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ACCEPTANCE

This thesis, CORRELATIONAL STUDY FOR PREDICTOR VARIABLES AFFECTING LENGTH OF STAY IN PEDIATRIC SICKLE CELL PATIENTS, by Jenny Schott, BS, RRT, was prepared under the direction of the Master's Thesis Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the Master's of Science in the College of Health and Human Sciences, Georgia State University.

The Master's Thesis Advisory Committee, as representatives of the faculty, certify that this thesis has met all standards of excellence and scholarship as determined by the faculty.

_____

Douglas S. Gardenhire, Ed.D, RRT-NPS, FAARC
Committee Chair

_____

Ralph Zimmerman, M.S., RRT-NPS
Committee Member

_____

Robert B. Murray, M.S., RRT
Committee Member

_____

Date

AUTHOR'S STATEMENT

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Jenny C. Schott, BS, RRT

3313 Vintage Circle Southeast

Smyrna, GA 30080

The director of this thesis is:

Douglas S. Gardenhire, Ed.D, RRT-NPS, FAARC

Director of Clinical Education

Division of Respiratory Therapy

Byrdine F. Lewis School of Nursing and Health Professions

Georgia State University

P.O. Box 4019

Atlanta, GA 30302-4019

Curriculum Vitae

Jenny C. Schott, BS, RRT
3313 Vintage Circle Southeast
Smyrna, GA 30080

EDUCATION

Georgia State University – Atlanta, Georgia
Byrdine F. Lewis School of Nursing & Health Professions
Division of Respiratory Therapy
Masters of Science in Health Sciences with a Major of Respiratory Therapy, Candidate

University of Alabama at Birmingham – Birmingham, Alabama
Collat School of Business
Department of Marketing, Industrial Distribution, & Economics
Bachelors of Science, Marketing, May 2005

PROFESSIONAL EXPERIENCE

Piedmont Hospital - Atlanta, Georgia
Respiratory Therapist, April 2013-present

CERTIFICATIONS

Registered Respiratory Therapist #134234, February 2013
Respiratory Care Professional, State of Georgia, #9113

PROFESSIONAL SOCIETIES

American Association for Respiratory Care
National Board for Respiratory Care

SPECIAL RECOGNITION

Lambda Beta National Honor Society Member, Spring 2013

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CORRELATIONAL STUDY FOR PREDICTOR VARIABLES AFFECTING LENGTH OF STAY ON PEDIATRIC SICKLE CELL PATIENTS

By

JENNY CATHERINE SCHOTT, BS, RRT

B.S., University of Alabama at Birmingham, 2005

A Thesis
Presented in Partial Fulfillment of the Requirements for the
Degree of
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in
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ABSTRACT

CORRELATIONAL STUDY FOR PREDICTOR VARIABLES AFFECTING LENGTH OF STAY ON PEDIATRIC SICKLE CELL PATIENTS

By

Jenny Schott, BS, RRT

Sickle cell disease (SCD) and asthma most commonly affect African American children in the United States. SCD is an inherited disorder and one of the most prevalent genetic diseases worldwide. Acute chest syndrome (ACS) is a common complication associated with significant morbidity and is the leading cause of death among patients with sickle cell disease. Asthma is associated with an increase in SCD-related morbidity. Length of stay is a factor in determining costs and management of healthcare resources to this pediatric patient population. PURPOSE: The purpose of this study is to retrospectively investigate the length of stay for patients who have asthma, acute chest syndrome, and those with both asthma and acute chest syndrome in a pediatric population at an urban hospital. METHODS: A retrospective study using existing data from an urban tertiary children's hospital inpatient unit between January 1, 2012 and December 31, 2012. DATA ANALYSIS: Data analysis was performed using SPSS 17.0. Descriptive statistics were run for each variable. Contingency tables were run to determine if a patient's age and diagnosis had significance on the hospital length of stay. Intercorrelations were run to determine if age, diagnosis, and length of stay had an effect on each other. Davis conventions were used to analyze the results. RESULTS: Descriptive statistics indicated the mean age at discharge to be 7.02 years old, SD = $\pm$4.695 and mean length of stay 2.57 days. The data also indicated that the mean LOS for asthma 2.32 days, SD = $\pm$1.773, mean LOS for acute chest syndrome 3.79 days, SD = $\pm$2.239, and a mean LOS for both asthma and acute chest syndrome

3.81 days, SD = $\pm$3.172. Contingency statistics showed a negligible association (r_{eta} = 0.071) between the patient's age and diagnosis, and a low association (r_{eta} = 0.275) between the diagnosis and length of stay. Pearson product-moment correlation coefficients showed that the patient's age at discharge had a low association with length of stay ($r = 0.238$, $p < 0.01$).

CONCLUSIONS: The pediatric patient's age and diagnosis had very little impact of their length of stay within the hospital. The data also demonstrated that the patient population tended to be black, younger, have asthma as a discharge diagnosis, length of stay of less than 3 days, with a fairly even representation of males and females. Asthma represented the shortest length of stay, followed by acute chest syndrome, and then those patients with both asthma and acute chest syndrome, possibly suggesting that patients with co-morbidities have longer lengths of hospital stays.

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CHAPTER I

Introduction

Sickle cell disease (SCD) is an inherited disorder and one of the most prevalent genetic diseases worldwide, affecting over 250 million people (Poulter, Truszkowski, Thompson, & Liem, 2011). The highest prevalence of sickle cell disease is found in Sub-Saharan Africa, South and Central America, Saudi Arabia, and the Mediterranean (Hirani, Weibel, & Kane, 2011). In the U.S., the incidence of the disease occurs in 1 in 500 births among African Americans and 1 in 1400 births in Hispanic Americans (Hirani et al., 2011). SCD affects approximately 7200 people in Georgia, with just over 3000 of those between 0 and 19 years old ("CDC-Sickle Cell Disease in Georgia," n.d.). Incidence of sickle cell complications is inversely related to age, with the incidence of vaso-occlusive pain crisis or acute chest syndrome (ACS) decreasing steadily from childhood to adulthood (Poulter et al., 2011). SCD related mortality rates in African American children age 0-3 declined by 68% from 1983 to 2002 (Yanni, Grosse, Yang, & Olney, 2009). For the same time period, mortality rates for 4-9 years old decreased 39%, and ages 10-14 decreased 24% (Yanni et al., 2009).

SCD is a result of a mutation in the hemoglobin gene, passed down through families, that causes red blood cells to become sickle-shaped. These sickle-shaped cells may obstruct blood vessels, causing pain, infection, tissue death, and injury within the major organs due to the ineffective oxygen carrying capacity of the red blood cells (Hirani et al., 2011). There are several different genotypes of sickle cell disease. People who inherit two sickle cell genes, one from each parent, have what is called sickle cell anemia, or HbSS ("CDC - Facts About Sickle Cell Disease" 2011). HbSS is usually the most severe form of all the types. HbSC is a form of sickle cell disease in which they inherit one sickle cell gene ("S") from one parent, and abnormal

hemoglobin gene ("C") from the other parent. The other common types of SCD are HbS beta 0-thalassemia and HbS +-thalassemia (CDC - Facts About Sickle Cell Disease," 2011). In each of these types, the person has one "S" gene and one gene for beta thalassemia which is another type of anemia. The "0" is the more severe form and "+" is the milder form of SCD (CDC - Facts About Sickle Cell Disease," 2011). People with one "S" gene and one normal gene carry the sickle cell trait (HbAS). According to the Centers for Disease Control and Prevention, these people usually do not have any signs of the disease, but they can pass their trait to their children (CDC - Facts About Sickle Cell Disease," 2011).

Acute chest syndrome, or ACS, is a common complication associated with significant morbidity and is the leading cause of death among patients with sickle cell disease. ACS is also identified as a significant risk factor for early death. ACS is characterized by a new infiltrate on chest radiograph and some combination of fever, chest pain, and respiratory symptoms such as tachypnea, cough, or dyspnea (Paul et al., 2011; Poulter et al., 2011). Known risk factors for ACS development are younger age, high hemoglobin levels, lower hemoglobin F, and higher steady state white blood cell count (Bryant, 2005). Proposed causes of ACS include infections, pulmonary vascular occlusion, atelectasis, pulmonary edema, and bronchospasms (Taylor et al., 2004). Although there is an increased awareness that acute chest syndrome is the leading cause of death in patients with sickle cell disease, the diagnosis is often delayed, optimal treatment is unknown, and the cause is usually not determined (Vichinsky et al., 2000). Access to comprehensive, multidisciplinary care by providers familiar with the health issues of people with SCD is lacking in much of the United States. According to the CDC, fewer than 10% of Americans with SCD have access to specialized treatment centers for management of the disease ("CDC - Sickle Cell Disease and Thalassemia," 2012).

Over the past 20 years, asthma prevalence has doubled, with about 34 million people affected (Anim, Strunk, & DeBaun, 2011). The presence of asthma is most common in African-American children affecting about 14.6% of the population (Anim et al., 2011). Specifically in Georgia, asthma affects approximately 900,000 people, with African-Americans representing the largest percentage of asthmatics with 18.6% ("CDC-Asthma in Georgia," 2011). Low-income populations, minorities, and children living in inner cities experience a greater number of emergency department visits, hospitalizations, and deaths due to asthma than the general population ("CDC - Asthma - Adolescent and School Health," n.d.). Diagnosis of asthma is primarily based on symptoms, family and medical history, and clinical findings, which includes pulmonary function testing. Pulmonary function testing detects the presence of airway obstruction and the response to treatment, typically in those patients 5 years and older.

Asthma is common chronic disorder of the airways characterized by recurrent wheezing. Asthma is defined by reversible airway obstruction, bronchial inflammation characterized by presence of eosinophils in the airway, and bronchial hyperresponsiveness perpetuated by irritant stimuli (Bryant, 2005). Triggers of asthma include smoke, cold air, exercise, dust mites, pets, and allergic rhinitis, just to name a few (Bryant, 2005). Individuals with asthma experience episodes where airway restriction results in difficulty in breathing. The severity of asthma attacks can range from mild to severe and can lead to hospitalization and potentially death from the most severe cases.

Asthma is associated with an increase in SCD-related morbidity and those patients with asthma had nearly four times as many episodes of ACS and more frequent painful episodes (Boyd, Macklin, Strunk, & DeBaun, 2006). Children with SCD and asthma were younger at the time of their first episode with a median age of 2.4 years versus 4.6 years without and required

more transfusions (Boyd et al., 2006). Asthma and bronchial hyper-responsiveness are more common in children with SCD.

Recent studies have shown that the involvement of specialists in asthma and sickle cell care improves patient outcomes and reduces costs. Specifically, asthmatic patients cared for by specialists have shorter lengths of stay and fewer hospitalizations (Wazeka, Valacer, Cooper, Caplan, & DiMaio, 2001). Wazeka et al. (2001) and National Asthma Education and Prevention Program (2007) both report that pediatric patients that have an implementation of an asthma clinical pathway may reduce hospital length of stay and costs without increasing morbidity or rates of readmission. Length of stay can be related to hospital policies, as well as the severity of the illness (Kelleher, 1993).

Purpose of the Study

The purpose of this study was to retrospectively investigate the length of admission for patients who have asthma, sickle cell disease, and those with both asthma and sickle cell disease in the pediatric population at an urban hospital. The length of hospitalization can be important in determining and managing healthcare resources within the hospital. It could also potentially impact the health care costs and quality of care delivered to the patient. The desired outcome of the study is to increase awareness of the impact of these diseases on the pediatric population and to aid in determining which patient population is at highest risk for longer admission rates.

The following research questions were addressed to guide the acquisition of data required to satisfy the requirements of the purpose statement.

1. What is the average patient's age?
2. What is the patient's gender?
3. What is the patient's ethnicity?

4. What is the patient's discharging diagnosis?

5. What is the patient's length of hospital stay?

6. Does having a comorbidity increase the hospital length of stay?

7. What pediatric age group has the shortest and longest length of stay?

Significance of study

This study is significant in that it may determine if the length of stay correlates with care the patient receives, along with the costs incurred. This study may also determine whether using clinical practice guidelines contributes to a shorter length of stay. It may also improve initial physician decisions and predict patient outcomes if results can be generalized for the pediatric population. This study may also identify certain variables that may be predictors of future failure or success in the treatment these patients receive.

Definition of words and terms

Acute chest syndrome: A new infiltrate on chest x-ray, along with one or more of these symptoms: fever, cough, dyspnea, or hypoxia.

Clinical practice guidelines: A range of accepted approaches for the diagnosis, management, and treatment of a specific disease utilized by medical personnel.

Length of stay: The duration of stay at the same hospital from admittance to discharge.

Hyperresponsiveness: Exaggerated narrowing of the airways as a result of being exposed to stimuli.

Painful crisis: Uncontrolled pain that causes severe distress for the sickle cell patient.

Pediatric population: Includes those 0 to 18 years old

Delimitations

This study includes a pediatric population between January 1, 2012 and December 31, 2012. The results of this study can only be generalized to this population group.

Although these limiting factors are considered outside the control of the researcher, it is important to recognize each one in order to effectively evaluate the significance of this study. These limitations are not only present in the research setting, but are also limiting factors in the clinical setting.

Assumptions

The intention of this study is to prove that patients with both asthma and sickle cell disease have a longer length of stay in the hospital. The reason for this assumption is that comorbidities often cause more complications and longer lengths of stay. Complications can arise from determining how to treat the patient without negatively impacting the other disease processes. In patients with SCD who have developed ACS, it will be assumed that the length of stay will be longer compared to those patients without ACS. ACS is a more serious complication, with significant increases in early death.

It is also assumed that those patients who were treated according to a clinical practice guideline will have a shorter length of stay, as these guidelines have been proven to efficiently treat patients with that specific disease. Additionally, it is assumed that patients older than 5 years will have a diagnosis of asthma, or asthma with sickle cell disease due to the complications with diagnosing asthma in those patients younger than 5 years.

CHAPTER II

Review of Literature

Health care spending in the United States has been growing substantially compared with other developing nations, with an expenditure of over $2.5 trillion in 2009 (Oyetunji et al., 2013). Yet, there seems to be no slow down because health care expenditures have been on the rise for the last 10 consecutive years (Oyetunji et al., 2013). Rising costs have attracted the attention of the healthcare community as an important public health issue (Green et al., 2012). As a consequence, focus has shifted to making health care delivery more efficient without sacrificing quality of care (Oyetunji et al., 2013). Although many measures of quality care are being evaluated and validated, one measure that has been advocated as a metric for both quality of care and the efficient use of health care dollars is hospital length of stay (Oyetunji et al., 2013). Given the current era of maximizing every health care dollar without necessarily sacrificing quality, it is important to assess the quality of health care provided to ensure patients are receiving adequate care (Oyetunji et al., 2013). Therefore, length of stay (LOS) is a potentially important outcome measure and needs to be investigated to evaluate its efficacy in correctly predicting patient outcome (Oyetunji et al., 2013).

SCD leads to a considerable burden on the medial system, due to the acute and chronic complications and emergency department utilization of these patients. Twenty years ago, infants born with SCD often did not survive childhood. Improvements in medical technology and drug therapy have contributed to patients with SCD surviving well into adulthood (Green et al., 2012). Despite that, health and life-expectancy outcomes are dependent on disease management and continuity of care throughout childhood, adolescence and adulthood (Green et al., 2012). Characterized by painful vaso-occlusive episodes, increased susceptibility to infection, and

serious complications such as acute chest syndrome and stroke, SCD leads to frequent emergency room visits, hospitalizations, and consequently, high health care expenditures (Mayer, Konrad, & Dvorak, 2003). Chronic diseases like SCD can be devastating physically, financially, and socially (Mayer et al., 2003). Admittedly, determining with high accuracy is difficult as estimates are compounded by multiple variables such as patient care, insurance, and morbidity, all of which can influence length of stay (Mak, Grant, McKenzie, & McCabe, 2012). Children with SCD like most children with complex, chronic health conditions, receive substantially more medical care than children without SCD (Bundy, Strouse, Casella, & Miller, 2011).

Multiple variables can influence length of stay. Differences in socioeconomic status can have an impact on care. These factors include age, insurance status, and living in an urban area. Peak incidence for acute chest syndrome in children is between 2-4 years old and gradually declines with age (Paul, Castro, Aggarwal, & Oneal, 2011). ACS in the first 3 years of life significantly increased the odds of more frequent episodes during childhood (Paul et al., 2011). However, patients 21 and older were predictive of higher emergency department (ED) visit rates and were more likely to visit multiple facilities (Wolfson, Schrager, Khanna, Coates, & Kipke, 2012). In one study, approximately 73% of ED visits by SCD patients were in adults 20 and older (Yusuf, Atrash, Grasse, Parker, & Grant, 2010).

According to Mvundura, Amendah, Kavanagh, Sprinz, and Grosse, (2009) children enrolled in Medicaid programs had significantly more ED visits and were significantly more likely to have an inpatient admission compared with privately insured patients. Children with SCD with Medicaid had about 4 times more ED visits than those with other insurance, and 40% fewer outpatient visits (Myundura et al., 2009). The prevalence among African Americans and

Hispanics of lacking insurance, being underinsured, or on Medicaid could be a contributing factor (Yusuf et al., 2010). Wolfson et al. (2012) correlates private insurance, as well as being uninsured with the association of lower rates of ED visits. Urban access to care has been shown to effect patients with SCD. Patients further from a self-identified provider of comprehensive SCD care had higher rates of ED visits with a lower likelihood of inpatient admission (Wolfson et al., 2012). Distance from a comprehensive SCD center likely represents a barrier to care. (Wolfson et al., 2012). There were just fewer than 3,000 patients included in the Wolfson et al. (2012) study and 5% of the sample was responsible for 40% of the visits. While we do not know the characteristics of the 5%, it may not be representative of the population being studies. Inconsistencies in self-identification and single defined categories in race and ethnicity accuracies are limitations.

As of 2008, asthma was estimated to affect 7 million children in the United States and just over 297,000 children in Georgia ("CDC-Asthma in Georgia," 2011). It is the most common chronic disease of childhood and accounts for about 190,000 pediatric hospitalizations yearly in the United States (Edwards & Fox, 2008). No other single disease accounts for a larger proportion of health care costs than asthma, with costs of more than 12.7 billion dollars per year (Shelledy, McCormick, LeGrand, Cardenas, & Peters, 2005). Asthmatic patients cared for by specialists have shorter lengths of stay and fewer hospitalizations (Wazeka et al., 2001). The data show that the average overall LOS for all patients decreased from 4.25 days in 1994 to 2.7 days in 1998 (Wazeka et al., 2001). Total hospital charges for all pediatric asthma admissions decreased by 26% from 1995 to 1998, from a mean of $9,329.52 per asthma admission in 1995, to a mean of $6,875.90 per admission in 1998 (Wazeka et al., 2001). Overall pediatric nursing costs decreased by 35% from 1995 to 1998; general nursing costs decreased by 27% per patient

case from 1996 to 1998 (Wazeka et al., 2001). Total medication acquisition costs were reduced by 40% from 1996 to 1998 (Wazeka et al., 2001). Shelledy et al. (2005) also found a decrease in overall costs. Hospital costs decreased from $7,867 to $806 when in-home asthma assessment and teaching program was provided by respiratory therapists (Shelledy et al., 2005). However, the cost of implementing the program was approximately $640 per patient (Shelledy et al., 2005).

Given growing demands to manage costs and maximize efficiency in acute hospital services, information on patterns of resource utilization, including length of hospital stay, is valuable (Moloney, Smith, Bennett, O'riordan, & Silke, 2005). Accurate predictions of patient length of stay (LOS) in the hospital can effectively manage hospital resources and increase efficiency of patient care (Mak et al., 2012). The literature review will offer a subjective comparison and impact of the length of hospitalization for children with asthma, sickle cell disease, and those with both asthma and sickle cell disease. It will focus on outcomes such as length of stay, impact of utilizing clinical pathways, and readmission rates. Resources for the review were derived from CINHAL and PubMed using the following search terms: "asthma", "acute chest syndrome", "hospitalization", "risk factors", and "sickle cell" within the pediatric population.

Impact of Length of Stay

Patients with SCD make relatively high use of urgent care services, including inpatient care (Green et al., 2012). According to Green et al. (2012), 36% of SCD patient admissions resulted in a length of stay of less than two days, and 74% of total bed days are patients with multiple admissions (Green et al., 2012). Patients with short length of stay and multiple admissions may be good candidates for primary care interventions to reduce their risk of SCD-

related complications and admissions (Green et al., 2012). They may also benefit from more supportive management when they attend emergency departments, sickle cell centers and outpatient clinics, as many aspects of the management of SCD patients are outside the scope of primary care teams (Green et al., 2012). Improper ED attendance diverts ED staff attention and resources from severe and acute cases that need urgent hospital care. In addition, it adds to the waiting times in the ED, compromises the quality of care a patient receives and increases cost (Green et al., 2012). This analysis of sickle cell crisis admissions provided an opportunity to not only characterize the admissions but to identify practices with higher levels of admissions especially related to multiple admissions or short length of stays (Green et al., 2012). It also establishes a baseline to monitor progress and validate associations in relation to improving primary care support for patients and reducing ED admissions (Green et al., 2012).

As anticipated, the number of major comorbidities is associated with higher expected average daily charges and total charges and longer lengths of stay (Mayer et al., 2003). Expected total charges for an individual without major comorbidities total $4,029 (Mayer et al., 2003). For each additional comorbidity, charges increase by $1,000 or more (Mayer et al., 2003). With each additional major comorbidity, an increase of approximately $100 in average daily charges and an increase of three-quarters of a day in expected length of stay (Mayer et al., 2003). This suggests that the significance of the expected increase in resource utilization associated with each additional comorbidity increases as the total number of comorbidities increases (Mayer et al., 2003). The results of Mayer et al. (2003) study strongly suggest that disease severity plays the primary role in determining the level of hospital resource utilization among this sample of hospitalizations (Mayer et al., 2003). Hospitalizations complicated by comorbidities have substantially higher lengths of stay and total charges (Mayer et al., 2003). In addition, patients

admitted through emergency departments may lack a routine source of ambulatory care or be characterized by chronic mismanagement of their disease (Mayer et al., 2003). One study found lower rates of emergency department and inpatient visits among sickle cell patients using comprehensive ambulatory clinics, suggesting that aggressive outpatient management may avoid more serious illness and minimize the need for intensive treatment in an inpatient setting (Mayer et al., 2003).

Length of Stay

Poulter et al. (2011) found that age, time to ACS diagnosis, use of medications, and days of oxygen supplementation accounted for 49% of the variability in length of hospitalizations. Time to ACS diagnosis and days of oxygen supplementation were independent predictors of length of hospitalization. This study demonstrated that ACS is less severe in the pediatric patient with hemoglobin SC disease compared to hemoglobin SS disease. Vichinsky et al. (2000) found no difference in hospitalization length for ACS by genotype. These findings were consistent with other research. Vichinsky et al. (2000) and Taylor et al. (2004) determined that the average length of hospitalization was approximately 10 days for patients with ACS. Prolonged hospitalization was found in older patients, patients with pain in arms and legs at presentation, those with low platelet count at diagnosis, and those with extensive radiographic abnormalities, transfusion, and respiratory failure (Vinchinsky et al., 2000). Panepinto, Brousseau, Hillery, and Scott (2005) also found that the LOS was longer for children who were older; however, they found the average LOS was 4.4 days and increased by nearly 2 days for those children 15-18 years of age. Panepinto et al. (2005) found a strikingly large number of hospitalizations and significantly longer LOS for VOC in older children with sickle cell disease compared to younger children (Panepinto et al., 2005). In Panepinto et al. (2005), age appears to be a marker of disease

severity; however, the etiology of this is unclear. Conversely, the study by Paul et al. (2011) showed children who developed ACS had longer hospital stays and more frequently required admission to the intensive care unit.

Visits for SCD were the most likely to result in admission (45%) compared with asthma (12%) (Bundy et al., 2011). Three quarters of visits with primary diagnoses of SCD occurred among children who were seen in the same institution's emergency department on more than 1 occasion during 2003 to 2004, compared with 51% of asthma visits (Bundy et al., 2011). Among these repeat ED users, visits for SCD remained more likely than those for asthma to be considered urgent or result in admission (Bundy et al., 2011). Visits for children seen greater than 2 times for SCD in the same institution had 24 times the odds of those for children seen greater than 2 times for asthma of being deemed urgent by the resource utilization method or result in admission (Bundy et al., 2011). Bundy et al. (2011) observed that children with SCD with multiple visits to the same ED during the study period were substantially more likely than asthmatic children with multiple visits to be hospitalized or have urgent visits (Bundy et al., 2011).

The hospitalization rate remains substantial, generating nearly one-half of all US health care costs for asthma (Eisner, Katz, Yelin, Shiboski, & Blanc, 2001). Hospitalization rates for asthma have actually increased in some demographic subgroups, such as young adults and the urban poor, despite recent therapeutic advances (Eisner et al., 2001). Understanding the factors underlying hospitalization for asthma could help explain the recent rise in asthma morbidity (Eisner et al., 2001). Previous studies have identified several factors that contribute to increased hospitalization risk among adults with asthma (Eisner et al., 2001). Demographic characteristics, such as poverty, low educational attainment, female gender, and African–American race, have

been associated with a greater risk of hospitalization for asthma (Eisner et al., 2001). Poor health care access and inadequate preventive asthma care have also been frequently cited as contributing factors (Eisner et al., 2001). In these studies, however, separating the independent effects of demographic characteristics, health care access, and disease severity has been difficult (Eisner et al., 2001).

Clinical Practice Guidelines Affecting Length of Stay

Clinical practice guidelines (CPGs) are evidence-based multidisciplinary care plans which describe the essential steps needed in the care of patients with a specific clinical problem (Rotter, Kinsman, James, Machotta, & Steyerberg, 2012). They are used to translate clinical guidelines into local protocols and clinical practice (Rotter et al., 2012). Clinical practice guidelines have been proposed as a strategy to optimize resource allocation in a climate of increasing healthcare costs (Rotter et al., 2012). They are usually developed for inpatient diagnoses requiring multi-disciplinary inputs and for which care is relatively predictable (Banasiak & Meadows-Oliver, 2004). The goals of clinical pathways are to reduce unintended variations in care, reduce resource utilization, improve patient education, and improve quality of care (Banasiak & Meadows-Oliver, 2004).

Management of SCD and ACS is primarily supportive care and includes respiratory therapy, antibiotics, and red-cell transfusions (Crabtree et al., 2011). An important aspect of ACS management is early diagnosis (Taylor et al., 2004). However, symptoms can vary widely between patients; therefore clinical examination is potentially the most misleading aspect of assessment of ACS (Taylor et al., 2004). Crabtree et al. (2011) examined the implementation of an evidence-based guideline for children and adolescents with SCD with ACS or at risk for ACS (Crabtree et al., 2011). The guideline was based on interventions to potentially decrease the

development of ACS in those at risk, heightened alert for ACS detection, and aggressive treatment to prevent significant morbidity and mortality (Crabtree et al., 2011). A pilot data was collected before Crabtree et al. (2011) implemented their CPG, and found that the average length of stay had not been affected and pulmonary interventions and clinical respiratory score (CRS) assessments were not being administered according to the guideline (Crabtree et al., 2011). Outcome measures designed to evaluate success of the guideline included length of stay, number of exchange transfusions, average cost per SCD admission, and adherence to respiratory interventions (Crabtree et al., 2011). These outcomes indirectly measured morbidity and the efficiency of care. Implementation of this guideline demonstrated that even when evidence is limited, standardization of care can produce significant improvement in clinical outcomes (Crabtree et al., 2011).

Average length of stay was reduced from 5.8 days during the pilot study and before implementation to 4.1 days after the institution of the CPG (Crabtree et al., 2011). Average cost per SCD admission decreased from $30,359 in fiscal year 2008 before implementation of the guideline to $22,368 in the first 6 months of 2010, which is a reduction of $7,991, or about 26 percent decrease in cost (Crabtree et al., 2011). Crabtree et al. (2011) attributed the decrease in average length of stay and room charges for SCD admissions after implementation of the guideline (Crabtree et al., 2011). Average length of stay for patients with SCD decreased from 5.4 days in 2007, 2008, and 2009 to 4.1 days in the first 6 months of fiscal year 2010 (Crabtree et al., 2011). The mainstay of successful treatment for children with SCD with ACS or at risk for ACS is high-quality supportive care (Crabtree et al., 2011). Implementation of a standardized approach to care for children at risk for ACS and those with ACS revealed significant changes in clinical outcomes (Crabtree et al., 2011). The use of the CRS as a standardized method for

evaluating clinical respiratory status played an important role in minimizing variation in assessment as well as management for these children (Crabtree et al., 2011).

As with SCD, some institutions have developed and implemented clinical pathways due to the increasing number of children with asthma being hospitalized (Banasiak & Meadows-Oliver, 2004). Since 1980, the prevalence of people ever having been diagnosed with asthma increased nearly 74% (Banasiak & Meadows-Oliver, 2004). Banasiak and Meadows-Oliver (2004) found that children cared for using an inpatient asthma clinical guideline had a remarkably shorter hospital stay than did children who were not cared for using an asthma pathway (Banasiak & Meadows-Oliver, 2004). Similarly, Johnson, Blaisdell, Walker, and Eggleston (2000) showed that when using a clinical guideline in the treatment of children with asthma, the length of stay was reduced for those children (Banasiak & Meadows-Oliver, 2004). On the other hand, Wazeka et al. (2001) did not find a significant difference in the length of stay for children using an asthma clinical pathway versus those who did not within the first year of using the clinical pathway at their institution. However, this group did find that the length of stay decreased significantly the longer that the pathway was used (Wazeka et al., 2001).

Like Banasiak and Meadows-Oliver (2004) and Johnson et al. (2000), Edwards and Fox (2008), found that the use of an inpatient asthma clinical practice guideline decreases length of stay. Length of stay for clinical pathway patients was 2.33 ± 1.06 days with an average stay of 2.33 days (Edwards & Fox, 2008). Length of stay for control patients was 2.7 ± 1.06 days with an average stay of 2.70 days (Edwards & Fox, 2008). Use of the asthma clinical pathway reduced length of hospital stay by 0.372 days (Edwards & Fox, 2008). Unfortunately this study failed to show improved quality of care, such as increased receipt of asthma education, appropriate prescribing of discharge medications based on asthma classification, or a reduced

readmission rate (Edwards & Fox, 2008). Likewise, Shelledy et al. (2005) found that the mean LOS decreased from 3.10 days to 0.63 days in moderate to severe asthmatics who were given a an in-home asthma teaching program. Conversely, Kwan-Gett et al. (1997) in a retrospective study of a pediatric inpatient asthma clinical guideline, found no significant difference in LOS following implementation of a clinical practice guideline. However, the average LOS prior to pathway implementation was only 2 days (Kwan-Gett et al., 1997). Johnson et al. (2000) in a prospective, randomized, controlled trial showed a decreased length of stay of 13 hr (from 2.23 days to 1.68 days) and decreased routine charges in pediatric patients treated along asthma clinical guidelines in an intervention compared to a control group.

Conclusion

Sickle cell disease and acute chest syndrome affect the lives of many children within the African American and Hispanic communities. The disease is a condition that is difficult to cope with, especially for children. It is a chronic condition that will ultimately take their life, much too early. Despite recent advances in our knowledge of ACS and SCD, mortality still remains a large factor for these patients. Understanding the variables and risks factors for this disease can help providers with delivering the best care possible to extend the lives of many.

As with sickle cell disease, asthma is a chronic disease that affects many American children. The rising costs of healthcare are becoming a concern and burden for many people. Focus is on how to deliver more efficient care, without sacrificing quality of care. One parameter that has been advocated as a systematic measurement for both quality of care and the efficient use of health care dollars is the inpatient length of stay. In addition, length of stay is important to compare between those children with asthma and sickle cell disease, and those with only asthma or sickle cell disease. Understanding the effects of comorbidities on children may

help to provide a more focused approach to care, with an impact of length of stay and potentially, costs.

CHAPTER III

Methodology

The study performed is a retrospective study using existing data from an urban tertiary children's hospital. The data will be used to answer the preset research questions.

1. What is the average patient's age?
2. What is the patient's gender?
3. What is the patient's ethnicity?
4. What is the patient's discharging diagnosis?
5. What is the patient's length of hospital stay?
6. Does having a comorbidity increase the hospital length of stay?
7. What pediatric age group has the shortest and longest length of stay?

Population

The subjects used were children from an urban tertiary children's hospital inpatient unit between January 1, 2012 and December 31, 2012. The patients for this study will be a cross section of different ages and genders that will be utilized to compute statistics and answer preset research question. The inclusion criterions were as follows: children who were admitted with the diagnosis of either asthma, acute chest syndrome, or a combination of asthma exacerbation and acute chest syndrome. Children that were excluded were those that had any other discharging diagnosis than asthma, acute chest syndrome, or a combination of asthma and acute chest syndrome and those patients that were transported to another hospital.

Instrumentation

All data collection was performed by a Clinical Business Requirements Analyst at the approved hospital for this project in accordance with the rules and regulations of the approved

hospital. The data was collected from computer charts at the urban tertiary children's hospital inpatient unit under the direction of the researcher. Data was collected as part of documentation files in the computerized charting database utilized by the hospital and all identifiable markers were removed. Approval was granted by the Institutional Review Board at Georgia State University and from the hospital where data collection was completed.

All possible variables were discussed and critiqued for this study. Variables used included age, race, gender, hospital inpatient length of stay, and discharging diagnosis. The researcher requested the above variables be gathered for the previous year, leaving out all direct patient identifiers. The discharge diagnoses were based on ICD-9 codes, which is a classification system used to assign codes for patient diagnosis within a hospital. Patients included in the study had ICD-9 codes of 517.3 (acute chest syndrome), 493 (asthma), or a combination of both at the time of discharge. The ICD-9 code for asthma includes all types of asthma exacerbations. All ages, races, and genders were included in the study. The Clinical Business Analyst in the Business Intelligence department at the study hospital searched for the data with the above parameters, as outlined by the IRB requirements. After the researcher met with the analyst, the analyst ran a formula to gather the data in the computerized charting database to extract the information for 25% of the data, make sure it would be reliable, and answer what we wanted. Upon reviewing the preliminary data, 12 months of data were ran. A report was generated from Epic patient charting software and identifiable markers were excluded for the researcher, and a copy was kept at the urban tertiary children's hospital inpatient unit.

Once the data reports were created, it was checked for variability by a major professor in the Respiratory Care Program. To ensure reliability of measure, the instrument was used on a selected group of patients. This patient group was checked again by the analyst at the urban

tertiary children's hospital inpatient unit to make sure that what was recorded on each instrument matched that in the patient files. The patients were selected by chart review from January 1, 2012, to December 31, 2012. All of the patients selected were first time admittance for the year. If a patient was admitted multiple times during the year, only their first admittance was included. Inclusion criterion was specifically discharge diagnosis that included either asthma, acute chest syndrome, or a combination of acute chest syndrome and asthma. Exclusion criterion included those that had another diagnosis than asthma or sickle cell disease, and those patients that were transported to another hospital. The patient's variables were recorded and placed into the instrument for further evaluation and analysis.

Data Analysis

All statistical analyses were run using SPSS 17.0 statistical software. Descriptive statistics were calculated for each variable. Nominal data was used for gender, race, and discharging diagnosis. For example, male patients were assigned 1, female patients were 2. Black patients were given number 1, Hispanic patients were 2, other was given 3, and white patients were given 4. Patients with discharge diagnosis of acute chest syndrome were assigned 1, asthma patients 2, and those with both acute chest syndrome and asthma were given 3. Age and length of stay were run as ratio data. The magnitude of correlations between variables was interpreted using the Davis conventions (Davis, 1971).

Coefficient	**Description**
.70 or higher	Very strong association
.50 to .69	Substantial association
.30 to .49	Moderate association
.10 to .29	Low association
.01 to .09	Negligible association

Person Product Moment correlation coefficients were calculated for all ratio data. Eta correlation coefficients were used for calculations made between ratio and nominal data. The data was placed into the tables by a brief narrative.

CHAPTER IV

Results

The purpose of this study was to retrospectively investigate the length of admission for patients who have asthma, acute chest syndrome, and those with both asthma and acute chest syndrome in the pediatric population at an urban hospital between January 1, 2012, and December 31, 2012. This research study explored correlations between each variable to increase awareness of these parameters and to aid in determining which patient population is at highest risk for longer admission rates.

Descriptive Data

Sex, race, discharge diagnosis, age, and length of stay are presented in multiple tables below. Four hundred forty nine pediatric charts were included in this study. The mean age of these pediatric patients was 7.02 years old at the time of discharge, with a standard deviation of 4.695. The frequency of pediatric males and females included in the study are represented below in Table 1. Males represent just over half of the sample population with 245, while the number of females included in the study was 204.

Table 1. Sex (n=449)

	Frequency	Percent
Male	245	54.6
Female	204	45.4

The races of those patients included in the study are shown in Table 2. The Black race was represented 92% of the study, or 413 pediatric patients. Fourteen hispanic children were included in the study, while there were 18 pediatric patients that were represented in the other race category. The least represented race was white, with 4 patients, or 0.9% of this study population.

Table 2. Race (n=449)

	Frequency	Percent
Black	413	92.0
Hispanic	14	3.1
Other	18	4.0
White	4	0.9

The discharge diagnosis of the pediatric population included in this study were represented as Acute Chest Syndrome, Asthma, or both ACS and Asthma as shown in Table 3. Acute Chest Syndrome accounted for 11.8%, or 53 pediatric patients. Asthma diagnosis represented the majority of the patients, with 375 or 83.5%. Those patients with both ACS and Asthma were 21 pediatric patients, or 4.7%.

Table 3. Discharge Diagnosis (n=449)

	Frequency	Percent
Acute Chest Syndrome	53	11.8
Asthma	375	83.5
Both (ACS and Asthma)	21	4.7

The mean length of stay per diagnosis is represented in Table 4. Asthma accounted for the shortest length of stay, with a mean of 2.32 days and a standard deviation of 1.773. Acute chest syndrome had a mean of 3.79 days, with a standard deviation of 2.239. Patients with both asthma and acute chest syndrome accounted for the longest average length of stay, with a mean of 3.81 days and a standard deviation of 3.172.

Table 4. Length of Stay per diagnosis (n=449)

	Mean	Std. Deviation
Acute Chest Syndrome	3.79	2.239
Asthma	2.32	1.773
Both (ACS and Asthma)	3.81	3.172

Figure 1 represents the length of stay of the patients included in the study. The majority of patients, or 81.3 percent, stayed in the hospital for 3 days or less. The length of stay with the most patients was 2 days, which accounted for 161 patients, or 35.9 percent of the total population.

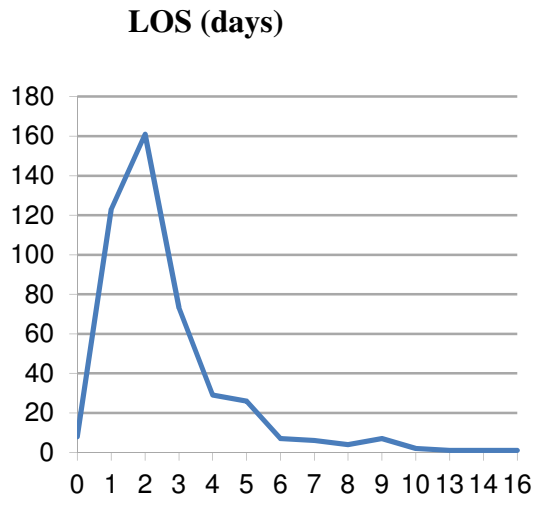

Figure 1. Length of Stay (days)

Figure 2 shows the dispersion of the age of the patients included in this study. The most represented patients in the study were ages 4, 5, 6, and 1, respectively. The least represented patients were ages 18, 15, and 16, respectively. Four years old represented the highest number of patients in the study, with 50. Eighteen years old represented the fewest number of patients in the study, with 4.

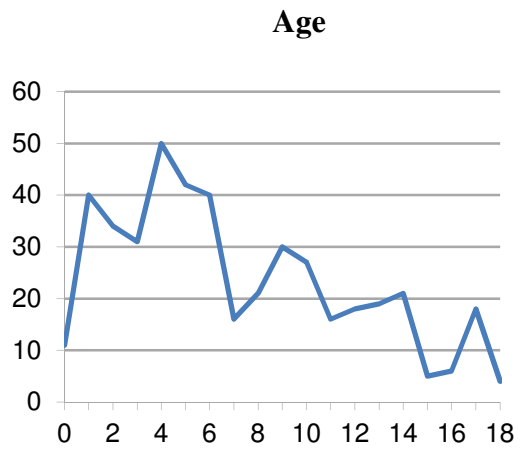

Figure 2. Age in years of admitted patients

Correlations

Intercorrelations are presented in Table 5. According to the Davis conventions, the patient's age at discharge had a low association with length of stay (r = 0.238, p = 0.000). Therefore, the patient's age has very little impact on their length of stay in the hospital.

Table 5. Intercorrelations (n = 449)

		Age	LOS
Age (at the time of discharge)	Pearson Correlation	1	.238**
	Sig. (2-tailed)		.000
Length of Stay (LOS)	Pearson Correlation	.238**	1
	Sig. (2-tailed)	.000	

Note: All coefficients were Pearson product-moment correlations.
**. Correlation was significant at the 0.01 level (2-tailed).

According to the Davis conventions, there was a negligible association (r_{eta} = 0.071) between the patient's age and diagnosis. As indicated, the patient's age does not affect which diagnosis the patient will have.

According to the Davis conventions, there was a low association (r_{eta} = 0.275) between the length of stay and diagnosis. As indicated, the patient's diagnosis has little impact of the patient's length of stay. However, length of stay has more of an impact on diagnosis than age.

CHAPTER V

Discussion

Acute chest syndrome is a common complication associated with significant morbidity and is the leading cause of death among patients with sickle cell disease. ACS is also identified as a significant risk factor for early death. Asthma affects millions of children and is associated with an increase in SCD-related morbidity. Recent studies have shown that the involvement of specialists in asthma and sickle cell care improves patient outcomes and reduces costs. Therefore it is crucial to find and compare length of hospital stay and whether co-morbidities complicate pediatric hospital stays. Length of stay is a measure in determining overall costs and whether a specific patient population is most at risk for longer hospital stays.

The focus of this study was to investigate the length of hospital stay for pediatric patients who have asthma, acute chest syndrome, and those with both asthma and sickle cell disease at a local urban hospital. The mean length of stay was 2.32 days in the asthma pediatric population. Acute chest syndrome followed, with a mean length of stay of 3.79 days. The longest mean length of stay was for patients with both asthma and acute chest syndrome at 3.81 days. The mean length of stay for patients with both asthma and acute chest syndrome is relatively similar to those patients with acute chest syndrome alone. Acute chest syndrome may have more of a significant role in the length of stay versus asthma, as evidenced by a length of stay that was 1.5 days shorter. However, when measuring the association between length of stay and diagnosis, there was a low association. This could be due to the fact that 83.5% of the study population was made up of pediatric patients diagnosed with asthma. Acute chest syndrome accounted for 11.8% of the study, while those with both asthma and acute chest syndrome only represented 4.7%. In the general pediatric population, the incidence of acute chest syndrome is considerably

less than the incidence of asthma. Our study included 53 pediatric acute chest syndrome patients and 21 patients with both ACS and asthma. Poulter et al. (2011) examined 71 pediatric patients with both ACS and asthma. Bryant et al. (2005) included 60 acute chest syndrome patients in their study, and Taylor et al. (2004) included 45 acute chest syndrome patients.

Our study showed similar results in length of stay for pediatric asthma patients. Shelledy et al. (2005) found that mean hospital length of stay for pediatric asthma patients was 3.10 days (Shelledy et al., 2005). Another study showed average overall length of stay for asthma patients decreased from 4.25 days in 1994 to 2.7 days in 1998 (Wazeka et al., 2001). The decrease in length of stay by 1.5 days over a four-year period from 1994 to 1998 could even be lower today and similar to the length of stay that our study found.

While our study found that length of stay for sickle cell patients was close to 4 days, Green et al. (2012), found that 36% of SCD patient admissions resulted in LOS of less than two days. However, the study does was not specific to the reason for admission or types of complications of these patients. Our study only looked at sickle cell patients with acute chest syndrome, which is the most complex and life-threatening complication of sickle cell disease. Similar to our study, Crabtree et al. (2011) found the average length of stay for patients with SCD decreased from 5.4 days in 2007, 2008, and 2009 to 4.1 days in early 2010 due to implementation of educational interventions. The study in 2010 just included the first 6 months; therefore it may not include the same amount of data from the previous three years studied. Vinchinsky et al. (2000) found that the average length of hospitalization for acute chest syndrome pediatric patients was 10.5 days and that prolonged hospitalization was found in older patients. Vinchinsky et al. (2000) included 30 centers and 538 patients, some of which were on mechanical ventilation. Paul et al. (2011) also showed children who developed ACS had longer

hospital stays and more frequently required admission to the intensive care unit. Our study did not include those patients admitted to the intensive care unit, which could impact the overall length of stay. In addition, our study only included unique patient visits. Repeat admissions were excluded. There is the possibility that degree of disease severity could impact the overall length of stay. Taylor et al. (2004) also found the average length of stay was 10 days for patients with sickle cell disease, with 60% of patients staying more than 8 days. However, Taylor et al. (2004) included patients up to thirty-seven years old whereas our oldest patients were eighteen. Another study found the mean length of hospital stay to be 6.4 days in patients with both ACS and asthma, while those with ACS had a mean LOS of 8.6 days (Bryant 2005). Bryant (2005) research suggests that co-morbidities do not impact the length of stay. In contrast, Mayer et al. (2003) found that hospitalizations complicated by co-morbidities have substantially higher lengths of stay and total charges.

Statistics in the United States show that SCD is most common among African Americans, with the incidence of SCD occurring in 1 in 500 births, followed by Hispanic Americans occurring in 1 in 1400 births (Hirani et al., 2011). In addition, asthma is most common in African American children (Anim et al., 2011). Our study was consistent with the overall sickle cell disease and asthma population with 92% of our study being African American, 3.1% Hispanic, 0.9% White, and 4% as other race not represented from one of those above.

Both Paul et al. (2011) and Bryant (2005) found that peak incidence for acute chest syndrome in children is between 2-4 years old and gradually declines with age. The mean age of our study was 7.02 years old and showed that the length of stay decreased with age after 3 years old. However, our study did not show the differences in length of stay with diagnosis per age group. Panepinto et al. (2005) also found that the LOS was longer for children who were older;

however, they found the average LOS was 4.4 days and increased by nearly 2 days for those children 15-18 years of age. Our study did not show a correlation between age and length of stay. Conversely, Panepinto et al. (2005) found a strikingly large number of hospitalizations and significantly longer LOS for VOC in older children with sickle cell disease compared to younger children (Panepinto et al., 2005). In Panepinto et al. (2005), age appears to be a marker of disease severity; however, the etiology of this is unclear. Taylor et al. (2004) found that the age group of 13 to18 years old presented with the greatest number of symptoms consistently, while our study for the same age group was the least represented group, with only 16.2% of our study. Bryant (2005) found that development of ACS is favored by a younger age, high hemoglobin levels, lower hemoglobin F, and higher steady state white blood cell count. The study ranged from 1.5 year old to17 years old and represented 55% female and 45% male (Bryant 2005). Sixty children with SCD were included in the study and 53% had asthma prior to development of ACS (Bryant 2005). The study didn't show any differences between male and female (Bryant 2005). No significant differences between age, sex, hemoglobin level, or LOS of children with asthma and SCD and those without (Bryant 2005). As with our study, age and diagnosis were not significant factors in the length of stay in patients with asthma, acute chest syndrome and those with both asthma and acute chest syndrome. However, Taylor et al. (2004) found a difference in length of stay for males and females. Length of stay for males was 11.4 days versus 9.7 days for females (Taylor et al., 2004). This study included patients ranged from 1 year old to 37 years old, with 46 percent of cases under 13 years old (Taylor et al., 2004). Older patients may have impacted the length of stay between males and females.

Recommendations for future research

Future research in the area of length of hospital stay and disease management in the pediatric population should be continued. With increasing health care costs, length of stay is one measure that affects those costs. Finding ways to decrease the length of hospital stay for pediatric patients without sacrificing quality of care can greatly impact the future of health care and the health of the patient.

While there is an abundance of research on asthma, more research could be focused on sickle cell disease, specifically acute chest syndrome, as it is the leading cause of death in those patients. There are national clinical practice guidelines in caring for the pediatric asthma patients, which have shown to decrease frequency and length of hospitalization when followed. The etiologies of asthma are well understood, as is the treatment plan. Therefore, mortality has significantly decreased over the last 20 years. On the other hand, acute chest syndrome is not well understood, and how asthma may play a role in the development of acute chest syndrome. Even though sickle cell disease only impacts a relatively small number of Americans compared with asthma, creation of clinical practice guidelines could impact the care and length of stay for those patients.

Future studies could include a larger population of patients with acute chest syndrome and those with both asthma and acute chest syndrome to determine if asthma does have a role in longer hospital stays or more complications. In addition, those patients admitted to the intensive care unit could be included to determine if disease severity plays a role in the care they receive and length of stay. Another aspect to examine is whether a small number of patients are admitted to the hospital frequently and if they make up the majority of admissions. Intervention and education could play a major role in reducing those frequencies of hospital visits.

Conclusion

Current studies on how length of stay impacts the care of patients with sickle cell disease, asthma, and those with both sickle cell and asthma are limited. The goal of this study along with others should improve awareness of the impact of these diseases on the pediatric population and to aid in determining which patient population is at highest risk for longer admission rates. The length of hospitalization can be important in determining and managing healthcare resources within the hospital. It could also potentially impact the health care costs and quality of care delivered to the patient. According to this study, age and diagnosis are not significant factors in length of hospital stay for the pediatric patient. An overwhelming majority of the patients in the study were African American, which is representative of both asthma and sickle cell disease in the overall population. This study also showed that the patients tended to be younger, have asthma as a discharge diagnosis, and length of stay less than 3 days. It is hoped that further research will be conducted in order to provide clinicians with the comprehensive knowledge needed to provide pediatric patients suffering from asthma and sickle cell disease with care that may have a greater impact on patient outcomes.

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