 5 Years to 11 Years	.6757	2.4947	1.9654	.8498	4.5456
Dummy Variable Age 12 Years or older	1.7108	14.6561***	5.5332	2.3046	13.2849
Participant Gender	-.1217	.1544	.8854	.4825	1.6247
Beta-agonist to Anti-inflammatory Ratio	.6577	4.3236*	1.9304	1.0385	3.5884
Primary Care Provider Gender	-.0675	.0437	.9347	.4965	1.7598
Primary Care Provider Specialty	1.0996	4.4051*	3.0029	1.0755	8.3850
Participant Insurance Benefit	.1463	.1555	1.1576	.5593	2.3957
Constant	-5.2308	16.0214***			
-2 Log Likelihood	285.961				
Model Chi-square ($df = 8$)	60.245				
p Value	.0000				
Overall Rate of Correct Classification	83.6%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Population-Related Factors And Environment-Related Factors: External Environment

Study findings for hypotheses H.1. through H.2.a. are presented in Table 35 through Table 40.

Hypothesis H.1.

It was hypothesized that when population-related factors (patient-related factors and provider-related factors) and external environment factors are considered together in

one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test health services use. *This research supports the hypothesis.*

Hypothesis H.1.a. It was hypothesized that the probability of being admitted to the hospital would be greater for participants who are four years of age or younger, have high beta-agonist to anti-inflammatory medication ratios, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods, when controlling for pre-test year hospital admission. *This research partially supports the hypothesis.* As shown in Table 35, the overall predictive model for hospital admission was statistically significant ($\chi^2 = 73.081$, $p = .0000$). Two predictor variables were significantly related to the likelihood of being admitted to the hospital: 1) age dummy variable, 12 years or older; and 2) beta-agonist to anti-inflammatory medication ratio. Participants age 12 years or older were four times more likely to be admitted to the hospital compared to participants age four years or younger (odds ratio = 4.1). Participants with a high beta-agonist to anti-inflammatory medication ratio were almost three times as likely to be admitted to the hospital compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.7). The classification results indicate high success, with an overall rate of correct classification of 80.3% in the analysis sample.

Table 35

Results Of Logistic Regression Model For Hospital Admission
Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Hospital Admission	2.1201	45.7295***	8.3324	4.5071	15.4042
Dummy Variable Age 5 Years to 11 Years	.6590	2.6702	1.9328	.8768	4.2605
Dummy Variable Age 12 Years or older	1.4056	10.5515***	4.0780	1.7463	9.5231
Participant Gender	.1410	.2022	1.1514	.6229	2.1282
Beta-agonist to Anti-inflammatory Ratio	.9765	9.7546***	2.6551	1.4386	4.9002
Primary Care Provider Gender	.0800	.0618	1.0833	.5763	2.0363
Primary Care Provider Specialty	.7183	2.0873	2.0510	.7740	5.4348
Participant Insurance Benefit	.2019	.2712	1.2237	.5724	2.6161
Neighborhood Urbanicity	-.3787	1.0780	.6848	.3350	1.3996
Neighborhood Ethnicity	.0595	.0275	1.0613	.5253	2.1441
Neighborhood Affluence	-.0682	.0314	.9341	.4393	1.9863
Constant	-4.7822	12.1173***			
-2 Log Likelihood	288.114				
Model Chi-square (*df* = 11)	73.081				
p Value	.0000				
Overall Rate of Correct Classification	80.3%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis H.1.b. It was hypothesized that the probability of using emergency department services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods, when controlling for pre-test year emergency department services use.

This research partially supports the hypothesis. As shown in Table 36, the overall predictive model for using emergency department services was statistically significant (χ^2 =76.146, p =.0000).

Table 36

Results Of Logistic Regression Model For Emergency Department Services Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[2]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year ED[3] Services Use	1.7957	47.2131***	6.0236	3.6092	10.0532
Dummy Variable Age 5 Years to 11 Years	.4760	2.1547	1.6096	.8525	3.0392
Dummy Variable Age 12 Years or older	.8251	5.3357*	2.2822	1.1332	4.5964
Participant Gender	-.1064	.1565	.8990	.5306	1.5232
Beta-agonist to Anti-inflammatory Ratio	.5723	4.7175*	1.7723	1.0575	2.9705
Primary Care Provider Gender	.2931	1.1306	1.3406	.7810	2.3011
Primary Care Provider Specialty	-.2723	.4649	.7616	.3481	1.6662
Participant Insurance Benefit	.4913	2.1894	1.6344	.8526	3.1331
Neighborhood Urbanicity	.4215	1.8396	1.5243	.8289	2.8028
Neighborhood Ethnicity	.5693	3.4525	1.7671	.9693	3.2217
Neighborhood Affluence	-.0679	.0426	.9433	.4903	1.7807
Constant	-3.0206	7.6479**			
-2 Log Likelihood	375.570				
Model Chi-square (*df* = 11)	76.146				
p Value	.0000				
Overall Rate of Correct Classification	71.6%				
n	341				

[1]Logistic Regression
[2]Unstandardized logistic regression coefficient
[3]ED - Emergency Department
*p < .05 **p < .01 ***p < .005

Two predictor variables were significantly related to the likelihood of using emergency department services: 1) age dummy variable, 12 years or older; and 2) beta-

agonist to anti-inflammatory medication ratio. Participants age 12 years or older were over twice as likely to use emergency department services compare to participants age four years or younger (odds ratio = 2.3). Participants with a high beta-agonist to anti-inflammatory medication ratio were almost twice as likely to use emergency department services compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.8). The classification results indicate moderate success, with an overall rate of correct classification of 71.6% in the analysis sample.

Hypothesis H.1.c. It was hypothesized that the probability of using primary care provider services would be more for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods, when controlling for pre-test year primary care provider services use. *This research partially supports the hypothesis.* As shown in Table 37, the overall predictive model for using primary care provider services was statistically significant (χ^2 =18.577, p =.0500). Beta-agonist to anti-inflammatory medication ratio was the only predictor variable significantly related to the likelihood of using primary care provider services. In this study, participants with a high beta-agonist to anti-inflammatory medication ratio were twice as likely to use primary care provider services compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.2). The classification results indicate moderate success, with an overall rate of correct classification of 69.9% in the analysis sample. Conservative interpretation of study results is recommended given the wide confidence interval noted for the pre-test year predictor variable (1.0159,

35.6826).

Table 37

Results Of Logistic Regression Model For Primary Care Provider Services Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP* Services Use	1.7952	3.9099*	6.0208	1.0159	35.6826
Dummy Variable Age 5 Years to 11 Years	.1856	.3900	1.2039	.6725	2.1553
Dummy Variable Age 12 Years or older	.3152	.8109	1.3705	.6902	2.7213
Participant Gender	-.2436	.8368	.7838	.4650	1.3210
Beta-agonist to Anti-inflammatory Ratio	.7880	8.1670***	2.1991	1.2809	3.7754
Primary Care Provider Gender	.0229	.0075	1.0232	.6086	1.7202
Primary Care Provider Specialty	.2912	.5864	1.3380	.6350	2.8193
Participant Insurance Benefit	-.2062	.4083	.8137	.4323	1.5315
Neighborhood Urbanicity	-.2363	.5612	.7896	.4255	1.4650
Neighborhood Ethnicity	-.1390	.2078	.8702	.4787	1.5819
Neighborhood Affluence	-.4277	1.9368	.6520	.3570	1.1908
Constant	-1.0140	.5341			
-2 Log Likelihood	393.212				
Model Chi-square (*df* = 11)	18.577				
p Value	.0500				
Overall Rate of Correct Classification	69.9%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Hypothesis H.1.d. It was hypothesized that the probability of being classified primary care provider high users would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately

urban neighborhoods, when controlling for pre-test year primary care provider high users. *This research partially supports the hypothesis.*

As shown in Table 38, the overall predictive model for being classified primary care provider high users was statistically significant (χ^2 =105.922, p =.0000). Three predictor variables were significantly related to the likelihood of being classified primary care provider high users: 1) age dummy variable, 5 years to 11 years; 2) age dummy variable, 12 years or older; and 3) beta-agonist to anti-inflammatory medication ratio. Participants age 5 years to 11 years were almost three times as likely to be classified primary care provider high users compared to participants age four years or younger (odds ratio = 2.8). Participants age 12 years or older were almost six times as likely to be classified primary care provider high users compared to participants age four years or younger (odds ratio = 5.9). Participants with a high beta-agonist to anti-inflammatory medication ratio were 2.5 times more likely to be classified primary care provider high users than participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.6). The classification results indicate high success, with an overall rate of correct classification of 84.2% in the analysis sample.

Table 38

Results Of Logistic Regression Model For Primary Care Provider High User Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[*] High User	2.8800	63.4722***	17.8143	8.7713	36.1805
Dummy Variable Age 5 Years to 11 Years	1.0415	5.2009*	2.8335	1.1577	6.9351
Dummy Variable Age 12 Years or older	1.7828	12.9202***	5.9466	2.2495	15.7199
Participant Gender	.0213	.0039	1.0215	.5220	1.9990
Beta-agonist to Anti-inflammatory Ratio	.9489	7.9408***	2.5928	1.3350	4.9973
Primary Care Provider Gender	-.1309	.1394	.8773	.4414	1.7437
Primary Care Provider Specialty	.5628	1.0917	1.7556	.6108	5.0458
Participant Insurance Benefit	.3125	.5934	1.3668	.6172	3.0270
Neighborhood Urbanicity	-.0759	.3054	.9269	.4204	2.0438
Neighborhood Ethnicity	-.1720	.1957	.8419	.3929	1.8043
Neighborhood Affluence	-.4024	.8622	.6687	.2860	1.5635
Constant	-4.8651	11.2059***			
-2 Log Likelihood	255.273				
Model Chi-square (*df* = 11)	105.922				
p Value	.0000				
Overall Rate of Correct Classification	84.2%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[*]PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Hypothesis H.1.e. It was hypothesized that the probability of using specialist services would be more for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods, when

controlling for pre-test year specialist services use. *This research partially supports the hypothesis.*

As shown in Table 39, the overall predictive model for using specialist services was statistically significant (χ^2 =71.387, p =.0000). Three predictor variables were significantly related to the likelihood of using specialist services: 1) age dummy variable, 12 years or older; 2) beta-agonist to anti-inflammatory medication ratio; and 3) neighborhood urbanicity. Participants age 12 years or older were twice as likely to use specialist services compared to participants age four years or younger (odds ratio = 2.0). Participants with a high beta-agonist to anti-inflammatory medication ratio were three times more likely to use specialist services compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 3.1). Participants residing in predominately urban neighborhoods were almost twice as likely to use specialist services compared to participants residing in non-urban neighborhoods (odds ratio = 1.7). The classification results indicate moderate success, with an overall rate of correct classification of 68.1% in the analysis sample.

Table 39

Results Of Logistic Regression Model For Specialist Services
Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Specialist Services Use	1.4871	33.5801***	4.4244	2.6755	7.3164
Dummy Variable Age 5 Years to 11 Years	.4996	2.5989	1.6481	.8978	3.0254
Dummy Variable Age 12 Years or older	.7089	4.1017*	2.0319	1.0231	4.0351
Participant Gender	.0415	.0251	1.0424	.6235	1.7428
Beta-agonist to Anti-inflammatory Ratio	1.1188	18.4446***	3.0612	1.8371	5.1007
Primary Care Provider Gender	.0857	.1040	1.0895	.6471	1.8345
Primary Care Provider Specialty	-.2897	.5499	.7485	.3480	1.6097
Participant Insurance Benefit	.1138	.1253	1.1205	.5967	2.1040
Neighborhood Urbanicity	.5538	3.2081*	1.7399	1.0216	3.1894
Neighborhood Ethnicity	.2428	.6639	1.2748	.7109	2.2860
Neighborhood Affluence	-.2127	.4499	.8084	.4342	1.5051
Constant	-2.1217	4.1543*			
-2 Log Likelihood	389.766				
Model Chi-square (*df* = 11)	71.387				
p Value	.0000				
Overall Rate of Correct Classification	68.1%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Hypothesis H.2.

It was hypothesized that when population-related factors (patient-related factors and provider-related factors) and external environment are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of

health services cost, when controlling for pre-test year health services cost. *This research supports the hypothesis.*

Hypothesis H.2.a. It was hypothesized that the probability of being classified high total health care cost would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in predominately urban neighborhoods, when controlling for pre-test year total health care cost. *This research partially supports the hypothesis.* As shown in Table 40, the overall predictive model for being classified high health care cost was statistically significant (χ^2 =61.089, p =.0000). Three predictor variables were significantly related to the likelihood of being classified high total health care cost: 1) age dummy variable, 12 years or older; 2) beta-agonist to anti-inflammatory medication ratio; and 3) primary care provider specialty. Participants age 12 years or older were over five times more likely to be classified high total health care cost compared to participants age four years or younger (odds ratio = 5.4). Participants with a high beta-agonist to anti-inflammatory medication ratio were twice as likely to be classified high total health care cost compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 2.2). Participants managed by pediatric primary care providers were four times as likely to be classified high total health care cost compared to participants managed by general practice primary care providers (odds ratio = 4.0). The classification results indicate high success, with an overall rate of correct classification of 83.6% in the analysis sample.

Table 40

Results Of Logistic Regression Model For High Total Health Care Cost Excluding Environment-Related Factors: Health Care Environment

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Total Health Care Cost	1.9769	33.8480***	7.2206	3.7097	14.0546
Dummy Variable Age 5 Years to 11 Years	.7846	3.1723	2.1914	.9242	5.1961
Dummy Variable Age 12 Years or older	1.6828	13.4315***	5.3804	2.1877	13.2329
Participant Gender	-.0943	.0848	.9100	.4825	1.7163
Beta-agonist to Anti-inflammatory Ratio	.7781	5.6902*	2.1774	1.1489	4.1268
Primary Care Provider Gender	-.0694	.0434	.9330	.4859	1.7915
Primary Care Provider Specialty	1.3887	5.8515*	4.0096	1.3015	12.3525
Participant Insurance Benefit	.1696	.1860	1.1849	.5481	2.5614
Neighborhood Urbanicity	.0481	.0155	1.0492	.4924	2.2359
Neighborhood Ethnicity	.3796	1.0542	1.4616	.7082	3.0165
Neighborhood Affluence	-.0673	.0292	.9349	.4322	2.0223
Constant	6.2328	16.7759*			
-2 Log Likelihood	274.180				
Model Chi-square (*df* = 11)	61.089				
p Value	.0000				
Overall Rate of Correct Classification	83.6%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

Population-Related Factors And Environment-Related Factors

Study findings for hypotheses I.1. through I.2.a. are presented in Table 41 through Table 46.

Hypothesis I.1.

It was hypothesized that when population-related factors and environment-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, the asthma management program, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test year health services use. *This research supports the hypothesis.*

Hypothesis I.1.a. It was hypothesized that the probability of being admitted to the hospital would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods, when controlling for pre-test year hospital admission. *This research partially supports the hypothesis.* As shown in Table 41, the overall predictive model for hospital admission was statistically significant ($\chi^2 =$ 129.408, $p = .0000$). Two asthma management program dummy predictor variables were significantly related to the likelihood of being admitted to the hospital: 1) participants who declined to enroll in the asthma management program; and 2) participants who were not referred to the asthma management program. Participants who declined to enroll in the asthma management program were almost 17 times more likely to be admitted to the

hospital compared to participants enrolled in the program (odds ratio = 16.9). Participants who were not referred to the asthma management program were almost 11 times more likely to be admitted to the hospital (odds ratio = 11.0). The classification results indicate high success, with an overall rate of correct classification of 86.6% in the analysis sample.

Hypothesis I.1.b. It was hypothesized that the probability of using emergency department services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods, when controlling for pre-test year emergency department services use. *This research partially supports the hypothesis.* As shown in Table 42, the overall predictive model for using emergency department services was statistically significant ($\chi^2 = 122.628$, p =.0000). Two asthma management program dummy predictor variables were significantly related to the likelihood of using emergency department services: 1) participants who declined to enroll in the asthma management program; and 2) participants who were not referred to the asthma management program. Participants who declined to enroll in the asthma management program were twice as likely to use emergency department services compared to participants enrolled in the program (odds ratio = 2.2). Participants who were not referred to the asthma management program were over 12 times more likely to use emergency department services compared to participants enrolled in the asthma management program (odds ratio = 12.3). The classification results indicate high

success, with an overall rate of correct classification of 75.2% in the analysis sample.

Table 41

Results Of Logistic Regression Model For Hospital Admission Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	b[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Hospital Admission	2.4621	37.0880***	11.7293	5.3106	25.9060
Dummy Variable Age 5 Years to 11 Years	.4886	1.1187	1.6300	.6592	4.0309
Dummy Variable Age 12 Years or older	.7524	2.0909	2.1221	.7653	5.8839
Participant Gender	.0941	.0670	1.0986	.5390	2.2392
Beta-agonist to Anti-inflammatory Ratio	.3749	1.0715	1.4548	.7154	2.9585
Primary Care Provider Gender	-.2811	.5946	.7549	.3695	1.5425
Primary Care Provider Specialty	.0064	.0001	1.0064	.3485	2.9065
Participant Insurance Benefit	.2170	.2424	1.2423	.5237	2.9471
Neighborhood Urbanicity	.0743	.0313	1.0771	.4731	2.4519
Neighborhood Ethnicity	.3681	.7986	1.4450	.6446	3.2393
Neighborhood Affluence	.2611	.3319	1.2983	.5341	3.1563
Primary Care Provider Office In Neighborhood	.8160	1.7212	2.2615	.6683	4.5842
Primary Care Provider Office With Late Hours In Neighborhood	-.3389	.1273	.7126	.1108	4.5842
Dummy Variable Declined Asthma Management Program	2.8288	37.8072***	16.9257	6.8697	41.7019
Dummy Variable Not Referred To Asthma Management Program	2.4019	22.8038***	11.0439	4.1209	29.5976
Constant	-4.9139	11.6173***			
-2 Log Likelihood	231.786				
Model Chi-square (*df* = 15)	129.408				
p Value	.0000				
Overall Rate of Correct Classification	86.6%				
n	341				

[1]Logistic Regression

[§]Unstandardized logistic regression coefficient

*p < .05 **p < .01 ***p < .005

Table 42

Results Of Logistic Regression Model For Emergency Department Services Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year ED[a] Services Use	1.7068	35.4966***	5.5111	3.1434	9.6623
Dummy Variable Age 5 Years to 11 Years	.2857	.6752	1.3307	.6732	2.6305
Dummy Variable Age 12 Years or older	.3384	.7150	1.4028	.6402	3.0738
Participant Gender	-.1744	.3529	.8400	.4726	1.4931
Beta-agonist to Anti-inflammatory Ratio	.0840	.0747	1.0876	.5955	1.9862
Primary Care Provider Gender	.0353	.0140	1.0359	.5772	1.8593
Primary Care Provider Specialty	-.4323	.9181	.6490	.2680	1.5714
Participant Insurance Benefit	.5880	2.6106	1.8003	.8823	2.4519
Neighborhood Urbanicity	.3828	1.2141	1.4664	.7422	2.8969
Neighborhood Ethnicity	.4630	1.8527	1.5888	.8157	3.0946
Neighborhood Affluence	.0223	.0039	1.0225	.5061	2.0657
Primary Care Provider Office In Neighborhood	-.6260	1.2784	.5347	.1807	1.5827
Primary Care Provider Office With Late Hours In Neighborhood	.9577	1.7719	2.6525	.6307	11.1547
Dummy Variable Declined Asthma Management Program	.7927	2.0337*	2.2094	1.1054	4.4161
Dummy Variable Not Referred To Asthma Management Program	2.5071	34.8305***	12.2689	5.3360	28.2095
Constant	-2.7934	5.4119*			
-2 Log Likelihood	329.088				
Model Chi-square (*df* = 15)	122.628				
p Value	.0000				
Overall Rate of Correct Classification	75.2%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[a]ED - Emergency Department
*p < .05 **p < .01 ***p < .005

Hypothesis I.1.c. It was hypothesized that the probability of using primary care provider services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods, when controlling for pre-test year primary care provider services use. *This research partially supports the hypothesis.* As shown in Table 43, the overall predictive model for using primary care provider services was statistically significant ($\chi^2 = 82.487$, $p = .0000$). Two dummy asthma management program predictor variables were significantly related to the likelihood of using primary care provider services: 1) participants who declined to enroll in the asthma management program; and 2) participants who were not referred to the asthma management program. Participants who declined to enroll in the asthma management program were nine times more likely to use primary care provider services compared to participants enrolled in the program (odds ratio = 9.0). Participants who were not referred to the asthma management program were almost 37 times more likely to use primary care provider services compared to participants enrolled in the asthma management program (odds ratio = 36.9). The classification results indicate moderate success, with an overall rate of correct classification of 72.5% in the analysis sample. Conservative interpretation of this result is recommended given the wide confidence interval noted for the pre-test year predictor variable (4.9449, 339.4367) and the asthma management program dummy variable, not referred to the program (7.7074, 177.5120).

Table 43

Results Of Logistic Regression Model For Primary Care Provider Services Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	b[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[a] Services Use	3.7128	11.8441***	40.9691	4.9449	339.4367
Dummy Variable Age 5 Years to 11 Years	-.0110	.0012	.9891	.5274	1.8550
Dummy Variable Age 12 Years or older	-.3889	.9262	.6778	.3070	1.4966
Participant Gender	-.4041	1.9263	.6676	.3773	1.1812
Beta-agonist to Anti-inflammatory Ratio	.1904	.3590	1.2097	.6489	2.2552
Primary Care Provider Gender	-.1520	.2768	.8590	.4875	1.5134
Primary Care Provider Specialty	.1337	.1031	1.1430	.5054	2.5853
Participant Insurance Benefit	-.2377	.4454	.7884	.3992	1.5847
Neighborhood Urbanicity	-.2094	.3328	.8111	.3982	1.6521
Neighborhood Ethnicity	-.1418	.1755	.8678	.4471	1.6846
Neighborhood Affluence	-.2624	.6180	.7692	.3999	1.4796
Primary Care Provider Office In Neighborhood	-.5342	1.0138	.5861	.2072	1.6581
Primary Care Provider Office With Late Hours In Neighborhood	-.0368	.0029	.9638	.2498	3.7190
Dummy Variable Declined Asthma Management Program	2.1987	20.8925***	9.0136	3.5111	23.1397
Dummy Variable Not Referred To Asthma Management Program	3.6106	20.3578***	36.9887	7.7074	177.5120
Constant	-2.5547	2.5958			
-2 Log Likelihood	329.302				
Model Chi-square (*df* = 15)	82.487				
p Value	.0000				
Overall Rate of Correct Classification	72.5%				
n	341				

[1]Logistic Regression

[§]Unstandardized logistic regression coefficient

[a]PCP - Primary care provider

*p < .05 **p < .01 ***p < .005

Hypothesis I.1.d. It was hypothesized that the probability of being classified primary care provider high users would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods. *This research partially supports the hypothesis.* As shown in Table 44, the overall predictive model for being classified primary care provider high users was statistically significant ($\chi^2 = 146.182$, $p = .0000$). Three predictor variables were significantly related to the likelihood of being classified primary care provider high users: 1) age dummy variable, 12 years or older; and 2) two asthma management program dummy variables, participants who declined to enroll in the asthma management program and participants who were not referred to the asthma management program. Participants age 12 years or older were over three times more likely to be classified primary care provider high users compared to participants age four years or younger (odds ratio = 3.3). Participants who declined to enroll in the asthma management program were almost 12 times more likely to be classified primary care provider high users compared to participants enrolled in the program (odds ratio = 11.6). Participants who were not referred to the asthma management program were almost 11 times more likely to be classified primary care provider high users compared to participants enrolled in the asthma management program (odds ratio = 10.7). The classification results indicate high success, with an overall rate of correct classification of 86.9% in the analysis sample.

Table 44

Results Of Logistic Regression Model For Primary Care Provider High User Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year PCP[a] High User	2.5639	41.5740***	12.9868	5.9570	28.3124
Dummy Variable Age 5 Years to 11 Years	.9108	3.0033	2.4864	.8876	6.9652
Dummy Variable Age 12 Years or older	1.1826	4.4734*	3.2328	1.0906	9.7620
Participant Gender	-.0500	.0166	.9512	.4450	2.0334
Beta-agonist to Anti-inflammatory Ratio	.0411	.0127	1.0451	.4856	2.2491
Primary Care Provider Gender	-.4113	1.0976	.6628	.3071	1.4306
Primary Care Provider Specialty	.0941	.0256	1.0986	.3473	3.4755
Participant Insurance Benefit	.0895	.0420	1.0936	.4649	2.5724
Neighborhood Urbanicity	.0916	.0413	1.0959	.4529	2.6517
Neighborhood Ethnicity	.0297	.0047	1.0302	.4405	2.4090
Neighborhood Affluence	.0462	.0092	1.0473	.4061	2.7009
Primary Care Provider Office In Neighborhood	.7091	1.3399	2.0323	.6116	6.7524
Primary Care Provider Office With Late Hours In Neighborhood	-1.6033	2.3463	.2012	.0259	1.5655
Dummy Variable Declined Asthma Management Program	2.4543	26.0107***	11.6377	4.5316	29.8870
Dummy Variable Not Referred To Asthma Management Program	2.3666	22.7317***	10.6610	4.0298	28.2041
Constant	-4.3835	8.5479***			
-2 Log Likelihood	215.013				
Model Chi-square (*df* = 15)	146.182				
p Value	.0000				
Overall Rate of Correct Classification	86.9%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
[a]PCP - Primary care provider
*p < .05 **p < .01 ***p < .005

Hypothesis I.1.e. It was hypothesized that the probability of using specialist services would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods, when controlling for pre-test year specialist services use. *This research partially supports the hypothesis.* As shown in Table 45, the overall predictive model for using specialist services was statistically significant ($\chi^2 = 116.029$, $p = .0000$). Four predictor variables were significantly related to the likelihood of using specialist services: 1) beta-agonist to anti-inflammatory medication ratio; 2) neighborhood urbanicity; and 3) two asthma management program dummy variables, participants who declined to enroll in the asthma management program and participants who were not referred to the asthma management program. Participants with a high beta-agonist to anti-inflammatory medication ratio were almost twice as likely to use specialist services compared to participants with a low beta-agonist to anti-inflammatory medication ratio (odds ratio = 1.9). Participants residing in urban neighborhoods were over twice as likely to use specialist services compared to participants residing in non-urban neighborhoods (odds ratio = 2.4). Participants who declined to enroll in the asthma management program were almost five times as likely to use specialist services compared to participants who enrolled in the asthma management program (odds ratio = 4.8). Participants who were not referred to the asthma management program were over nine times more likely to use specialist services compare to participants enrolled in the asthma management program (odds ratio = 9.1).

Table 45

Results Of Logistic Regression Model For Specialist Services
Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	*b*[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Specialist Services Use	1.2265	19.2693***	3.4094	1.9717	5.8954
Dummy Variable Age 5 Years to 11 Years	.3433	1.0587	1.4097	.7329	2.7111
Dummy Variable Age 12 Years or older	.1980	.2574	1.2190	.5672	2.6195
Participant Gender	-.0282	.0099	.9722	.5576	1.6952
Beta-agonist to Anti-inflammatory Ratio	.6313	4.7472*	1.8800	1.0655	3.3174
Primary Care Provider Gender	-.1726	.3613	.8415	.4793	1.4772
Primary Care Provider Specialty	-.6812	2.6017	.5060	.2211	1.1578
Participant Insurance Benefit	.1732	.2527	1.1891	.6052	2.3365
Neighborhood Urbanicity	.8587	6.1240*	2.3600	1.1955	4.6586
Neighborhood Ethnicity	.3047	.8877	1.3562	.7195	2.5562
Neighborhood Affluence	-.0709	.0426	.9315	.4750	1.8268
Primary Care Provider Office In Neighborhood	.5751	1.2699	1.7772	.6537	4.8318
Primary Care Provider Office With Late Hours In Neighborhood	-.3329	.2248	.7168	.1810	2.8388
Dummy Variable Declined Asthma Management Program	1.5620	19.6359***	4.7685	2.3896	9.5154
Dummy Variable Not Referred To Asthma Management Program	2.2105	30.4147***	9.1206	4.1576	20.0083
Constant	-1.8449	2.8061			
-2 Log Likelihood	345.123				
Model Chi-square (*df* = 15)	116.029				
p Value	.0000				
Overall Rate of Correct Classification	75.5%				
n	341				

[1]Logistic Regression
[§]Unstandardized logistic regression coefficient
*p < .05 **p < .01 ***p < .005

The classification results indicate high success, with an overall rate of correct classification of 75.5% in the analysis sample.

Hypothesis I.2.

It was hypothesized that when population-related factors and environment-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, the asthma management program, and neighborhood urbanicity will all be predictive of health services cost, when controlling for pre-test year health services cost. *This research supports the hypothesis.*

Hypothesis I.2.a. It was hypothesized that the probability of being classified high total health care cost would be greater for participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program, and/or reside in predominately urban neighborhoods, when controlling for pre-test year total health care cost. *This research partially supports the hypothesis.* As shown in Table 46, the overall predictive model for being classified high total health care cost was statistically significant ($\chi^2 = 96.814$, $p = .0000$). Three predictor variables were significantly related to the likelihood of being classified high health care cost: 1) age dummy variable, 12 years of age or older; and 2) two asthma management program dummy variables, participants who declined to enroll in the asthma management program and participants who were not referred to the asthma management program. Participants age 12 years or older were almost three times more likely to be

classified high total health care cost compared to participants age four years or younger (odds ratio = 2.7). Participants who declined to enroll in the asthma management program were almost 10 times more likely to be classified high total health care cost compared to participants enrolled in the program (odds ratio = 9.6). Participants who were not referred to the asthma management program were over eight times more likely to be classified high total health care cost compared to participants enrolled in the asthma management program (odds ratio = 8.2). The classification results indicate high success, with an overall rate of correct classification of 90.0% in the analysis sample.

Table 46

Results Of Logistic Regression Model For High Total Health Care Cost Including Population-Related Factors And Environment-Related Factors

Predictor Variable[1]	b[§]	Wald Statistic	Adjusted Odds Ratio	95% Confidence Interval Lower	Upper
Pre-test Year Total Health Care Cost	2.1594	29.4576***	8.6663	3.9734	18.9017
Dummy Variable Age 5 Years to 11 Years	.4566	.9613	1.5786	.6337	3.9324
Dummy Variable Age 12 Years or older	1.0092	4.0495*	2.7434	1.0266	7.3312
Participant Gender	-.1319	.1353	.8765	.4341	1.7695
Beta-agonist to Anti-inflammatory Ratio	.1420	.1513	1.1526	.5635	2.3574
Primary Care Provider Gender	-.4304	1.4110	.6503	.3196	1.3228
Primary Care Provider Specialty	1.0335	2.8392	2.8110	.8448	9.3534
Participant Insurance Benefit	.0786	.0325	1.0818	.4599	2.5444
Neighborhood Urbanicity	.3436	.6421	1.4100	.6085	3.2673
Neighborhood Ethnicity	.4367	1.1619	1.5476	.6995	3.4238
Neighborhood Affluence	.1633	.1429	1.774	.5049	2.7460
Primary Care Provider Office In Neighborhood	.0619	.0091	1.0638	.2984	3.7921
Primary Care Provider Office With Late Hours In Neighborhood	.0360	.0014	1.3067	.1594	6.7410
Dummy Variable Declined Asthma Management Program	2.2579	24.6936***	9.5632	3.9250	23.3007
Dummy Variable Not Referred To Asthma Management Program	2.1066	19.3459***	8.2200	3.2151	21.0159
Constant	-6.0483	15.3375***			
-2 Log Likelihood	238.455				
Model Chi-square (*df* = 15)	96.814				
p Value	.0000				
Overall Rate of Correct Classification	90.0%				
n	341				

[1]Logistic Regression

[§]Unstandardized logistic regression coefficient

*p < .05 **p < .01 ***p < .005

CHAPTER V: CONCLUSIONS, IMPLICATIONS FOR HEALTH POLICY, AND RECOMMENDATIONS FOR FURTHER RESEARCH

Introduction

Asthma health care has been a priority for policy makers in both the private and public sector. Of particular interest is the role of patient-related and contextual factors in explaining health care utilization behaviors. Therefore, this research focused on the relationship between patient-related factors, contextual factors and health services use, for an insured population of children with asthma.

The Behavior Model of Utilization (Phillips, et al., 1998) offered a systematic and organized approach to identify and test various variables that influence pediatric asthma health services. Two major sets of factors and their relative contribution to pediatric health services use were tested. First, patient-related factors and contextual factors were measured to explore the context within asthma health services occurred. Previously unexplored variables, such as primary care provider gender and availability of neighborhood-based primary care provider services were included. Second, the explanatory power of the Behavior Model of Utilization for pediatric asthma health services use in one urban, regional managed care company was tested. Explanatory models, based on logistic regression analyses, were developed at the participant and primary care provider level. These models were used to test the relative contribution of patient-related and contextual factors to asthma health services use. Of particular significance was the contextual factor: the asthma management program.

Asthma Management Program

To improve the health and well-being of children with asthma, policy makers and clinicians must understand both the context within which asthma health services occurs and the relative contribution of patient-related factors and contextual factors to health services use. Review of summary results for bivariate analyses (Tables 53 through Table 55-C, Appendix A) and multivariate analyses (Table 56 through Table 59, Appendix B), revealed the pivotal role the asthma management program played in promoting appropriate resource utilization behaviors and reducing costs for children with asthma insured by one urban, regional managed care company.

Context of Asthma Health Care

In this research, patient-related factors, provider-related factors, and environment-related factors were measured to explore the context within which asthma health services occurs.

Predisposing Characteristics (Age). This research did not support the findings of previous research regarding the relationship between age and asthma health services use. For example, Weiss and Budetti (1993) concluded that children under five years of age have experienced the fastest increase in asthma-related hospital admissions over the past decade. Additionally, these authors found a disproportionate increase in hospital rates across age groups. Specifically, children four years of age or younger experienced the largest increase (5.0% annually) in asthma-related hospital admissions compared to other age groups (2.9% annually).

In this research, participants age 12 years or older were significantly more likely to use health services or be classified high total health care cost compared to children age four years or younger or children age 5 years to 11 years. It was interesting to note that over 80 percent of the children enrolled in the asthma management program were 11 years of age or younger.

Need (Beta-agonist To Anti-inflammatory Medication Ratio). Need was used as a proxy for illness severity (National Committee for Quality Assurance, 1999) and defined as participants' beta-agonist to anti-inflammatory medication ratio. In this study, participants with a high (3:1 or greater) beta-agonist to anti-inflammatory medication ratio were significantly more likely to use health services or be classified high total health care cost compared to participants with a low (less than 3:1) beta-agonist to anti-inflammatory medication ratio. Interestingly, participants enrolled in the asthma management program were significantly less likely to have a high beta-agonist to anti-inflammatory medication ratio compared to participants who declined to enroll in the program or participants not referred to the program by their primary care provider.

Generally, these research findings are consistent with previous research (Kelso, et al., 1996; Balkrishnan, et al., 1998; Donahue, et al., 1997). For example, Kelso and colleagues (1996) conducted a non-randomized control trial with a two year intervention to determine if a comprehensive long-term asthma management program stressing the importance of anti-inflammatory medications would improve outcomes. Study results revealed participants with a low beta-agonist to anti-inflammatory ratio had fewer hospital admissions and fewer emergency department visits. Balkrishnan and colleagues

(1998) demonstrated similar results. These authors used paired t-tests to evaluate differences in health services use between participants with a high beta-agonist to anti-inflammatory medication ratio and participants with a low beta-agonist to anti-inflammatory mediation ratio. Study results revealed that introduction of prophylactic inhaled anti-inflammatory medications improved both clinical and economic outcomes. Specifically, hospital admissions were reduced 50 percent, emergency department visits were reduced 15 percent, and primary care provider visits were reduced 20 percent.

Finally, Donahue and colleagues (1997) conducted a population based study of asthma members insured by a large health maintenance organization. In this study, effectiveness of anti-inflammatory medications was examined under conditions of actual use among a large, diverse population with asthma. Adjusted analysis revealed use of anti-inflammatory medications was related to a 50 percent reduction in risk of asthma-related hospitalizations. Conversely, increases in beta-agonist prescriptions were positively correlated with risk of asthma hospitalization.

Provider-Related Factors (Individual Enabling). Differences noted in pediatric asthma health services use and cost were not statistically significant. Overall, this research did not support the findings of previous research regarding the influence of insurance benefits on health services use (Lozano, et al., 1995). Lozano and colleagues (1995) conducted a historical cohort study, using Medicaid claims data, to evaluate whether African-American children with asthma used hospital and emergency department services more frequently than Caucasian children with similar insurance. Study results revealed African-American children were more likely to use emergency

department services or be hospitalized compared to Caucasian children. Odd ratios reported were 1.70 for emergency department visits and 1.42 for hospital admissions. The authors concluded that higher emergency department use was not fully explained by poverty or inadequate health care insurance. Study results also revealed that African-American children were less likely to use primary care provider services, suggesting suboptimal use of preventive services.

Provider-Related Factors (Provider Enabling). Relationships between primary care provider gender and asthma health services use have not been reported in the literature. In this study, differences noted in the likelihood of using health services or being classified high total health care cost between participants whose care was managed by female primary care providers and participants whose care was managed by male primary care providers were not statistically significant. Likewise, differences noted in the likelihood of using health services or being classified high total health care cost between participants whose care was managed by pediatric primary care providers and participants whose care was managed by general practice primary care providers were not statistically significant. However, participants who declined to enroll in the asthma management program were significantly more likely to be managed by pediatric primary care providers compared to participants enrolled in the program or participants not referred to the program.

Much debate in the literature surrounds the management of patients with asthma by primary care providers versus specialists. The results of this research support those reported in the literature by Lawrence (1998) and Seid, et al., (1997). In the study

reported by Lawrence (1998), Lovelace Health Care Innovations employed primary care physicians instead of specialists to manage patients with asthma in a free standing asthma clinic. Program evaluation results revealed significant reductions in hospital admissions (60%) and emergency department visits (82%) when patients were managed by general practice primary care providers. Study results reported by Seid et al., (1997) supported results reported by Lawrence (1998). Seid and colleagues (1997) conducted a retrospective, two group comparison study, to explore the influence of hospital based specialists and pediatric primary care physicians on asthma-related health services use. Mann Whitney rank sum test revealed no significant differences in illness burden between the two groups. Likewise, an independent *t*-test revealed no significant differences in financial or clinical outcomes.

The results of this research do not support the study results reported by Vollmer and colleagues (1997). These authors conducted a cross-sectional analysis of patients with asthma in a large health maintenance organization to examine the role of physician specialty. Study results revealed specialists were more likely to manage exacerbations of asthma symptoms in the outpatient setting compared to emergency department settings. Given these findings, the authors concluded that the use of specialists to manage patients with asthma was both beneficial to patients and the organizations.

Health Care Environment (Availability). Relationships between availability of primary care provider offices in participant neighborhoods and health services use have not been reported in the literature. In this research, differences in the likelihood of using health services or being classified high total health care cost between participants

with primary care provider offices, offering late hours, located in their neighborhoods and participants without primary care provider offices, offering late hours, located in their neighborhoods were not statistically significant. Likewise, differences in the likelihood of using health services or being classified high total health care cost between participants with primary care provider offices located in their neighborhoods and participants without primary care provider offices located in their neighborhoods were not statistically significant. However, participants who declined to enroll in the asthma management program were significantly more likely to have their primary care provider's office located in their neighborhood. Conservative interpretation of study findings is recommended given the limited number of participants' neighborhoods with primary care provider offices.

Health Care Environment (Organization). In this research, participants who enrolled in the asthma management program were significantly less likely to use health services or be classified high total health care cost compared to participants who declined to enroll in the program or were not referred to the program. These findings are consistent with empirical evidence published in the literature (Lahdensuo et al., 1996; Kelly, et al., 1998; Hanchak, et al., 1996; Greineder, et al., 1998). For example, Lahdensuo and colleagues (1996) conducted a prospective, randomized, controlled trial over a 12 month period to explore relationships between self-management and quality of care. Study results indicated that patients participating in the asthma self-management group had fewer unscheduled admissions to the hospital and experienced fewer emergency department visits compared to the traditional management group.

Research conducted by Kelly and colleagues (1998) supported these findings. In this study, forty children with moderate to severe asthma enrolled in an asthma camp to participate in asthma-related education, athletic events and social activities. Study findings revealed significant improvement in patient outcomes following participation in the camp. Specifically, emergency department visits decreased 59 percent with an 85 percent reduction in hospital admissions. Missed days from school declined significantly from 266 days to 188 days.

Hanchak and colleagues (1996) reported similar results for a large, independent practice model health maintenance organization. These authors reported significant improvement in clinical outcomes following participant completion of the *Pediatric Asthma Patient Management Program.* Specifically, hospital admissions decreased 56 percent, hospital days decreased 73 percent, and emergency department visits decreased 57 percent. Fee-for-service costs declined 48 percent representing a cost savings of $2,200 annually for each program participant.

Finally, a prospective, observational pre-test/post-test design with a control group was conducted by Greineder and colleagues (1998) to determine if identification of high risk asthma would decrease resource utilization. Study results revealed a small statistically significant reduction in resource utilization for the control group while the study group demonstrated larger and highly statistically significant reductions in emergency department visits, hospital admissions, and outpatient utilization; 60 percent, 74 percent, and 72 percent, respectively.

External Environment (Neighborhood Urbanicity). Participants who declined to enroll in the asthma management program were significantly less likely to reside in urban neighborhoods. Overall, differences noted in health services use or cost categories between participants residing in urban neighborhoods and participants residing in non-urban neighborhoods were not statistically significant. Study results did reveal that participants residing in urban neighborhoods were significantly less likely to be classified primary care provider high users than participants residing in non-urban neighborhoods.

Results of this research did not support empirical evidence published in the literature related to American's urban poor. For example, results of several small area analyses indicated asthma morbidity and mortality are concentrated in urban, inner-city neighborhoods which are characterized by poverty and large minority populations (Evans, 1992; Gottlieb, et al., 1995; Shukla & Pestian, 1996). These authors concluded that the majority of unscheduled hospital admissions occur in urban areas. Shukla and Pestian (1996) also indicated that unscheduled hospital admissions in Virginia occurred in urban areas where most people had health insurance and easy access to primary care services.

External Environment (Neighborhood Ethnicity and Neighborhood Affluence). Differences in the likelihood of using health services or being classified high total health care cost between participants residing in predominately non-Caucasian neighborhoods and participants residing in predominately Caucasian neighborhoods were not statistically significant. In this study, approximately 30 percent of participants enrolled in the asthma management program resided in low-income neighborhoods

compared to 23.5 percent of participants who declined to enroll in the program and 18.6 percent of participants who were not referred to the program. However, differences noted in the likelihood of using health services or being classified high total health care cost between participants residing in low-income neighborhoods and participants residing in non low-income neighborhoods were not statistically significant.

These findings do not support empirical evidence published in the literature (Blixen, et al., 1997; Gottlieb, et al., 1995; Zoratti, et al., 1998). For example, Blixen and colleagues (1997) argued it is unclear whether poor asthma outcomes are associated with ethnicity or social class. These authors used a structured interview process to explore patient-related and environment-related factors influencing use of emergency department services in three urban hospitals. Study results revealed 45 percent of participants regularly used anti-inflammatory medications while 75 percent managed their asthma with beta-agonist medications. About 63 percent of the participants had accessed emergency department services in the last three months. Over eight percent reported six emergency department visits during the same time frame.

A small area analysis conducted by Gottlieb and colleagues (1995) supported these findings. Study results revealed the asthma hospitalization rate for Boston was twice the age and gender adjusted rate for Massachusetts. Asthma hospitalization rates were highest for the 0 to 4 age group but declined progressively through ages 15 to 24 years. Areas with higher asthma hospitalization rates also had a greater proportion of African-American and Hispanic people. Population areas with lower socioeconomic status exhibited higher asthma hospitalization rates. A strong, positive correlation was

noted between the percentage of people living in poverty and asthma hospitalization rates.

Finally, empirical research conducted by Zoratti and colleagues (1998) demonstrated the correlation between ethnicity and health services use. Study results revealed a statistically significant difference in emergency department use rate between African-Americans and Caucasians. Annual emergency department use rate for African-Americans was 0.71 compared to 0.28 for Caucasians. Annual hospital admission rates were also higher for African-Americans. Interestingly, annual use rates for primary care physician visits were similar between groups. Differences in emergency department visits remained statistically significant after adjusting for socioeconomic class whereas differences in hospital admissions became borderline significant. The authors concluded that ethnic differences may be confounded by predisposing factors or socioeconomic status.

Relative Contribution To Health Services Use

In this research, explanatory models, using logistic regression analysis, were developed to test the relative contribution of patient-related factors and contextual factors to health services use. Pre-test year health services use or cost variables were entered as covariates in the explanatory models to control for pre-test year differences noted between groups and to more accurately assess program effect. The R statistic was used to interpret the magnitude of contribution for individual predictor variables to the dependent variable, health services use (Hair, et al., 1995). This statistic is an index of the partial correlation between each predictor variable and the dependent variable. Small

contributions to the model are associated with smaller absolute values of the R statistic.

Hospital Admission. As shown in Table 47, when patient-related factors were considered together in one model (one-factor model), participant age and beta-agonist to anti-inflammatory medication ratio were predictive of the likelihood of being admitted to the hospital, when holding the pre-test year measure constant. The percent correct classification for the likelihood of being admitted to the hospital was 32.9 percent. When provider-related factors (two-factor model) and external environment factors (three-factor model) were added to the explanatory model, participant age and beta-agonist to anti-inflammatory medication ratio remained the only significant predictor variables.

When health care environment factors (four-factor model) were added to the model, participant age and beta-agonist to anti-inflammatory medication ratio were no longer significant variables. Instead, two dummy variables for the asthma management program, declined to enroll in the asthma management program and not referred to the program, emerged as significant predictor variables. The asthma management program (R=0.32, R=0.23) remained the only predictor variable significantly related to the likelihood of being admitted to the hospital, when population-related and environment-related factors were used to construct a best fit model. In this model, participants who were not enrolled in the asthma management program were significantly more likely to be admitted to the hospital. Overall rate of correct classification for the best fit model was 86.6%. The percent correct classification for the likelihood of being admitted to the hospital was 48.1 percent. The four-factor model had the highest percent correct

classification for the likelihood of being admitted (50.7%).

Emergency Department Services. As shown in Table 48, when patient-related factors were considered together in one model (one-factor model), participant age and beta-agonist to anti-inflammatory medication ratio were predictive of using emergency department services, when holding the pre-test year measure constant. The percent of correct classification for the likelihood of using emergency department was 59.4 percent. When provider-related factors (two-factor model) and external environment factors (three-factor model) were added to the explanatory model, participant age and beta-agonist to anti-inflammatory medication ratio remained the only significant predictor variables.

When health care environment factors (four-factor model) were added to the model, participant age and beta-agonist to anti-inflammatory medication ratio were no longer significant variables. Instead, two dummy variables for the asthma management program, declined to enroll in the asthma management program and not referred to the program, emerged as significant predictor variables. The asthma management program (R=0.08, R=0.28) remained the only predictor variable significantly related to the likelihood of using emergency department services, when population-related and environment-related factors were used to construct a best fit model. In this model, participants who were not enrolled in the asthma management program were significantly more likely to use emergency department services. Overall rate of correct classification for the best fit model was 76.5%. The rate of correct classification for the likelihood of using emergency department services was 61.5 percent for the best fit

Table 47

Explanatory Models For The Likelihood Of Being Admitted To The Hospital

Predictor Variable[1]	Adjusted Odds Ratio One Factor[a] Model	Adjusted Odds Ratio Two Factor[b] Model	Adjusted Odds Ratio Three Factor[c] Model	Adjusted Odds Ratio Four Factor[d] Model	Adjusted Odds Ratio Best Fit Model
Model Chi-square p Value Correct Classification Rate n	70.816 0.0000 81.5% 314	72.272 0.0000 81.2% 314	73.081 0.0000 80.3% 314	129.408 0.0000 86.6% 314	125.703 0.0000 86.6% 314
Pre-test Hospital Admission	7.9874**	7.9090**	8.3324**	11.7293**	11.0349**
Dummy Variable Age 5 Years to 11 Years	1.6877	1.6944	1.9328	1.6300	1.4757
Dummy Variable Age 12 Years or older	3.6482**	4.0046**	4.0780**	2.1221	1.9346
Participant Gender	1.0296	1.0126	1.1514	1.0986	
Beta-agonist to Anti-inflammatory Ratio	2.4472**	2.4951**	2.6551**	1.4548	1.4794
Primary Care Provider Gender		1.0759	1.0833	.7549	
Primary Care Provider Specialty		1.5998	2.0510	1.0064	1.0858
Participant Insurance Benefit		1.1951	1.2237	1.2423	
Neighborhood Urbanicity			.6848	1.0771	.9941
Neighborhood Ethnicity			1.0613	1.4450	
Neighborhood Affluence			.9341	1.2983	
Primary Care Provider Office In Neighborhood				2.2615	
Primary Care Provider Office With Late Hours In Neighborhood				.7126	
Dummy Variable Declined Asthma Management Program				16.9257**	16.1521**
Dummy Variable Not Referred To Asthma Management Program				11.0435**	9.7704**

[1]Logistic Regression
[a]Patient-Related Factors
[b]Patient-Related Factors + Provider-Related Factors
[c]Patient-Related Factors + Provider-Related Factors + External Environment Factors
[d]Patient-Related Factors + Provider-Related Factors + External Environment Factors + Health Care Environment Factors
**p < .005

Table 48

Explanatory Models For The Likelihood
Of Using Emergency Department Services

Predictor Variable[1]	Adjusted Odds Ratio One Factor[a] Model	Adjusted Odds Ratio Two Factor[b] Model	Adjusted Odds Ratio Three Factor[c] Model	Adjusted Odds Ratio Four Factor[d] Model	Adjusted Odds Ratio Best Fit Model
Model Chi-square	**72.756**	**75.458**	**76.146**	**122.628**	**116.254**
p Value	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Correct Classification Rate	**70.1%**	**72.4%**	**71.6%**	**75.2%**	**76.5%**
n	**314**	**314**	**314**	**314**	**314**
Pre-test ED Services Use	6.2301**	6.4050**	6.0236**	5.5111**	5.4579**
Dummy Variable Age 5 Years to 11 Years	1.6090	1.6357	1.6096	1.3307	1.2016
Dummy Variable Age 12 Years or older	2.3512*	2.2904*	2.2822*	1.4028	1.2308
Participant Gender	.9936	.9852	.8990	.8400	
Beta-agonist to Anti-inflammatory Ratio	1.6509*	1.6655*	1.7723*	1.0876	1.0459
Primary Care Provider Gender		1.3164	1.3406	1.0359	
Primary Care Provider Specialty		.7089	.7616	.6490	.6463
Participant Insurance Benefit		1.4193	1.6344	1.8003	
Neighborhood Urbanicity			1.5243	1.4664	1.2111
Neighborhood Ethnicity			1.7671	1.5888	
Neighborhood Affluence			.9344	1.0225	
Primary Care Provider Office In Neighborhood				.5347	
Primary Care Provider Office With Late Hours In Neighborhood				2.6525	
Dummy Variable Declined Asthma Management Program				2.2094*	2.0182*
Dummy Variable Not Referred To Asthma Management Program				12.2689**	12.7373**

[1]Logistic Regression
[a]Patient-Related Factors
[b]Patient-Related Factors + Provider-Related Factors
[c]Patient-Related Factors + Provider-Related Factors + External Environment Factors
[d]Patient-Related Factors + Provider-Related Factors + External Environment Factors + Health Care Environment Factors
*p < .05 **p < .005

model. The two-factor model had the highest rate for correctly classifying the likelihood of using emergency department services (65.9%).

Primary Care Provider Services. In this research, explanatory models for the likelihood of using primary care provider services were not stable. Therefore, conservative interpretation of study results is recommended given the wide confidence intervals for each multivariate analysis discussed in chapter 4. Further research is needed to test the relative contribution of patient-related factors and contextual factors to the likelihood of using primary care provider services. Consequently, this measure was excluded from further analyses.

Primary Care Provider High User

As shown in Table 49, when patient-related factors were considered together in one model (one-factor model), participant age and beta-agonist to anti-inflammatory medication ratio were predictive of being classified primary care provider high users, when holding the pre-test year measure constant. The percent correct classification for the likelihood of being classified primary care provider high user was 58.2 percent. When provider-related factors (two-factor model) and external environment factors (three-factor model) were added to the explanatory model, participant age and beta-agonist to anti-inflammatory medication ratio remained the only significant predictor variables.

When health care environment factors (four-factor model) were added to the model, beta-agonist to anti-inflammatory medication ratio was no longer a significant variable. Instead, two asthma management program dummy variables, declined to enroll

in the program and not referred to the program, emerged as significantly related to the likelihood of being classified primary care provider high user. The percent correct classification for being classified primary care provider high user was 57.1 percent.

Participant age and the asthma management program remained significant predictor variables, when population-related and environment-related factors were used to construct a best fit model. In the best fit model, participants who were 5 years or older or not enrolled in the asthma management program were significantly more likely to be classified primary care provider high users. Relative contribution for the asthma management program variables (R=0.26, R=0.24) was greater than the relative contribution for participant age (R=0.08), when holding the pre-test year measure constant. Overall rate of correct classification for the best fit model was 87.2%. The percent correct classification for the likelihood of being classified primary care provider high user was 55.8 percent. The one-factor model, patient-related factors, had the highest rate for correctly classifying primary care provider high users (58.2%).

Specialist Services. As shown in Table 50, when patient-related factors were considered together in one model (one-factor model), participant age and beta-agonist to anti-inflammatory medication ratio were predictive of using specialist services, when holding the pre-test year measure constant. The percent correct classification for the likelihood of using specialist services was 66.5 percent. These variables remained significant predictors when provider-related factors (two-factor model) and external environment factors (three-factor model) were added to the explanatory model. In the three-factor model, neighborhood urbanicity emerged as a significant predictor variable.

Table 49

Explanatory Models For The Likelihood
Of Being Classified Primary Care Provider High User

Predictor Variable[1]	Adjusted Odds Ratio One Factor[a] Model	Adjusted Odds Ratio Two Factor[b] Model	Adjusted Odds Ratio Three Factor[c] Model	Adjusted Odds Ratio Four Factor[d] Model	Adjusted Odds Ratio Best Fit Model
Model Chi-square p Value Correct Classification Rate n	95.479 0.0000 82.9% 314	97.138 0.0000 83.9% 314	105.922 0.0000 84.2% 314	146.182 0.0000 86.9% 314	142.172 0.0000 87.2% 314
Pre-test PCP High User	13.9277***	14.5815**	17.8143**	12.9868**	12.4026**
Dummy Variable Age 5 Years to 11 Years	2.1436	2.2697	2.8335*	2.4864	2.8101*
Dummy Variable Age 12 Years or older	4.4629**	5.1471**	5.9466**	3.2628*	3.7380*
Participant Gender	.9340	.9213	1.0215	.9512	
Beta-agonist to Anti-inflammatory Ratio	1.9743*	1.9943*	2.5829**	1.0451	1.1450
Primary Care Provider Gender		1.0048	.8733	.6628	
Primary Care Provider Specialty		1.2971	1.7556	1.0986	1.2451
Participant Insurance Benefit		1.5116	1.3668	1.0936	
Neighborhood Urbanicity			.9269	1.0959	1.0109
Neighborhood Ethnicity			.8419	1.0302	
Neighborhood Affluence			.6687	1.0473	
Primary Care Provider Office In Neighborhood				2.0323	
Primary Care Provider Office With Late Hours In Neighborhood				.2012	
Dummy Variable Declined Asthma Management Program				11.6377**	11.0905**
Dummy Variable Not Referred To Asthma Management Program				10.6610**	9.4893**

[1]Logistic Regression
[a]Patient-Related Factors
[b]Patient-Related Factors + Provider-Related Factors
[c]Patient-Related Factors + Provider-Related Factors + External Environment Factors
[d]Patient-Related Factors + Provider-Related Factors + External Environment Factors + Health Care Environment Factors
*$p < .05$ **$p < .005$

When health care environment factors (four-factor model) were added to the model, participant age was no longer a significant variable. Instead, two asthma management program dummy variables, declined to enroll in the program and not referred to the program, emerged as significantly related to the likelihood of using specialist services. Beta-agonist to anti-inflammatory medication ratio and neighborhood urbanicity remained significant predictor variables.

Beta-agonist to anti-inflammatory medication ratio, neighborhood urbanicity, and the asthma management program remained significant predictor variables, when population-related and environment-related factors were used to construct a best fit model. In the best fit model, participants who had a high beta-agonist to anti-inflammatory medication ratio, resided in urban neighborhoods, or were not enrolled in the asthma management program were significantly more likely to use specialist services. Relative contribution for the asthma management program (R=.020, R=0.25) was greater than the relative contribution for beta-agonist to anti-inflammatory medication ratio (R=0.09) or neighborhood urbanicity (R=0.09). Overall rate of correct classification for the best fit model was 75.6%. The percent of correct classification for the likelihood of using specialist services was 67.6 percent. The four-factor model had the highest rate for correctly classifying the likelihood of using specialist services (69.5%).

Table 50

Explanatory Models For The Likelihood Of Using Specialist Services

Predictor Variable[1]	Adjusted Odds Ratio One Factor[a] Model	Adjusted Odds Ratio Two Factor[b] Model	Adjusted Odds Ratio Three Factor[c] Model	Adjusted Odds Ratio Four Factor[d] Model	Adjusted Odds Ratio Best Fit Model
Model Chi-square	**67.897**	**69.057**	**71.387**	**116.029**	**113.064**
p Value	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Correct Classification Rate	**67.5%**	**66.9%**	**68.1%**	**75.5%**	**75.6%**
n	**314**	**314**	**314**	**314**	**314**
Pre-test Specialist Services Use	4.4254**	4.4485**	4.4244**	3.4094**	3.3856**
Dummy Variable Age 5 Years to 11 Years	1.6974	1.6814	1.6481	1.4097	1.3471
Dummy Variable Age 12 Years or older	2.2645*	2.1208*	2.0319*	1.2190	1.1773
Participant Gender	1.0876	1.0891	1.0424	.9722	
Beta-agonist to Anti-inflammatory Ratio	2.8267**	2.8609**	3.0612**	1.8800*	1.9590*
Primary Care Provider Gender		1.1734	1.0895	.8415	
Primary Care Provider Specialty		.7056	.7485	.5060	.5145
Participant Insurance Benefit		1.0268	1.1205	1.1891	
Neighborhood Urbanicity			1.7399*	2.3600*	1.9565*
Neighborhood Ethnicity			1.2748	1.3562	
Neighborhood Affluence			.8084	.9315	
Primary Care Provider Office In Neighborhood				1.7772	
Primary Care Provider Office With Late Hours In Neighborhood				.7168	
Dummy Variable Declined Asthma Management Program				4.7685**	4.6554**
Dummy Variable Not Referred To Asthma Management Program				9.1206**	8.6095**

[1]Logistic Regression
[a]Patient-Related Factors
[b]Patient-Related Factors + Provider-Related Factors
[c]Patient-Related Factors + Provider-Related Factors + External Environment Factors
[d]Patient-Related Factors + Provider-Related Factors + External Environment Factors + Health Care Environment Factors
*$p < .05$ **$p < .005$

Total Health Care Cost. As shown in Table 51, when patient-related factors were considered together in one model (one-factor model), participant age and beta-agonist to anti-inflammatory medication ratio were predictive of being classified high total health care cost, when holding the pre-test year measure constant. The percent of correct classification for the likelihood of being classified high total health care cost was 27.1 percent. When provider-related factors (two-factor model) were added to the explanatory model, primary care provider specialty emerged as a significant predictor variable. Participant age and beta-agonist to anti-inflammatory medication ratio remained significant variables. These three variables remained significant predictors when external environment factors were added to the model (three-factor model).

When health care environment factors (four-factor model) were added to the model, participant age remained statistically significant. However, beta-agonist to anti-inflammatory medication ratio and primary care provider specialty were no longer significant variables. Instead, two asthma management program dummy variables, declined to enroll in the program and not referred to the program, emerged as significantly related to the likelihood of being classified high total health care cost. The percent correct classification for the likelihood of being classified high total health care cost almost doubled to 47.8 percent.

Participant age and the asthma management program remained significant predictor variables, when population-related and environment-related factors were used to construct a best fit model. In this model, participants who were 12 years of age or older or were not enrolled in the asthma management program were significantly more

likely to be classified high total health care cost. Relative contribution for the asthma management program (R=0.25, R=0.23) was greater than the relative contribution for participant age (R=0.08). Overall rate of correct classification for the best fit model was 90.0%. The percent correct classification for the likelihood of being classified high total health care cost was 38.8 percent. The four-factor model had the highest rate for correctly classifying the likelihood of being classified high total health care cost (47.8%).

Table 51

Explanatory Models For The Likelihood
Of Being Classified High Total Health Care Cost

Predictor Variable[1]	Adjusted Odds Ratio One Factor[a] Model	Adjusted Odds Ratio Two Factor[b] Model	Adjusted Odds Ratio Three Factor[c] Model	Adjusted Odds Ratio Four Factor[d] Model	Adjusted Odds Ratio Best Fit Model
Model Chi-square **p Value** **Correct Classification Rate** **n**	**54.563** **0.0000** **83.3%** **314**	**60.245** **0.0000** **83.6%** **314**	**61.089** **0.0000** **83.6%** **314**	**96.814** **0.0000** **90.0%** **314**	**93.648** **0.0000** **90.0%** **314**
Pre-test Total Health Care Cost	6.3255**	6.4635**	7.2206**	8.6663**	9.0105**
Dummy Variable Age 5 Years to 11 Years	1.9127	1.9654	2.1914	1.5786	1.4913
Dummy Variable Age 12 Years or older	4.5293**	5.5332**	5.3804**	2.7434*	2.6743*
Participant Gender	.9258	.8854	.9100	.8765	
Beta-agonist to Anti-inflammatory Ratio	1.8327*	1.9304*	2.1774*	1.1526	1.1906
Primary Care Provider Gender		.9347	.9330	.6503	
Primary Care Provider Specialty		3.0029*	4.0096*	2.8110	2.7769
Participant Insurance Benefit		1.1576	1.1849	1.0818	
Neighborhood Urbanicity			1.0492	1.4100	1.1639
Neighborhood Ethnicity			1.4616	1.5476	
Neighborhood Affluence			.9349	1.1774	
Primary Care Provider Office In Neighborhood				1.0638	
Primary Care Provider Office With Late Hours In Neighborhood				1.3067	
Dummy Variable Declined Asthma Management Program				9.5632**	8.3541**
Dummy Variable Not Referred To Asthma Management Program				8.2200**	7.8007**

[1]Logistic Regression
[a]Patient-Related Factors
[b]Patient-Related Factors + Provider-Related Factors
[c]Patient-Related Factors + Provider-Related Factors + External Environment Factors
[d]Patient-Related Factors + Provider-Related Factors + External Environment Factors + Health Care Environment Factors
*$p < .05$ **$p < .005$

Implications For Asthma-Related Health Policy

Pediatric asthma health services use, in urban, regional managed care companies is clearly a complex issue. Many factors come into play in determining appropriate health services use for children with chronic diseases, such as asthma. In this research, the Behavior Model for Utilization was used to construct explanatory models that explained use of asthma health services in a managed care setting. The model enabled the identification and testing of various factors that influence pediatric asthma health services use in one urban, regional managed care company. More importantly, the conceptual model ensured that all available factors were equally considered.

Asthma Management Program

While a number of patient-related factors and contextual factors were studied, this research found that the contextual factor, asthma management program, was the only significant predictor variable across all health services outcome measures, when holding the pre-test measure constant (Table 52). More importantly, the asthma management program significantly reduced the likelihood of using health services or being classified high total health care cost for enrolled participants.

As shown in Table 52, when other predictor variables emerged as significant, the asthma management program contributed more to the explanatory power of the model, when holding the pre-test measure constant. Additionally, the asthma management program contributed as much or more to the explanatory power of several models than the pre-test year measures. For example, the relative contribution for the asthma management program dummy variable, declined to enroll in the program, was equal

to the relative contribution for the pre-test year measure in the explanatory model for the likelihood of being admitted to the hospital. The relative contribution of the asthma management program dummy variable, not referred to the program, was equal to the relative contribution for the pre-test year measure in the explanatory model for the likelihood of using emergency department services. Finally, the relative contribution of the asthma management program dummy variable, not referred to the program, was greater than the relative contribution for the pre-test year measure in the explanatory model for the likelihood of using specialists services.

Table 52

Relative Contribution Of Significant Predictor Variables
For the Best-fit Explanatory Model

Health Services Outcome Measure[1]	Pre-Test Measure	R Value	Program[a]	R Value	Age	R Value	BA[b] Ratio	R Value	Urban[c]	R Value
Hospital Admit	X	0.32	X	0.32[d] 0.23[e]						
ED Services Use	X	0.28	X	0.08[d] 0.28[e]						
PCP High User	X	0.34	X	0.26[d] 0.24[e]	X	0.08[f] 0.11[g]				
Specialist Services	X	0.20	X	0.20[d] 0.25[e]			X	0.09	X	0.08
Total Health Care Cost	X	0.30	X	0.25[d] 0.23[e]	X	0.08				

[1]Logistic regression model
[a] Asthma management program
[b]Beta-agonist to anti-inflammatory medication ratio
[c]Neighborhood urbanicity
[d] Asthma management program dummy variable, declined to enroll in the asthma management program
[e] Asthma management program dummy variable, not referred to the asthma management program
[f]Age dummy variable, age 5 years to 11 years
[g] Age dummy variable, age 12 years or older

These results were further supported when pre-test year results were compared to post-test year results for each study group individually. Specifically, the likelihood of using pediatric health services was significantly reduced between the pre-test year and post-test year for participants enrolled in the asthma management program. The likelihood of being classified high total health care cost was also reduced. Conversely, the likelihood of using pediatric health services was significantly increased between the pre-test year and post-test year for participants not referred to the asthma management program by their primary care providers. The likelihood of being classified high total health care cost also increased significantly for this group. Differences in the likelihood of using health services between the pre-test year and post-test year, for participants who declined to enroll in the asthma management program, were not statistically significant. However, health services use increased over the two year period. The likelihood of being classified high total health care cost did increase significantly between the pre-test year and the post-test year for the declined group.

Health Policy Objectives

Study results indicate that the asthma management program, based on the *Guidelines For The Diagnosis And Management Of Asthma* (National Heart, Lung and Blood Institute, 1991), promotes appropriate asthma health services use and controls asthma-related health costs for this insured population of children with asthma. The program also enables the managed care company to meet the asthma-related *National Health Objectives for 2000*, promulgated by the Public Health Service (Weiss & Budetti, 1993). Specifically, program case managers accurately identified at risk populations and

tracked health changes over time; significantly reducing asthma-related hospital admissions for enrolled members. Finally, the asthma management program positions the company to receive a favorable accreditation review for the asthma quality indicator defined by the National Committee for Quality Assurance (1999). Specifically, study findings demonstrated a significant reduction in the likelihood of being admitted to the hospital or using emergency department services for members enrolled in the asthma management program. Additionally, members enrolled in the asthma management program were significantly less likely to use beta-agonist medications compared to members not enrolled in the program.

Recommendations

Several recommendations were made to administrators and clinicians from the managed care company following review of the explanatory models. First, study results indicate that the asthma management program influences both health services use and associated cost; particularly in poor, urban neighborhoods within the managed care company's service delivery area. Therefore, a recommendation was made to implement the asthma management program plan-wide. Second, additional research is needed to explore potential barriers to education for members who declined to enroll in the program or members who were not referred to the program by their primary care providers. Use of focus groups may offer a viable strategy for eliciting feed back from the managed care company's customer base.

Focus groups, for primary care providers, should be designed to increase partnerships. Results of this study should be shared with primary care providers to elicit

their support in referring patients with asthma to the program. Potential barriers should be identified and strategies developed to increase primary care provider support. Focus groups for participants, who declined to enroll in the program, and their families should target reasons the program is not meeting their needs. Potential barriers to participation should be explored and strategies developed to increase member participation in the program.

Third, utility of the asthma management program for members 12 years or older should be explored. Experts in education and information technology may be needed to design distribution methods which are more attractive to this age group. Offering asthma-related education through the internet may provide opportunities to engage these members and influence their decisions about asthma health care.

Finally, results of this study should be shared with employer groups insured by the managed care company, given the tremendous economic burden associated with asthma. Focus groups may provide opportunities to explore work-related issues that prevent parents and their children from actively participating in the program. Once potential barriers are identified, case managers can tailor the asthma management program to meet the unique needs of working parents.

The Behavior Model Of Utilization In Pediatric Asthma Health Care

The Behavior Model of Utilization offered a viable conceptual framework to construct explanatory models that explained use of health services for pediatric members with asthma in one, urban managed care company. However, two limitations should be considered when the Behavior Model of Utilization is used to explain health services use.

First, the categorization of a variable as patient-related, provider-related or environment-related is subject to different interpretations. Likewise, operational definitions associated with these variables are open to debate. Clearly, it is not the specific category or operational definition that is important; what is important is that the conceptual model can be used to ensure that all factors are equally considered. Second, it is difficult to capture some factors quantitatively. Specifically, data related to health care financing or personal health choices may not be available. Other factors such as convenience of care or medical staff practice patterns are difficult to quantify.

It should be recognized that the performance of a managed care company can not be adequately measured by any one indicator. For example, managed care companies provide many services ranging from health care to member education to population research to community service. Each of these services has many aspects of member satisfaction, effectiveness of care, availability, comprehensiveness in addition to health services use and associated cost.

Recommendations For Further Research

Additional research is needed to address each of the major purposes of this study. Research is needed to further identify patient-related factors, contextual factors (provider-related factors and environment-related factors) and health behavior factors that may explain health services use and associated cost. For example, it is known that parental work status, family structure and parental perception of illness severity are important determinants of health services use. These variables would be considered patient-related factors. Similarly, regular sources of health care, convenience of care and

medical staff practice patterns are important determinants of health services use. These variables would be considered provider-related factors. Additional health care environment variables to consider include health care financing or the distance from participants' residence to primary care provider offices. Personal choice factors requiring further study include the immediate living conditions of members with asthma. Specifically, the presence of smokers or animals in the home as well as the presence of airway irritants should be evaluated. Functional status variables related to missed days from school or missed days from work to care for ill children should be included as morbidity measures in future research efforts.

In addition to factors that were not included, additional research is needed for variables that were included. For example, a patient-related factor deserving greater definition and study is patient need. Beta-agonist to anti-inflammatory medication ratios are, at best, a proxy for illness severity. It remains unclear whether this variable is a function of illness burden or physician prescribing behaviors. The influence of participant specific residence, ethnicity, and affluence on health services use should also be investigated. In this study, participant zip code was used as proxy to investigate these factors.

The other major purpose of this research was to test the explanatory power of the Behavior Model of Utilization for health services use in managed care companies. To validate the explanatory power of the model demonstrated in this study, additional research, with a larger study population, is needed. In addition, it would be valuable to better understand the influence of asthma, as a chronic disease, on health services use

outside the managed care setting. There is a need for greater standardization of methodologies to facilitate analysis and comparisons of the influence of chronic disease on health services use. Therefore, it would be valuable to investigate the explanatory power of the Behavior Model of Utilization in other chronic diseases, such as diabetes, hypertension, congestive heart failure, or chronic obstructive lung disease.

Finally, the implications of the Behavior Model of Utilization must be clearly analyzed to ensure that managed care company responsibilities related to population research, member satisfaction, and community service are not impacted negatively in the struggle to balance quality with cost. This research focused on health services use since these issues are of concern to policy makers, administrators and clinicians. Clearly, there is a need to apply this research to develop new performance measures and improve existing performance measures by which the quality of managed care companies are judged; both from an accreditation perspective, a consumer perspective, and a health policy perspective.

The Behavior Model of Utilization played a key role in explaining health services use for an insured pediatric population with asthma. The critical role the asthma management program played in promoting the health and well-being of enrolled members was elucidated. Information gleaned from this empirical study can be used to encourage appropriate resource utilization, formulate pediatric asthma health policy, and deliver cost-effective, quality health care. More importantly, company administrators and clinicians can demonstrate the value of their efforts by achieving measurable improvements in the health and well-being of children in the communities they serve.

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Appendix A

Summary Results For Bivariate Hypotheses

Table 53
Summary Of Bivariate Hypotheses Testing Results For Population-Related Factors Specifically, Patient-Related Factors: Predisposing Characteristics and Need

Bivariate Hypothesis	Results
D. Population-Related Factors: Patient-Related Factors are expected to influence health services use/cost.	
D.1. Predisposing Characteristics (Age) are expected to influence health services use/cost.	
D.1.a. Participants four years of age or younger will be more likely to be admitted to the hospital than participants in other age groups.	Not Supported
D.1.b. Participants four years of age or younger will be more likely to use emergency department services than participants in other age groups.	Not Supported
D.1.c. Participants four years of age or younger will be less likely to use primary care provider services than participants in other age groups.	Not Supported
D.1.d. Participants four years of age or younger will be less likely to be classified primary care provider high users than participants in other age groups.	Not Supported
D.1.e. Participants four years of age or younger will be less likely to use specialist services than participants in other age groups.	Not Supported
D.1.f. Participants four years of age or younger will be more likely to be classified high total health care cost than participants in other age groups.	Not Supported
D.2. Need (Beta-agonist to Anti-inflammatory Medication Ratios) is expected to influence health services use/cost.	
D.2.a. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to be admitted to the hospital than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported
D.2.b. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to use emergency department services than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported
D.2.c. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to use primary care provider services than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported
D.2.d. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified primary care provider high users than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported
D.2.e. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to use specialist services than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported
D.2.f. Participants with a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified high total health care cost than participants with a low beta-agonist to anti-inflammatory medication ratio.	Supported

Table 54-A

Summary Of Bivariate Hypotheses Testing Results For Population-Related Factors
Specifically, Provider-Related Factors: Individual Enabling and Provider Enabling

Bivariate Hypotheses	Results
D. Population-Related Factors: Provider-Related Factors are expected to influence health services use/cost.	
D.3. Individual Enabling (Insurance Benefits) is expected to influence health services use/cost.	
D.3.a. Participants insured by Medicaid will be more likely to be admitted to the hospital than participants insured by commercial products.	Not Supported
D.3.b. Participants insured by Medicaid will be more likely to use emergency department services than participants insured by commercial products.	Not Supported
D.3.c. Participants insured by Medicaid will be less likely to use primary care provider services than participants insured by commercial products.	Not Supported
D.3.d. Participants insured by Medicaid will be less likely to be classified primary care provider high users than participants insured by commercial products.	Not Supported
D.3.e. Participants insured by Medicaid will be less likely to use specialist services than participants insured by commercial products.	Not Supported
D.3.f. Participants insured by Medicaid will be more likely to be classified high total health care cost than participants insured by commercial products.	Not Supported
D.4. Provider Enabling (Primary Care Provider Gender) is not expected to influence health services use/cost.	
D.4.a. There will be no difference in the likelihood of being admitted to the hospital between participants managed by female primary care providers or participants managed by male primary care providers.	Supported
D.4.b. There will be no difference in the likelihood of using emergency department services between participants managed by female primary care providers or participants managed by male primary care providers.	Supported
D.4.c. There will be no difference in the likelihood of using primary care provider services between participants managed by female primary care providers or participants managed by male primary care providers.	Supported
D.4.d. There will be no difference in the likelihood of being classified primary care provider high user between participants managed by female primary care providers or participants managed by male primary care providers.	Supported
D.4.e. There will be no difference in the likelihood of using specialist services between participants managed by female primary care providers or participants managed by male primary care providers.	Supported
D.4.f. There will be no difference in the likelihood of being classified high total health care cost between participants managed by female primary care providers or participants managed by male primary care providers.	Supported

Table 54-B
Summary Of Bivariate Hypotheses Testing Results For Population-Related Factors Specifically, Provider-Related Factors: Individual Enabling and Provider Enabling

Bivariate Hypotheses	Results
D. Population-Related Factors: Provider-Related Factors are expected to influence health services use/cost.	
D.5. Provider Enabling (Primary Care Provider Specialty) is not expected to influence health services use/cost.	
D.5.a. There will be no difference in the likelihood of being admitted to the hospital between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported
D.5.b. There will be no difference in the likelihood of using emergency department services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported
D.5.c. There will be no difference in the likelihood of using primary care provider services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported
D.5.d. There will be no difference in the likelihood of being classified primary care provider high user between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported
D.5.e. There will be no difference in the likelihood of using specialist services between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported
D.5.f. There will be no difference in the likelihood of being classified high total health care cost between participants managed by pediatric primary care providers or participants managed by general practice primary care providers.	Supported

Table 55-A

Summary Of Bivariate Hypotheses Testing Results For Environment-Related Factors Specifically, Health Care Environment and External Environment

Bivariate Hypotheses	Results
E. Environment-Related Factors: Health Care Environment is expected to influence health services use/cost.	
E.1. Availability (Primary Care Provider Office In The Neighborhood) is expected to influence health services use/cost.	
E.1.a. Participants will be more likely to be admitted to the hospital when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.	Not Supported
E.1.b. Participants will be more likely to use emergency department services when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.	Not Supported
E.1.c. Participants will be more likely to use primary care provider services when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.	Not Supported
E.1.d. Participants will be more likely to be classified primary care provider high users when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.	Not Supported
E.1.e. There will be no difference in the likelihood of using specialist services between participants with their primary care provider office located in their neighborhood or participants without their primary care provider office located in their neighborhood.	Supported
E.1.f. Participants will be more likely to be classified high total health care cost when their primary care provider office is located in their neighborhood compared to participants without their primary care provider office located in their neighborhood.	Not Supported
E.2. Availability (Primary Care Provider Office With Late Hours In The Neighborhood) is expected to influence health services use/cost.	
E.2.a. Participants will be more likely to be admitted to the hospital when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.	Not Supported
E.2.b. Participants will be more likely to use emergency department services when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.	Not Supported
E.2.c. Participants will be more likely to use primary care provider services when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.	Not Supported
E.2.d. Participants will be more likely to be classified primary care provider high users when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.	Not Supported
E.2.e. There will be no difference in the likelihood of using specialist services between participants with their primary care provider office, offering late hours, located in their neighborhood and other participants.	Supported
E.2.f. Participants will be more likely to be classified high total health care cost when their primary care provider office, offering late hours, is located in their neighborhood compared to other participants.	Not Supported

Table 55-B

Summary Of Bivariate Hypotheses Testing Results For Environment-Related Factors Specifically, Health Care Environment and External Environment

Bivariate Hypotheses	Results
E. Environment-Related Factors: Health Care Environment is expected to influence health services use/cost.	
E.3. Organization (Asthma Management Program) is expected to influence health services use/cost.	
E.3.a. Participants enrolled in the asthma management program will be less likely to be admitted to the hospital than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E.3.b. Participants enrolled in the asthma management program will be less likely to use emergency department services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E.3.c. Participants enrolled in the asthma management program will be less likely to use primary care provider services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E.3.d. Participants enrolled in the asthma management program will be less likely to be classified primary care provider high user than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E.3.e. Participants enrolled in the asthma management program will be less likely to use specialist services than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E.3.f. Participants enrolled in the asthma management program will be less likely to be classified high total health care cost than participants who declined to enroll in the asthma management program or were not referred to the asthma management program.	Supported
E. Environment-Related Factors: External Environment is expected to influence health services use/cost.	
E.4. Community Enabling (Neighborhood Urbanicity) is expected to influence health services use/cost.	
E.4.a. Participants residing in urban neighborhoods will be more likely to be admitted to the hospital than participants residing in non-urban neighborhoods.	Not Supported
E.4.b. Participants residing in urban neighborhoods will be more likely to use emergency department services than participants residing in non-urban neighborhoods.	Not Supported
E.4.c. Participants residing in urban neighborhoods will be less likely to use primary care provider services than participants residing in non-urban neighborhoods.	Not Supported
E.4.d. Participants residing in urban neighborhoods will be less likely to be classified primary care provider high users than participants residing in non-urban neighborhoods.	Supported
E.4.e. Participants residing in urban neighborhoods will be less likely to use specialist services than participants residing in non-urban neighborhoods.	Not Supported
E.4.f. Participants residing in urban neighborhoods will be more likely to be classified high total health care cost than participants residing in non-urban neighborhoods.	Not Supported

Table 55-C

Summary Of Bivariate Hypotheses Testing Results For Environment-Related Factors Specifically, Health Care Environment and External Environment

Bivariate Hypotheses	Results
E. Environment-Related Factors: Community Enabling is expected to influence health services use/cost.	
E.5. Community Enabling (Neighborhood Ethnicity) is expected to influence health services use/cost.	
E.5.a. Participants residing in predominately non-Caucasian neighborhoods will be more likely to be admitted to the hospital than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.5.b. Participants residing in predominately non-Caucasian neighborhoods will be more likely to use emergency department services than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.5.c. Participants residing in predominately non-Caucasian neighborhoods will be less likely to use primary care provider services than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.5.d. Participants residing in predominately non-Caucasian neighborhoods will be less likely to be classified primary care provider high users than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.5.e. Participants residing in predominately non-Caucasian neighborhoods will be less likely to use specialist services than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.5.f. Participants residing in predominately non-Caucasian neighborhoods will be more likely to be classified high total health care cost than participants residing in predominately Caucasian neighborhoods.	Not Supported
E.6. Community Enabling (Neighborhood Affluence) is expected to influence health services use/cost.	
E.6.a. Participants residing in low-income neighborhoods will be more likely to be admitted to the hospital than participants residing in non low-income neighborhoods.	Not Supported
E.6.b. Participants residing in low-income neighborhoods will be more likely to use emergency department services than participants residing in non low-income neighborhoods.	Not Supported
E.6.c. Participants residing in low-income neighborhoods will be less likely to use primary care provider services than participants residing in non low-income neighborhoods.	Not Supported
E.6.d. Participants residing in low-income neighborhoods will be less likely to be classified primary care provider high users than participants residing in non low-income neighborhoods.	Not Supported
E.6.e. Participants residing in low-income neighborhoods will be less likely to use specialist services than participants residing in non low-income neighborhoods.	Not Supported
E.6.f. Participants residing in low-income neighborhoods will be more likely to be classified high total health care cost than participants residing in non low-income neighborhoods.	Not Supported

Appendix B

Summary Results For Multivariate Hypotheses

Table 56

Summary Results Multivariate Hypotheses For Patient-Related Factors

Multivariate Hypotheses	Results
F.1. When patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory medication ratio will be predictive of health services use, when controlling for pre-test year health services use.	Supported
F.1.a. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admission.	Partially Supported
F.1.b. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.	Partially Supported
F.1.c. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.	Partially Supported Model Unstable
F.1.d. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.	Partially Supported Model Unstable
F.1.e. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to use specialist services, when controlling for pre-test year specialist services use.	Partially Supported
F.2. When patient-related factors are considered together in one model, both participant age and participant beta-agonist to anti-inflammatory medication ratio will be predictive of health services cost, when controlling for pre-test year total health care cost.	Supported
F.2.a. Participants who are four years of age or younger and/or have a high beta-agonist to anti-inflammatory medication ratio will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.	Partially Supported

Table 57

Summary Results Multivariate Hypotheses For Population-Related Factors

Multivariate Hypotheses	Results
G.1. When patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, and primary care provider specialty will all be predictive of health services use, when controlling for pre-test year health services use.	Supported
G.1.a. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admission.	Partially Supported
G.1.b. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.	Partially Supported
G.1.c. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.	Partially Supported Model Unstable
G.1.d. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.	Partially Supported
G.1.e. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to use specialist services, when controlling for pre-test year specialist services use.	Partially Supported
G.2. When patient-related factors and provider-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, and primary care provider specialty will all be predictive of health services cost, when controlling for pre-test year health services cost.	Supported
G.2.a. Participants who are age four years or younger, have a high beta-agonist to anti-inflammatory medication ratio, and/or are managed by general practice primary care providers will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.	Partially Supported

Table 58

Summary Results Multivariate Hypotheses For Population-Related Factors and External Environment Factors

Multivariate Hypotheses	Results
H.1. When patient-related factors, provider-related factors, and external environment factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test year health services use.	Supported
H.1.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admission.	Partially Supported
H.1.b. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to use emergency department services, when controlling for pre-test year emergency department services use.	Partially Supported
H.1.c. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.	Partially Supported Model Unstable
H.1.d. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.	Partially Supported
H.1.e. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to use specialist services, when controlling for pre-test year specialist services use.	Partially Supported
H.2. When patient-related factors, provider-related factors, and external environment factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, and neighborhood urbanicity will all be predictive of health services cost, when controlling for pre-test year health services cost.	Supported
H.2.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, and/or reside in urban neighborhoods will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.	Partially Supported

Table 59

Summary Results Multivariate Hypotheses For Population-Related Factors and Environment-Related Factors

Multivariate Hypotheses	Results
I.1. When population-related factors and environment-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, asthma management program, and neighborhood urbanicity will all be predictive of health services use, when controlling for pre-test year health services use.	Supported
I.1.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be admitted to the hospital, when controlling for pre-test year hospital admission.	Partially Supported
I.1.b. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to use emergency department services, when controlling for pre-test emergency department services use.	Partially Supported
I.1.c. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to use primary care provider services, when controlling for pre-test year primary care provider services use.	Partially Supported Model Unstable
I.1.d. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be classified primary care provider high users, when controlling for pre-test year primary care provider high users.	Partially Supported
I.1.e. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to use specialist services, when controlling for pre-test year specialist services use.	Partially Supported
I.2. When population-related factors and environment-related factors are considered together in one model, participant age, participant beta-agonist to anti-inflammatory medication ratio, primary care provider specialty, asthma management program, and neighborhood urbanicity will all be predictive of health services cost, when controlling for pre-test year health services cost.	Supported
I.2.a. Participants who are four years of age or younger, have a high beta-agonist to anti-inflammatory medication ratio, are managed by general practice primary care providers, are not enrolled in the asthma management program and/or reside in urban neighborhoods will be more likely to be classified high total health care cost, when controlling for pre-test year total health care cost.	Partially Supported