2021

Emergency Department Utilization and Length of Stay Among Sickle Cell Patients

Rushali Naik
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral study by

Rushali Naik

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Miriam Ross, Committee Chairperson, Health Sciences Faculty
Dr. Matt Frederiksen-England, Committee Member, Health Sciences Faculty
Dr. Michael Brunet, University Reviewer, Health Sciences Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2021

Abstract

Emergency Department Utilization and Length of Stay Among Sickle Cell Patients

by

Rushali Naik

DPT, University of Tennessee, 2010

MSPT, Armstrong Atlantic State University, 2006

BS in Health Sciences, Armstrong Atlantic State University, 2004

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

May 2021

Abstract

Patients with sickle cell disease (SCD) utilize the emergency department (ED) frequently due to limited access to adult health care providers. Few providers are knowledgeable about caring for patients with sickle cell disease. This quantitative study's purpose and research questions addressed whether there was a correlation between ED utilization and ED length of stay (LOS) pre- and post-enrollment in an adult comprehensive sickle cell clinic between the years of 2012 and 2017. The Donabedian framework was used to examine the structure, process, and outcomes related to the benefits of care in a sickle cell center. The independent variables of pre- and post-enrollment of patients in a sickle cell specialty center in relation to the dependent variables of ED utilization and ED LOS were analyzed using a chi-square test and a paired sample *t* test, and age was measured as a covariate using linear regression. Results indicated a significant difference in ED utilization between the pre- and post-enrollment groups, with an increased ED utilization in the pre-enrollment group compared to patients enrolled in the SCD clinic group. There was no statistical significance for ED LOS in the pre-enrollment group compared to the post-enrollment group. Results also indicated a significant correlation between ED utilization and age, but no significant correlation between ED LOS and age. The positive social change benefits of this study include the advantage of specialty clinics for SCD patients to prevent ED admissions because of improvements in care, the importance of SCD specialty clinics for different regions, and the role health care administrators have with implementing policies for these clinics.

Emergency Department Utilization and Length of Stay Among Sickle Cell Patients

by

Rushali Naik

DPT, University of Tennessee, 2010

MSPT, Armstrong Atlantic State University, 2006

BS in Health Sciences, Armstrong Atlantic State University, 2004

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

Walden University

May 2021

Dedication

I would like to dedicate this dissertation to my daughter, Raiya, who is my motivation to strive for the best consistently, and to God for allowing me to meet my potential. I would also like to thank my family for their everlasting love and support.

Acknowledgments

I would like to thank Dr. Miriam Ross, Dr. Matt Frederiksen-England, and Dr. Mike Brunet. Your support and guidance have been key to my success. It is important that I give thanks to Dr. Jane Hankins, and Dr. Pradeep Podilla, for allowing me to use their dataset. Additionally, I would also like to acknowledge my daughter, parents, husband, sister, friends, and extended family for their support and trust. Thank you!

Table of Contents

List of Tables

List of Figures

Section 1: Foundation of the Study and Literature Review

The lack of sickle cell providers has been highlighted as one of the factors that affects emergency department (ED) utilization in adult patients with sickle cell disease (Ogu & Billet, 2018). The literature showed a gap regarding the administrative benefits, such as ED utilization and ED length of stay (LOS), of comprehensive sickle cell clinics. ED utilization is defined as the use of the ED department by SCD patients, and ED LOS is defined as the amount of time from the patient checking in to the ED to discharge from the ED or admission to the hospital. Unnecessary utilization of the ED could increase health care costs (Enard & Ganeline, 2013).

National estimates of SCD-related ED visits in the United States were $2.96 million (Lankzkron et al., 2010), and annual health care expenditure for SCD hospitalizations was over $900 million (Shah et al., 2019). ED utilization and LOS are important considerations for hospital administrators because unnecessary ED utilization can increase the overall cost of care and duplication of services, which can further burden hospitals (Ho et al., 2017).

The current study addressed ED utilization and ED LOS of patients who used the ED in the hospital system prior to attending an adult sickle cell center (pre-enrollment) and after attending an adult sickle cell center (post-enrollment). This study's dependent variables included ED utilization and ED LOS, and the independent variables included pre-enrollment and post-enrollment.

The information from this study could help providers understand and appreciate the best standard of care for SCD patients, which could translate into cost reduction for

health care systems. This study may also increase the understanding of the benefits for sickle cell patients when they attend comprehensive sickle cell centers, including how comprehensive sickle cell centers affect the ED utilization and LOS. In turn, this study may motivate hospital administrators to invest in sickle cell clinics.

Problem Statement

Caring for adult SCD patients is challenging due to limited adult providers who are educated in SCD (Ogu & Billet, 2018). Limited data are available on the effectiveness of adult comprehensive sickle cell clinics. Some studies suggested an increase in ED utilization when patients attend sickle cell centers, and some studies suggested a decrease in ED utilization when patients attend sickle cell centers (Artz et al., 2010; Binding et al., 2014; Smeltzer et al., 2016.) The problem was the evidence was not conclusive regarding the ED utilization patterns of patients who attend a comprehensive sickle cell center. Previous studies indicated adult patients with SCD received fragmented care due to a lack of specialized teams devoted to adult SCD (Ogu & Billet, 2018; Reich et al., 2019; Ter-Minassian et al., 2019). In a national study, primary care physicians did not feel comfortable treating SCD because they did not have enough education about SCD to understand the needs of these patients (Mainous et al., 2015). Due to the lack of sickle cell providers, there was limited evidence regarding the administrative benefits, such as ED utilization and ED LOS, among adult sickle cell patients who receive care in sickle cell centers. The limited evidence that did exist was inconclusive. In the current study, I compared the administrative outcomes that affect medical costs, such as ED utilization and ED LOS of adult SCD patients. The purpose of this quantitative study was to

examine the correlation in ED utilization and ED LOS among adult sickle cell patients who received care at an adult sickle cell center in Tennessee. The patients' ED utilization and ED LOS were compared from pre-enrollment to the center and post-enrollment to the center between the years of 2012 and 2017. Pre-enrollment was defined as prior to being a patient of the adult sickle cell center, and post-enrollment was defined as after being a patient of the adult sickle cell center.

Smeltzer et al. (2016) looked at a pediatric comprehensive sickle cell center and found that hospitalizations and clinic visits increased when the sickle cell center was located closer to the patient, suggesting that sickle cell patients who lived further away from a center may have inadequate medical care and access to care. Smeltzer et al. suggested the decrease in hospitalizations and clinic visits for patients who lived farther away from the comprehensive sickle cell center could be related to underreporting ED and inpatient utilization in other medical facilities closer to the patients' homes. However, Smeltzer et al. also found that patients' overall ED utilization rate was lower than the national averages for the pediatric SCD population.

Binding et al. (2014) investigated how sickle centers in high and low disease prevalence areas tended to show a reduction of admission rates, but the study included only a small sample size and was not designed to consider the ED utilization and LOS with SCD centers. The literature on whether sickle cell clinics reduce hospital and ED utilization was mixed and inconclusive. Some researchers found that using a multidisciplinary approach decreased ED utilization and using a SCD center reduced hospital inpatient admission rates (Blinder et al., 2015; Powell et al., 2016; Simpson et

al., 2017), while Smeltzer et al. (2016) suggested that the closer a patient lives to the ED or center, the ED utilization increases.

The data for the current study were obtained from a sickle cell center that provides multidisciplinary care and individualized pain plans based on the best standard of care, and hematologists specialized in treating SCD. The multidisciplinary approach at the center includes weekly team meetings between different health providers such as medical doctors from adult and pediatric hematology, ED providers, and primary care; nurse practitioners; and other ancillary health care staff such as nurses, social workers, and case managers. The results of this study may help administrators understand the benefits of sickle cell patients attending comprehensive sickle cell centers, including understanding how comprehensive sickle cell centers affect ED utilization and LOS. In turn, this study may motivate hospital administrators to invest in sickle cell clinics to help reduce the total cost of care. Hospital revenue in the ED is tied to improving performance metrics such as ED wait times, patients leaving without being seen, ED LOS, decisions to admit, and patient satisfaction (Feinberg & Stone-Griffith, 2016).

Purpose of the Study

The purpose of this quantitative study was to determine whether there was a correlation in ED utilization and ED LOS among adult sickle cell patients who received care at an adult sickle cell center, pre- and post-enrollment to the clinic, between the years of 2012 and 2017. ED utilization and LOS are important considerations for hospital administration because unnecessary ED utilization can increase the overall cost of care and duplication of services, which can further burden the hospitals (Ho et al., 2017).

When the ED LOS is long, there is one less ED bed available to another patient, which directly impacts the hospital's revenue (Feinberg & Stone- Griffith, 2016). It is in the best interest of hospital administrators to pay careful attention to ED optimization to improve performance and quality measures (Feinberg & Stone-Griffith, 2016). Hospitals are under regulatory pressure to reduce ED costs, improve efficiency, and increase throughput capacity, which then ties to hospital reimbursement. The current study would help determine administrative benefits of sickle cell centers.

The independent variables included pre- and post-enrollment to the sickle cell center. The dependent variables included ED utilization (frequency of ED visits) and ED LOS. The study addressed the dependent variables of the same patients with SCD prior to being enrolled into the sickle cell specialty center (pre-enrollment) and after being enrolled to the center (post-enrollment) to determine whether there was a statistical difference in ED LOS. The results of this study may provide insight regarding the benefits of providing specialized SCD care, which may include lower ED utilization, lower LOS, improved quality of care, and lower cost of care. The study may help health care leaders determine the usefulness of sickle cell clinics and may help administrators determine the benefits of investing in more comprehensive sickle cell centers.

ED utilization and LOS are important considerations for hospital administration because unnecessary ED utilization can increase the overall cost of care and duplication of services, such as repeating labs or diagnostics that could be performed as an outpatient instead, which can further burden the hospitals (Ho et al., 2017). It is in the best interest of hospital administrators to pay careful attention to ED optimization to improve

performance and quality measures (Feinberg & Stone-Griffith, 2016). Feinberg and Stone-Griffith (2016) stated that hospitals are under regulatory pressure to reduce ED costs, improve efficiency, and increase throughput capacity, which then ties to hospital reimbursement.

Adult sickle cell patients tend to utilize the ED or have increased inpatient admissions secondary to SCD-related complications (Chappidi et al., 2013; Cline et al., 2018; Glassberg, 2012). The increased complications may be related to the lack of sickle cell clinics and providers. The findings from this research may contribute to positive social change for the sickle cell community by increasing accessibility to comprehensive sickle cell centers, which may afford patients the opportunity to receive the best evidence-based care. Additionally, this study may-encourage increased funding for sickle cell clinics or sickle cell providers by providing administrative insights into the optimal care of patients with SCD.

Research Questions and Hypotheses

RQ1: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o1: There is no statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a1: There is a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ2: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o2: There is no statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a2: There is a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ3: Is there a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o3: There is no correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a3: There is a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

RQ4: Is there a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o4: There is no correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a4: There is a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

Theoretical Foundation of the Study

I used the Donabedian (1985) framework to examine the structure, process, and outcomes of attending a sickle cell center. The model provided a foundation for understanding whether the effectiveness of an adult sickle cell center reduces the use of the ED. The Donabedian framework includes three categories: structure, process, and outcome. The structure provides a model for determining how care is organized, the process determines what is known to be the best evidence-based medical care, and the outcome emphasizes the quality measures that affect the end result of care (Donabedian, 1985; Van Houdt et al., 2013). The Donabedian framework related to the current study in the following ways: The structure was the comprehensive sickle cell clinic; the process was the best practice standards already researched in sickle cell, which included multidisciplinary care and individualized care plans; and the outcome related to the use of ED utilization and LOS in the ED (see Figure 1).

Figure 1

Three Stages of the Donabedian Framework

Nature of the Study

The study had a retrospective correlational quantitative design. The independent variables were pre- and post-enrollment to the center, and the dependent variables were ED utilization and ED LOS. A chi-square test, a paired sample *t* test, and a linear regression analysis were used to compare the pre- and post-enrollment groups; linear regression was used to compare groups in relation to age.

I used a secondary data set collected by the former medical director of an adult sickle cell clinic in a southern U.S. state. The data set was a convenience sample to investigate the effectiveness of an adult sickle cell clinic related to ED utilization. The data set included data on all patients who came to the ED through a large hospital system in Tennessee and were diagnosed with SCD for the time frame of 2012 to 2017. Permission to access the secondary data set was obtained by completing the Collaborative Institutional Training Initiative (CITI) training and submitting a request to the organization's institutional review board (IRB) committee.

Each patient was counted as a unique patient, each visit was counted as an encounter, and patients may have had more than one encounter. The ED patient list was cross-referenced with the sickle cell center's list of patients to determine whether the patient attended the adult center and when the patient was first enrolled in the clinic. The data set also included the inpatient (IP) utilization, the LOS, the insurance carrier, and demographic information. All of the secondary data were de-identified, and no personal information was known to me.

Literature Search Strategy

To better understand the association between ED utilization and ED LOS in the sickle cell population, several databases were used to retrieve the most current literature on ED utilization in SCD, ED LOS in SCD, and factors that affect SCD ED utilization. Selected articles relating to the care of patients with SCD and outcomes such as ED utilization and ED LOS were identified. The keywords searched were *sickle cell disease*, *inpatient (IP) utilization*, *ED utilization*, and *comprehensive sickle cell centers*. Database searches were my primary means of searching for related articles. The following Walden University databases and search engines were used: EBSCO, Medline, PubMed, and the Thoreau multi database search. The search was focused initially on ages 18 years and older, but limited data existed in the adult population, so the search was expanded to include the pediatric population as well. The publication dates for scholarly articles ranged from 2009 to 2018.

Literature Review Related to Key Variables and/ or Concepts

The purpose of the literature review was to synthesize studies completed by researchers about ED utilization and ED LOS (the dependent variables) in SCD patients, and enrollment in a comprehensive sickle cell center (the independent variable). The literature review is divided into the following sections: (a) the general overview of SCD, (b) the typical barriers that adult sickle cell patients face, (c) the factors that affect ED utilization and LOS in adult sickle cell patients, and (d) current evidence on sickle cell centers.

General Overview of SCD

SCD is a group of inherited red blood cell disorders that can lead to multiple complications to the patient, such as vaso-occlusive pain crises and acute chest syndrome (Bojanowski, 2010). SCD results in hemolytic anemia and small vessels' blockade, which can lead to vaso-occlusive episodes and/or organ failure (Shah et al., 2019). The blockage of blood vessels can cause the following complications: acute chest syndrome secondary to sickling of blood vessels of the lungs; acute pain crises, also known as vaso-occlusive pain crises, which is caused secondary to sickled blood flow and deoxygenated blood; brain complications such as strokes; and heart problems such as ischemic heart disease and pulmonary hypertension (Lee et al., 2019; National Heart, Lung, and Blood Institute, n.d.; Shah et al., 2019). The sickle cell complications cause sickle cell patients to have increased hospitalizations and to frequently utilize the ED (Hemker et al., 2011).

Approximately 85% of the SCD-related ED visits had vaso-occlusive crises as the primary reason for admission, and the other 15% of the ED visits contributed to SCD

complications (Blinder et al., 2015). The other most common complications included infectious and parasitic disease and cerebrovascular complications such as seizures and strokes (Shah et al., 2019). Other sickle cell complications included splenic crises, which can lead to immunocompromise, gallstone, and priapism in males (Carden et al., 2016).

SCD is a disease that affects fewer than 200,000 people nationwide, and consequently the disease does not receive much research funding (Lee et al., 2019). People living with SCD have limited access to comprehensive care because providers do not have enough education/comfort to treat the disease (Mainous et al., 2015) and therefore have more difficulty managing patients' pain (Lee et al., 2019). When the sickle cell pain cannot be managed at home, ED utilization is increased (Smeltzer et al., 2016). Soboto (2011) performed a survey of 30 pediatric SCD centers and found that only 18 centers transitioned their patients to adult hematologists specializing in SCD. The mortality rates of young adults who were transitioning with SCD increased by two- to threefold (Hamideh & Alvarez, 2013).

Typical Barriers That Adult SCD Patients Face

SCD has limited research funding because there is a limited number of patients diagnosed with this illness (Lee et al., 2019). Limited research has shown a lack of educated providers in the SCD adult population (Mainous et al., 2015). The lack of health care providers in SCD adult care has been demonstrated in the overutilization of EDs for SCD care due to lack of access to care (Blinder et al., 2015; Ogu & Billet, 2018; Smeltzer et al., 2018; Ter-Minassian et al., 2019). Decreased adherence to health maintenance visits, such as regular checkups and regular assessment of blood levels, was noted more

among patients without private insurance, possibly related to health literacy, economic status, and access to health care issues (Smeltzer et al., 2016).

Other barriers that adult SCD patients face is decreased access to health care, such as the unsuccessful transition of pediatric patients to adult sickle cell care, and increased distance from a sickle cell center to the patient's house (Smeltzer et al., 2016). Other barriers include low socioeconomic status (Cronin et al., 2018; Smeltzer et al., 2016) and having private insurance versus Medicaid (Amendah et al., 2010; Cronin et al., 2018; Smeltzer et al., 2016). Age and fragmented care are also documented barriers to caring for the sickle cell patient (Blinder et al., 2015; Smeltzer et al., 2016).

Children who have SCD received adequate standardized care, but the patients who reach adulthood did not receive the same care due to a lack of providers (Ter-Minassian et al., 2019). Patients with high ED reliance incurred more days in the hospital and significantly higher health care costs (Blinder et al., 2015). SCD patients who transition from youth to adulthood have difficulty finding an adult provider devoted to SCD care (Ter-Minassian et al., 2019). Total costs per patient per month were lower for pediatric patients compared with adult patients due to fragmented care (Kauf et al., 2009). Adults comprised 75% of the SCD hospital admissions (Artz et al., 2010). Cronin et al. (2018) reported that financial security, health literacy, spirituality, and lacking cues to action like reminders were also perceived as barriers to sickle cell care. The current study addressed access to care by determining whether the comprehensive sickle cell specialty clinic affected the ED utilization and LOS before and after patients enrolled in the center.

Factors That Affect ED Utilization and LOS in Adult SCD Patients

Sickle cell patients face multiple barriers that make optimal management of their sickle cell disease difficult (Gray et al., 2018; Smelter et al., 2015). The challenges of sickle cell care contribute to poor sickle cell outcomes, increased utilization of the ED, increased hospitalizations, and increased cost of care (Blinder et al., 2015; Carden et al., 2016; Smeltzer et al., 2016). Carden et al. (2016) reported that increased disease-specific knowledge increased ED utilization as patients became more aware of SCD complications. Alternatively, other research suggested that health literacy and education affected ED utilization (Aisiku et al., 2009; Cronin et al., 2018). Age and disease severity have also been shown to increase ED utilization (Aisiku et al., 2009; Blinder et al., 2015). Multiple researchers found a common barrier was fragmented care or decreased providers specialized in treating the adult sickle cell patient (Blinder et al., 2015; Ogu & Billet, 2018; Ter-Minassian et al., 2019). Multiple studies suggested that a multidisciplinary approach to sickle cell care reduced ED utilization (Powell et al., 2016; Simpson et al., 2017).

Sickle Cell Centers

Fragmented care is a major barrier to adult sickle cell care (Blinder et al., 2015; Koch et al., 2014; Ogu & Billet, 2018; Ter-Minassian et al., 2019). The evidence regarding the correlation between ED utilization and comprehensive sickle cell centers was mixed and limited (Blinder et al., 2015; Powell et al., 2016; Simpson et al., 2017; Smeltzer et al., 2016). Lavelle et al. (2018) found that Federally Qualified Health Centers that provide comprehensive care increased ED utilization but decreased the number of

outpatient clinic visits; however, when the analysis was adjusted for the case-mix, the difference was attenuated. Similarly, patients who had more disease-specific knowledge, which is a type of learning that empowers caregivers and patients to make life-changing decisions, ED utilization increased as patients were more empowered of knowing their disease and when they needed to utilize the ED; comprehensive multidisciplinary centers are known to provide disease-specific knowledge (Carden et al., 2016). Alternatively, Blinder et al. (2015) found that ED reliance increased among post-transition patients and continued into adulthood secondary to decreased health care access once patients became adults. Similarly, Simpson et al. (2017) found that sickle cell centers that provided best practice advisories, an ED protocol, and a medical home, which is a method of providing comprehensive and continuous care to adults with an emphasis of care coordination and communication among high or super-utilizers, showed a tendency to decrease ED utilization and LOS; however, the sample size for this study was small and included only super-utilizers.

Simpson et al. (2017) and Powell et al. (2016) provided information on how a multidisciplinary approach affected ED utilization in the sickle cell population. The researchers found that monthly meetings, best practice advisories, and ED protocols helped to decrease ED visits, ED LOS, IP admissions, and IP LOS. The practices of monthly meetings, individualized pain plans for ED protocols, and best practice advisories are consistent with comprehensive sickle cell clinics' practices.

ED utilization for SCD patients was shown to be lower when a multidisciplinary approach was used, which included monthly team meetings and development of

individualized care plans (Powell et al., 2016; Simpson et al., 2017). Adult sickle cell centers used a multidisciplinary approach to care, and Powell et al. (2016) and Simpson et al. (2017) demonstrated that a multidisciplinary approach reduces ED utilization; however, there was a gap in the literature regarding whether a relationship exists between attending a comprehensive sickle cell center and ED utilization. Patients with SCD tend to utilize ED services more than clinic services due to the lack of sickle cell providers (Blinder et al., 2015). Cline et al. (2018) suggested alternative venues to manage uncomplicated vaso-occlusive crises such as day hospitals or ED observation units to decrease hospital admissions.

Smeltzer et al. (2016) found that the greater the distance between the comprehensive sickle cell clinic and the patient's house, the lower the ED utilization. Smeltzer et al. reported that patients who lived further away from a sickle cell center sometimes forego medical care. Smeltzer et al. also found that patients living within 35 miles of the hospital had 1.75 times the rate of hospitalization than those living 35 or more miles away. The results of this study indicated that the closer a patient lives to the hospital, the greater the ED utilization and hospitalizations, and therefore the greater the cost. However, Smeltzer et al. attributed this to underreporting of patients who lived farther away. Smeltzer et al. also found that hospitalizations and ED utilization rates in their multidisciplinary clinic were significantly lower than the national averages.

Binding et al. (2014) found that sickle cell centers with a lower prevalence of sickle cell population had similar ED visits and hospital admissions compared to sickle cell centers with a higher prevalence of sickle cell population. Artz et al. (2010) found a

downward trend in admissions, 30-day readmissions, and LOS after the establishment of a multidisciplinary sickle cell center. Both these studies showed mixed reviews of sickle cell centers' administrative benefits, therefore demonstrating a gap in the literature.

Comprehensive sickle cell clinics provide multidisciplinary care and individualized care plans that improve patient outcomes (Powell et al., 2016). Adult sickle cell patients have multiple complications, including vaso-occlusive pain crises and acute chest syndrome, which can increase ED utilization and hospitalizations (Blinder et al., 2015; Carden et al., 2016; Hemker et al., 2011). Most ED visits by adult SCD patients are due to a vaso-occlusive pain crisis; when the pain is not adequately addressed, it leads to a hospitalization (Blinder et al., 2015).

Literature Review Conclusion

The research findings regarding the correlation between comprehensive sickle cell centers and ED utilization are mixed, with some studies suggesting increased ED utilization (Carden et al., 2016; Lavelle et al., 2018; Smeltzer et al., 2016) and other studies suggesting decreased ED utilization (Powell et al., 2016; Simpson et al., 2017). The current study was conducted to determine the relationship between ED utilization and pre- and post-enrollment at a comprehensive sickle cell center. The literature did not indicate whether there are benefits for adults who attend comprehensive sickle cell centers with use of the ED.

Definitions

Best practice advisories: Evidence-based recommendations based on best practices (Simpson et al., 2017).

Comprehensive sickle cell clinic: A clinic that specializes in the care of adult sickle cell patients by using a multidisciplinary approach, which may include monthly team meetings and development of individualized care plans (Powell et al., 2016; Simpson et al., 2017).

Disease-specific knowledge: This type of learning empowers principal caregivers of children to make life-changing decisions that can be measured by behavior change over time (Carden et al., 2016).

ED (emergency department) utilization: Emergency department utilization by sickle cell patients. ED utilization was calculated by total use, called ED total and those visits that did not result in an admission, called ED independent (Epstein et al., 2006).

ED LOS (emergency department length of stay): The amount of time from checking into the ED to the discharge from the ED or admission to the hospital.

Fragmented care: When sickle cell patients transition from pediatric to adult care, their medical care is interrupted, which can then result in poorer clinical outcomes secondary to inconsistent and inadequate access to care (Blinder et al., 2015; Koch et al., 2014).

Health literacy: The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Carden et al., 2016).

Post-enrollment: A patient's ED utilization and ED LOS after attending the adult sickle cell center.

Pre-enrollment: A patient's ED utilization and ED LOS before attending the adult sickle cell center.

SCD (sickle cell disease): A group of inherited disorders of red blood cells in which abnormal hemoglobin is produced (Epstein et al., 2007).

Transition: This is the phase when a young adult receives uninterrupted, developmentally appropriate medical care (Gray et al., 2018).

Vaso-occlusive crises: These are also referred to as pain crises, which are a blockade of vessels secondary to sickled blood flow (Bojanowski, 2010; Lee et al., 2019).

Assumptions

It was important to acknowledge the assumptions that affected this study. I assumed that patients only went to the ED based on where the data for this study were collected. If a patient visited another ED, the information was not included in the secondary data. The study did not account for the ED utilization at other health care systems. The final assumption was that patients who attended the adult sickle cell clinic chose the associated health care hospital as their medical home.

Scope and Delimitation, and Limitations

The scope of the study concerned the methodology, which was quantitative and correlational with conclusions derived from a secondary data set. The previous medical director created this secondary data set at an adult sickle cell clinic, and the information technology analyst provided access to the data. The data set included data for all patients who had a primary diagnosis of SCD and had come to the ED through the health care system associated with the sickle cell center. Each patient visit was considered an

encounter, and each encounter was determined to be either pre-enrollment to the center or post-enrollment to the center. Additionally, the data set included the frequency of utilization, the LOS, the insurance carrier, demographic information, utilization before the center was established, and utilization after the center was established.

Permission to access the data set was accomplished by completing the CITI training and communicating with the organization's IRB. The independent variables that were analyzed in this study included pre-enrollment to the center and post-enrollment to the center, and the dependent variables included ED utilization and ED LOS. The study did not account for other factors that may have affected the results such as demographics, disease severity, distance from the patient's house to the ED, and insurance carriers.

The study was limited to data of patients who came to the ED through the hospital system associated with the adult sickle cell center in Tennessee. This meant that the results may not be generalizable to the entire sickle cell population. In addition, I did not consider sickle cell patients who received care at other sickle cell centers.

Significance, Summary, and Conclusions

The study's results may provide insight regarding the benefits of specialized SCD care, which may include lower ED utilization and lower LOS. In return, this could improve the quality of care while potentially lowering the cost of care. The study may help health care leaders determine the usefulness of sickle cell clinics and whether it is effective to invest in more comprehensive sickle cell centers.

Adult sickle cell patients tend to utilize the ED or have increased IP admissions secondary to SCD-related complications (Chappidi et al., 2013; Cline et al., 2018). The

increased number of complications may be related to the lack of sickle cell clinics/providers. The current findings may contribute to positive social change for the sickle cell community, sickle cell clinics, and sickle cell providers by providing standards and administrative insight into the optimal care of patients with SCD.

The gap in the literature pertained to how ED utilization correlated to attending a sickle cell center. The literature showed mixed findings related to sickle cell clinics and ED utilization. One study suggested an increase in utilization when the distance from the patient's house to the center was closer (Smeltzer et al., 2016). Other studies suggested a decrease in ED utilization when receiving care at a sickle cell center (Powell et al., 2016; Simpson et al., 2017). The current study may allow researchers, administrators, and medical teams to determine how ED utilization may be affected when patients attend a comprehensive sickle cell center. Section 2 provides information regarding the research design and data collection methods for this study.

Section 2: Research Design and Data Collection

In the previous section, I provided an extensive review of the current literature related to ED utilization and LOS in the sickle cell patients and the literature related to the benefits of comprehensive sickle cell centers in the adult sickle cell population. Although multiple researchers have explored the benefits of sickle cell centers among the pediatric sickle cell population, the research among the adult sickle cell population has been mixed. My study addressed the administrative outcome of ED utilization and ED LOS in an adult sickle cell clinic.

The purpose of this quantitative study was to examine the correlation in ED utilization and LOS among adult sickle cell patients who received care at the adult comprehensive sickle cell clinic pre- and post-enrollment to the center, between the years of 2012 and 2017. The ED LOS is directly related to how many ED beds are available to treat a patient, which affects hospital reimbursement; ED utilization is related to ED optimization to improve performance and quality measures, which also improves reimbursement (Feinberg & Stone-Griffith, 2016). The independent variables were pre- and post-enrollment to the sickle cell center, and the dependent variables were ED utilization (the frequency of ED visits) and ED LOS. This section includes the research design, methodology, threats to validity, and a summary.

Research Design and Rationale

The dependent variables were ED utilization and ED LOS, and the independent variables were the pre- and post-enrollment to the adult sickle cell center. The research design was retrospective, correlational, and quantitative. A chi-square test and a paired

sample *t* test were used to compare ED utilization and ED LOS in the pre- and post-enrollment group, and a regression analysis was used to compare age to ED utilization and ED LOS. The design choice included a secondary data set to compare pre- and post-enrollment, which required me to have IRB approval prior to accessing the data set at the organization providing the data. This data approval process was time-consuming and took 2 months. Another constraint with this design choice was that the data set included data collected from 2012 to 2017, meaning the data set was not the most current. However, this design was the most appropriate for this study, and matched previous studies that compared pre- and post-enrollment data.

Powell et al. (2018) used a retrospective study of unplanned acute care use (ED and IP admissions) pre- and post-initiation of a multidisciplinary care team intervention in a single urban academic health center in Pennsylvania. Simpson et al. (2016) also used a retrospective pre- and post-implementation design; however, this study included only 10 subjects. The study by Ter-Minassian et al. (2019) was a retrospective cross-sectional design that addressed yearly screening labs, hydroxyurea adherence, and documented vaccinations.

Methodology

Study Population

The target population for the current study was adult sickle cell patients age 18 years or older who received services at the emergency rooms of the hospital system associated with the adult sickle cell clinic. A total of 428 encounters of patients who went to the ED were examined, including the pre- and post-enrollment groups.

Sampling and Sampling Procedures

The secondary data set that was used in this study was previously collected by the health care system. The sampling strategy used for the original data was convenience sampling. The secondary data set that I used included de-identified information and did not include the patients' name, date of birth, medical record number, address, zip codes, or social security numbers. The letter of approval to access the data set was included in the appendix along with a copy of the organization's IRB approval. The data set was saved on my personal laptop that was password protected.

The data set included data on all the patients who came to the ED through the health care system associated with the sickle cell clinic who had a diagnosis of SCD. Each patient visit was considered an encounter, and each encounter was determined to be either pre-enrollment to the clinic or post-enrollment to the clinic. Additionally, the data set included the frequency of utilization, the LOS, the insurance carrier, demographic information, the utilization before the center was established, and the utilization after the center was established. The inclusion criteria included adult sickle cell patients age 18 years or older who were enrolled in the adult sickle cell center for the years 2012 through 2017. The exclusion criteria included any sickle cell patients younger than 18 years of age.

Power Analysis

The power analysis tool used was the G*Power, a free power analysis tool (Faul et al., 2007). Based on the power analysis, the required sample size for the logistic regression analysis was 84 (power = 0.80, alpha = 0.05, and predicted moderate effect

size = 0.3). The analysis used was a priori logistic regression. The power and the alpha level used were standard numbers that are typically used. The effect size that was used was a moderate effect size (see Figure 2).

Figure 2

Power Analysis

Exact – Correlation: Bivariate normal model

Options:	exact distribution	
Analysis:	A priori: Compute required sample size	
Input:	Tail(s)	= Two
	Correlation ρ H1	= 0.3
	α err prob	= 0.05
	Power (1−β err prob)	= 0.80
	Correlation ρ H0	= 0
Output:	Lower critical r	= −0.2145669
	Upper critical r	= 0.2145669
	Total sample size	= 84
	Actual power	= 0.8003390

Instrumentation and Operationalization of Constructs

The secondary data set was obtained from a large sickle cell center. Permission to use this data set was received by both creators of the data via email communication. The IRB program at the organization received my request to use the data, and my name was added to access the data set. The data set included data on all patients who came to the ED through the health care system associated with the clinic who had a diagnosis of SCD from the years 2012 to 2017. Each patient visit was considered an encounter, and each encounter was determined to be either pre-enrollment to the center or post-enrollment to the center. Additionally, the data set included the frequency of utilization, the LOS, the insurance carrier, demographic information, the utilization before the center was established, and the utilization after the center was established. The data were tested for accuracy by the IT systems analyst using sample patients. I looked at the ED utilization prior to being enrolled in the adult center and after being enrolled in the center.

The independent variables included the pre-enrollment to the adult sickle cell center, which was coded as 1, and post-enrollment to the adult sickle cell center, which was coded as 2. The ED utilization was measured by looking at the number of check-ins a patient made to an ED in the health care system associated with the sickle cell clinic, and the ED LOS was measured from the time a patient checked in to the ED to the time the patient was discharged from the ED. I looked at the pre-enrollment ED utilization, pre-enrollment ED LOS, post-enrollment ED utilization, and post-enrollment ED LOS. Table 1 includes a description of the variables.

Table 1

Description of Variables

Independent variables	Dependent variables	Covariates
Pre-enrollment to the adult sickle cell center	ED utilization	Age
Post-enrollment to the adult sickle cell center	ED LOS	Age

Data Analysis Plan

I analyzed data from the secondary data set using the Statistical Package for the Social Sciences (SPSS) Version 25. The pre-enrollment to the clinic group was coded as a 1, and the post-enrollment to the clinic was coded as 2. Additionally, if the patient had an ED visit, the encounter was coded as 1; other visit types were coded as 0.

Research Questions and Hypotheses

RQ1: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o1: There is no statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a1: There is a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ2: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o2: There is no statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a2: There is a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ3: Is there a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o3: There is no correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a3: There is a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

RQ4: Is there a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o4: There is no correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a4: There is a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

Detailed Analysis Plan

The research was a retrospective correlational quantitative design. The independent variables were pre- and post-enrollment to the center, and the dependent variables were ED utilization and ED LOS. Using SPSS Version 25, I compared the pre- and post-enrollment group using a chi-square test and a paired sample *t* test, and I compared the covariate of age using linear regression. Multiple studies suggested that the use of the ED increases with age (Blinder et al., 2015; Hemker et al., 2011; Kauf et al., 2009).

Results were interpreted using the odds ratio, which is a relative measure of effect that allowed the comparison of the intervention group relative to the comparison group. The confidence interval indicated the level of uncertainty around the measure of effect. I used a confidence interval (CI) of 95%, which is a common CI used in research studies. The assumed *p* value was $p < 0.05$, which indicated statistical significance between groups.

Threats to Validity

External Validity

Data for this study were obtained from a secondary data set from one hospital system and one comprehensive sickle cell center; therefore, the results are not generalizable to the total population. I looked at one sickle cell center in the region and did not look at any other sickle cell centers. Therefore, if patients utilized other EDs in the region, those visits were not accounted for and the sample was not representative of the whole population. However, the secondary data were comprehensive and obtained from multiple years, which provided a thorough analysis of the benefits of one large sickle cell specialty clinic.

Internal Validity

Errors of misdiagnosis upon presentation to the ED were identified as a threat to this study's validity. Furthermore, there was a chance of human error with delayed documentation, which may have affected the ED LOS. Because sickle cell patients have multiple complications, mortality was an aspect of this study that may have also affected the study's internal validity.

Construct Validity

The accuracy of the data collected in this data set was only as good as the data entered by the hospital and clinic staff. Simpson et al. (2017) used a similar methodology of using a pre- and post-enrollment design to assess ED and IP utilization; however, the study was limited to a small sample and included super-utilizers only. I used similar types of data associated with a large SCD clinic in one state.

Ethical Procedures

Permission to access the secondary data set was obtained from the specialty clinic by completing the CITI training and adding my name to the IRB submission. The data set was downloaded and stored on my password-protected personal laptop and on a personal USB drive, and both were stored in a safe when not in use. Furthermore, the laptop that was used to access the data set was encrypted. Device encryption helped protect the files and folders from unauthorized access in case the device was stolen. Before analyzing the data, I transferred the data from Excel to SPSS. The secondary data were de-identified and did not include the patients' identifiable information such as the names, dates of birth, addresses, or social security numbers. Additionally, IRB approval through Walden University was obtained when the proposal was approved. The approval number from the Walden IRB was 12-31-20-0735724.

Summary

In Section 2, I described the quantitative methodology for this correlational study. I used SPSS Version 25, and the population consisted of patients prior to enrollment in the sickle cell clinic, the post-enrollment group, and their ED utilization. The chosen analysis was a chi-square test and a paired sample *t* test, and a linear regression analysis was used to compare age as a covariate. Section 3 provides the statistical findings relative to the research questions and associated hypotheses.

Section 3: Presentation of the Results and Findings

The purpose of this quantitative study was to examine whether there was a correlation in ED utilization and ED LOS among adult sickle cell patients who received care at an ER in a major health care system prior to attending the clinic and after enrollment in the clinic between the years of 2012 and 2017. The study was conducted to determine administrative benefits of sickle cell centers, demonstrate the need for funding of sickle cell centers, and encourage evidence-based care for sickle cell patients. The independent variables were pre-enrollment and post-enrollment to the sickle cell center, and the dependent variables were ED utilization (the frequency of ED visits), and ED LOS. The covariate was age of patients.

The research questions and hypotheses were as follows:

RQ1: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o1: There is no statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a1: There is a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ2: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

H_o2: There is no statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

H_a2: There is a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

RQ3: Is there a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o3: There is no correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a3: There is a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017.

RQ4: Is there a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017?

H_o4: There is no correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

H_a4: There is a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017.

This section contains the data collection information of the secondary data set, the analysis and results of the research questions, and a summary.

Data Collection of Secondary Data Set

The information in section 3 includes the process for the collection of the secondary data set, how the data were collected, and the time frame of the data collection. Section 3 also includes the statistical analyses of data from the secondary data set collected from a sickle cell center. Data were analyzed using a paired sample *t* test to analyze the LOS in the pre-enrollment to the clinic group and post-enrollment to the clinic group. A chi-square analysis was used to analyze the ED utilization, which was a categorical test to compare the pre- and post-enrollment to the clinic groups. Linear regression was used to analyze age for both groups. Descriptive statistics included age, gender, and financial status (which included the type of insurance).

Obtaining Data, Time Frame, and Discrepancies of the Data Set

Obtaining Data

The secondary data set was collected from one sickle cell center located in a southern U.S. state. This convenience sample data set was obtained to investigate the effectiveness of an adult sickle cell clinic related to ED utilization and ED LOS. Permission to access the secondary data set was obtained by completing the CITI training. After this the data set owners added me to the data set organization's IRB. After receiving Walden University's IRB approval, I analyzed the de-identified data in IBM SPSS Version 25. The data set included data on all patients with a diagnosis of SCD who were admitted to the ED in a major hospital system for the time frame of 2012 to 2017.

Data Filters and Exclusions

The data set consisted of 622 patient pre- and/or post-enrollment to the clinic encounters. From these 622 encounters, 81 patients were removed from the data set because they did not have visits in both the pre- and post-enrollment groups. After removing the 81 patients, I analyzed a total of 412 patient encounters. Furthermore, to accurately answer Research Question 2 using a paired sample *t* test, I considered only 37 patients because these patients had matched samples in both the pre-enrollment to the clinic group and post-enrollment to the clinic group. The clinic group included 210 encounters in the pre-enrollment in an adult sickle cell clinic group and 112 encounters in the post-enrollment in an adult sickle cell clinic group. Additionally, removing the encounters with more than 10 ED visits may have provided a more normal distribution pattern; however, these patient encounters were not removed to provide a true picture of the ED utilization and ED LOS patterns in the sickle cell population.

Data Filters and Inclusions

The data set consisted of 412 encounters of sickle cell patients and included data on patients who went to a major hospital's ED department. All patients considered were 18 years old or older. Data that were analyzed from the data set included the medical record number, financial number, final classification that included whether the patient was in a pre- or post-enrollment phase, date of birth, age, gender, race, marital status, admit type (including emergency, urgent care, or elective), admit date, discharge date, LOS, and the initial appointment date. The secondary data set for this study included 412 encounters, which was far greater than the G*Power a priori power analysis required

sample size of 84 (power = 0.80; alpha = 0.05; and predicted moderate effect size = 0.3). The de-identified data from Excel were imported into IBM SPSS Version 25 for statistical analysis. The nonnumeric variables were recoded to ensure all data had numerical values for better analysis.

Descriptive Statistics

The nonnumeric data for admit type were recoded into numbers for more accurate analysis. Table 2 represents the demographic data including distribution of gender, race, and marital status. Table 3 includes the distribution of patients in the pre- and post-enrollment groups, and Table 4 includes the admit type group (emergency, elective, or urgent).

Table 2

Descriptive Statistics

Gender

	Frequency	Percent	Cumulative Percent
Female	183	44.4	44.4
Male	229	55.6	100.0
Total	412	100.0	

Race

	Frequency	Percent	Cumulative Percent
Black of African Amercican	408	99.0	99.0
Multiple	2	0.5	99.5
Other/ Unknown	2	0.5	100.0
Total	412	100.0	

Marital Status

	Frequency	Percent	Cumulative Percent
Divorced	3	0.7	0.7
Married	79	19.2	19.9
Single	330	80.1	100.0
Total	412	100.0	

Descriptive Statistics

	Minimum Statistics	Maximum Statistics	Mean Statistic	Std. Deviation Statistic
Age	18	53	27.63	7.507
LOS	0.564	29.951	6.146	4.086
Mortality	0.00	1.00	0.00243	0.049

As shown in Table 2, 44.4% (n = 183) of the patient encounters were women, and 55.6% (n = 229) of the patient encounters were men. In addition, 99% (n = 408) of the patient encounters were noted to be Black or African American, 0.5% (n = 2) of the patient encounters were of multiple races, and 0.5% (n = 2) of the patient encounters were noted as Other/Unknown. The data were representative of the sickle cell population where 1 in 400 African Americans and 1 in 19,000 Hispanic individuals have sickle cell disease (Stone, 2015). Most of the encounters were noted to be single (80.1%), 19.2 % were married, and 0.7% were divorced.

The descriptive statistics indicated that the mean age of the total encounters was 27.63 years, with a minimum age of 18 years and a maximum age of 53 years. The mean LOS in the ED was noted to be 6.146 hours, with a minimum of 0.564 hours and a maximum of 29.951 hours. The mean mortality rate was 0.002 encounters

with a minimum mortality of 0 encounters and a maximum of 1 encounter. Table 3 includes the distribution of patients in the pre- and post-enrollment groups, and Table 4 includes the admit type group (emergency, elective, or urgent).

Table 2

Pre-Enrollment to Clinic and Post-Enrollment to Clinic

	Frequency	Percent	Cumulative percent
Post-enrollment	197	47.8	47.8
Pre-enrollment	215	52.2	100.0

Table 3

Types of Patient Admissions

	Frequency	Percent	Cumulative percent
Elective	17	4.1	4.1
Emergency	285	69.2	73.3
Newborn	1	0.2	73,5
Urgent	109	26.5	100.0
Total	412	100.0	

Table 3 indicates the distribution of patients in the before enrollment to the clinic (pre-enrollment group) and after enrollment to the clinic (post-enrollment group). Table 4 includes the distribution in the admit type group (emergency, elective, or urgent). Table 3 shows that 47.8% (n = 197) of the patient encounters were categorized in the post-enrollment group, and 52.2% (n = 215) of the patient encounters were categorized in the pre-enrollment group. In addition, the data set was categorized into 4.1% (n = 17) of the encounters in the elective admission type, 69.2% (n = 285) of the encounters in the emergency admission type, 0.2% (n = 1) of the encounters in the newborn admission

type, and 26.5% (n = 109) of the encounters in the urgent care admission type. The data showed that only 285 encounters were related to ED utilization.

Study Results

After completing the collection, organization, and description of the secondary data set, I used inferential statistics to test the hypotheses of the research questions. The inferential statistics tests that were used included the chi-square test of association and the paired sample t test. Research Question 1 was answered using the chi-square test of association, and Research Question 2 was answered using a paired sample t test.

Research Question 1

RQ1: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

To answer this research question, the chi-square test was used. A chi-square test is nonparametric test to examine a possible association between two nominal variables (Allwright, 2019). This test allows a researcher to evaluate the association, interpret the chi-square, and interpret the strength of the association (Allwright, 2019). A chi-square association has no more than 20% of the expected counts as less than 5. When expected counts are equal to or close to the observed count, there is no relationship between the variables; when the alpha p value is less than 0.05, the results are considered significant, the null hypothesis can be rejected, and the alternative hypothesis can be accepted (Allwright, 2019). Mchugh (2013) reported the following assumptions for use of the chi-square test: The data should be frequencies or counts and not percentages, and the levels

of the variables should be mutually exclusive. In the current study, both the independent and dependent variables were nominal levels of data. The dependent variables were ED utilization and ED LOS, and the independent variables were pre-enrollment to the clinic and post-enrollment to the adult sickle cell center. The ED utilization was counted in frequencies (1 for an ED visit and 0 for any other visit). Each encounter was mutually exclusive, where each encounter could not be in both the pre-enrollment to the clinic group and post-enrollment to the clinic group.

A chi-square test was chosen for Research Question 1 because the data were collected as encounters and the variables were mutually exclusive. A patient encounter could not be in the pre-enrollment and post-enrollment group at the same point in time, and the dependent variable was nominal. The independent variable in the research question was pre-enrollment to the clinic or post-enrollment to the clinic. The dependent variable was whether the patients utilized the ED or not. Table 5 shows the cross-tabulation, Table 6 shows the chi-square tests that were used, Table 7 shows the correlation test, and Table 8 shows the odds' ratio (*OR*). Figure 3 shows the frequency of ED utilization in the pre-enrollment to the clinic group and post-enrollment to the clinic group.

The results of the chi-square test showed that there was a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017 (chi-square = 13.612^{a}, $df = 1$, $p < 0.05$). The alpha value was noted to be .000, which was less than *p* value of .05, and therefore the null hypothesis was rejected and the alternate hypothesis

was accepted. The Pearson chi-square test was used to analyze the data because the expected counts in the pre-enrollment to the clinic, post-enrollment to the clinic, non-emergency admit types, and ED utilization groups were all greater than 5.

To analyze the strength of the correlation, the Cramer's V test was used. The Cramer's V value was noted to be RR= 0.182, which is RR < 1, so there was a negative association between post-enrollment and ED utilization; however, the effect size was small or weak. Additionally, the *OR* = 2.221 (95% CI: 1.448, 3.406) suggesting that the counts in the post-enrollment group were 2.221 times more likely to use the nonemergency admit types, and less likely to use the emergency admit type.

The cross-tabulation table shows that in the post-enrollment group 39.6% of the counts were categorized in the nonemergency admit types, which included having an admit type of anything other than the emergency room, and 60.4% of the post-enrollment counts were categorized as having an emergency admit type. Alternatively, in the before registration to the clinic group, 22.8% of the counts were categorized in the nonemergency admit types, and 77.2% of the counts belonged in the emergency group. Figure 3 illustrates how the ED utilization in the post-enrollment group was lower than the pre-enrollment group; however, the nonemergency admit types category was higher in the post-enrollment group compared to the pre-enrollment group. The results indicated an increased use of other admit types such as elective admissions and/or urgent care admissions instead of ED utilization.

For RQ1, the null hypothesis was rejected, and the alternate hypothesis was accepted. There was a statistically significant difference in ED utilization among adult

sickle cell patients in the pre-enrollment group and the post-enrollment group, with the *OR* and cross-tabulation findings showing ED utilization was less in the post-enrollment group. Table 5 shows the cross-tabulation table for ED utilization in the pre-enrollment to clinic group and post-enrollment to clinic group. Table 6 includes the Chi-square analysis comparing ED utilization in the pre-enrollment and post-enrollment to clinic, and table 7 and 8 includes the test of correlation of strength and the odds ratio for the chi- square analysis.

Table 4

Final Classification Emergency Utilization Cross-Tabulation

			Non emergency admit types	Emergency	Total
Final Classification	Post-enrollment	Count	78	119	197
		Expected Count	60.7	136.3	197.0
		% within Final classification	39.6%	60.4%	100.0%
	Pre-enrollment	Count	49	166	215
		Expected Count	66.3	148.7	215.0
		% within Final classification	22.8%	77.2%	100.0%
Total		Count	127	285	412
		Expected Count	127.0	285.0	412.0
		% within Final classification	30.8%	69.2%	100.0%

Table 5

Chi-Square Tests for Association of Pre and Post-Enrollment to Sickle Cell Clinic and ED Utilization

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	13.612[a]	1	.000		
Continuity Correction[b]	12.836	1	.000		
Likelihood Ratio	13.681	1	.000		
Fisher's Exact Test				.000	.000
N of Valid Cases	412				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 60.73.
b. Computed only for a 2x2 table

Table 6

Test of Correlation for Strength of Association From Chi-Square Test

		Value	Approximate Significance
Nominal by Nominal	Phi	.182	.000
	Cramer's V	.182	.000
N of Valid Cases		412	

c. Correlation statistics are available for numeric data only.

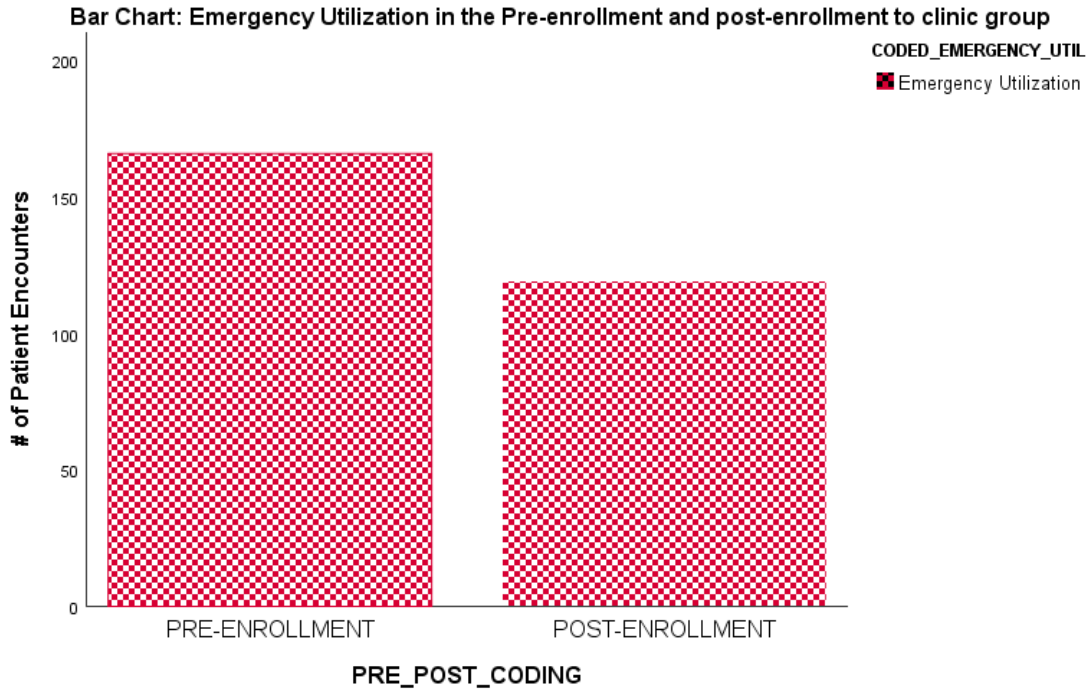
Table 7

Odd's Ratio for Likeliness of Using the ED

	Value	95% Confidence Interval Lower	Upper
Odds Ratio for Final Classification (Post-enrollment/ Pre-enrollment)	2.221	1.448	3.406
For cohort Non-emergency admit types	1.737	1.286	2.346
For cohort Emergency Utilization	.782	.684	.895
N of Valid Cases	412		

Figure 3

ED Utilization in Pre- and Post-Enrollment to the Clinic Groups



Research Question 2

RQ2: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017?

A paired t-test is used to compare two population means where you have two samples where observations in one sample can be paired with observations in the other sample (Walden University Academic Skills, 2020). The paired t test provides a hypothesis test of the difference between population means for a pair of random samples whose differences are approximately normally distributed (Walden University Academic

Skills, 2020). Statistical assumptions of the paired sample t-test include that the dependent variable should be a continuous variable; independent variables should consist of two categorical and related or matched groups; there should be no significant outliers and the groups should be normally distributed (Walden University Academic Skills, 2020). The dependent variable is the ED LOS, which is a continuous variable, and the independent variable is the pre-enrollment and post-enrollment groups, which are nominal variables. The data set however was not normally distributed and will be described in detail later in the study.

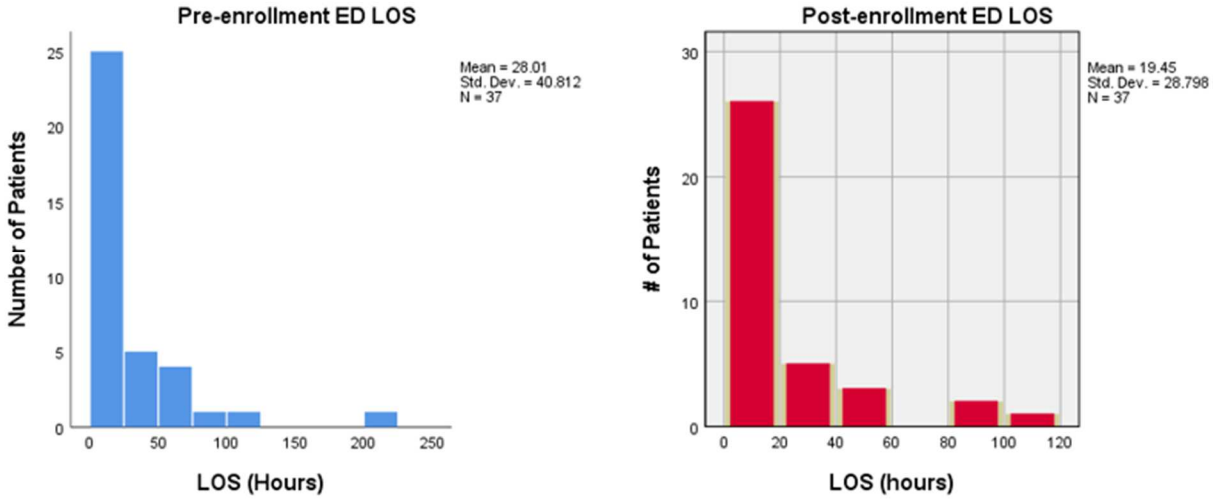
A paired sample t-test was used for research question 2 because the dependent variable (length of stay: LOS) is a continuous variable, and the independent variable is categorical and related (before enrollment to the clinic and after enrollment to the clinic). All the patients in this list were counted in both the pre-enrollment group or the post-enrollment group. To create a paired sample, a total of 37 patients were used for this dataset, which looked at 210 encounters in the before registration to the clinic group, and 112 encounters in the after registration to the clinic group. Since the sample size was greater than 20, a paired sample t-test was still used instead of the non-parametric test. To meet the assumption of using a paired sample t-test, the data had to be normally distributed. Figure 3 is a side-by-side bar graph that demonstrates the distribution of ED LOS in the pre-enrollment to clinic group compared to the distribution of ED LOS in the post-enrollment to clinic group. The standard error of skewness was 0.388, which is less than 0.5, which indicates the data is normally distributed.

The findings of the paired sample t-test demonstrates that the mean ED LOS of the pre-enrollment group, m = 28.01 hours, was higher than the mean ED LOS of the post-enrollment group, m = 19.45 hours. The mean difference between the before clinic enrollment ED LOS group and the after-clinic enrollment ED LOS group was m = 8.560, 95% *CI* (6.904, 24.024). Furthermore, p=.269 is $p > .05$, therefore the null hypothesis is accepted and the alternate hypothesis is rejected indicating that there was no statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017.

A two-tailed paired sample t-test revealed that ED LOS in the pre-enrollment to clinic group (m = 28.01) was not significantly different than the ED LOS in the post-enrollment to clinic group (m = 19.45), t (36) = 1.123, $p < 0.05$). The results of this study shows no strong evidence to suggest a statistically significant difference in ED LOS among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment in an adult sickle cell clinic (t = 11.123, df = 36, $p > .05$, 2 tailed test). However, it is important to note that although no significant difference was noted, the mean LOS of post-enrollment to the clinic was noted to be less than the mean LOS of the pre-enrollment to the clinic group. Table 10 represents the Means table of the paired sample t-test, and table 11 represents the findings of the paired t-test.

Figure 4

ED LOS in the Pre-Enrollment to Clinic and Post-Enrollment to Clinic Group



The mean ED LOS in the pre-enrollment group is 28.01 hours and the mean ED LOS in the post-enrollment group is 19.45 hours. Table 9 and 10 includes the means table for the paired sample t-test comparing ED LOS in the pre-enrollment and post-enrollment to the clinic groups, and the results of the paired sample t-test.

Table 8

Means Table for Paired Sample t Test of ED LOS in Pre-Enrollment and Post-Enrollment Groups

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-enrollment LOS	28.01	37	40.812	6.709
	Post-enrollment LOS	19.45	37	28.798	4.734

Table 9

Paired Samples t Test for ED LOS in the Pre-Enrollment and Post-Enrollment Groups

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	PreEnrolEDLOS – PostEnrolEDLOS	8.560	46.381	7.625	-6.904	24.024	11.123	36	.269

Research Question 3

RQ3: Is there a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017?

To analyze this research question, a linear regression analysis was used. To examine if there was a correlation in ED utilization and age, a linear regression analysis was used. The independent variable was age and the dependent variable was ED

utilization. Table 12 shows the Model summary table of ED utilization and age. The R-value is the multiple correlation coefficient and has a value of 0.120, indicating a small level of prediction. The R square is the coefficient of determinization, and represents the proportion of variance in the dependent variable (ED utilization) that can be explained by the independent variables (age). The R square value is 0.014, indicating that age explains 1.4% of the variability of ED utilization. Table 13 shows the ANOVA table of ED utilization with age. Table 13 shows whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, $F(1,410)= 6.012$, $p<.05$, R square = 0.014, indicating this model is a good fit of the data. Table 14 shows the coefficient table of ED utilization with age indicating how much the ED utilization varies with an independent variable (age) when all other independent variables are held constant. The coefficient table shows us that the coefficient for age is equal to -.007, indicating that for each one-year increase in age, there is a decrease in ED utilization of 0.007 hours, where $p<.05$.

Therefore, the statistical analysis for RQ3 accepts the alternate hypothesis that there is a correlation between age and ED utilization, where an increased age decreases ED utilization. Research question 1 also accepted the hypothesis that there was a significant difference in ED utilization in the pre-enrollment to clinic group and post-enrollment to clinic group, with less ED utilization noted in the post-enrollment to the clinic group. Since the patients in the pre-enrollment group were also examined in the post-enrollment group, the patients in the post-enrollment group would be naturally older due to maturity. Using the findings from the linear regression, where 1.4% of the

variability in the ED utilization may have been related to age, which may have impacted the significant difference in ED utilization with pre/post-enrollment to clinic findings.

Table 10

Model Summary for ED Utilization and Age

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.120[a]	.014	.012	.460

a. Predictors: (Constant), AGE
b. Dependent Variable: CODED_EMERGENCY_UTIL

Table 11

Coefficient Table for ED Utilization and Age

Unstandardized Coefficients		Standardized Coefficients		
B	Std. Error	Beta	t	Sig.
.896	.086		10.369	.000
-.007	.003	-.120	-2.452	.015

a. Dependent Variable: CODED_EMERGENCY_UTIL

Table 12

ANOVA Table for ED Utilization and Age

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1.270	1	1.270	6.012	.015[b]
	Residual	86.582	410	.211		
	Total	87.852	411			

a. Dependent Variable: CODED_EMERGENCY_UTIL
b. Predictors: (Constant), AGE

Research Question 4

RQ4: Is there a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017?

To analyze this research question, another linear regression analysis was used. The independent variable was age and the dependent variable was ED utilization. Table 15 shows the Model summary table of ED LOS and age. The R-value is the multiple correlation coefficient and has a value of 0.093, indicating a very small level of prediction. The R square value is 0.009, indicating that age explains 0.09% of the variability of LOS. Table 16 shows the ANOVA table of ED LOS with age. The table shows that the independent variable does not statistically significantly predict the dependent variable, $F(1,410) = 3.592$, $p>0.05$, R square = 0.009, indicating this model is not a good fit of the data. Table 17 shows the coefficient table of ED LOS with age indicating how much the ED LOS varies with an independent variable (age) when all other independent variables are held constant. The coefficient table shows us that the coefficient for age is equal to -.053, indicating that for each one-year increase in age,

there is a decrease in ED LOS of 0.053 hours, where p>.05, and therefore no statistical significance is noted.

Therefore, the statistical analysis for RQ4 accepts the null hypothesis that there is no correlation between age and ED LOS. Research question 2 also accepted the null hypothesis that there was no significant difference in ED LOS in the pre-enrollment to clinic group and post-enrollment to clinic group. Using the findings from the linear regression and the paired sample t-test, ED LOS was not correlated to age, nor enrollment to a sickle cell clinic.

Table 13

Model Summary for ED LOS and Age

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.093[a]	.009	.006	4.245856314784

a. Predictors: (Constant), AGE
b. Dependent Variable: LOS_ED_ONLY

Table 14

ANOVA Test for ED LOS and Age

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	64.747	1	64.747	3.592	.059[b]
	Residual	7391.191	410	18.027		
	Total	7455.938	411			

a. Dependent Variable: LOS_ED_ONLY
b. Predictors: (Constant), AGE

Table 15

Coefficient Table for ED LOS and Age

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
		B	Std. Error	Beta	T	Sig.	Lower Bound	Upper Bound
1	(Constant)	5.723	.799		7.166	.000	4.153	7.293
	AGE	-.053	.028	-.093	-1.895	.059	-.108	.002

a. Dependent Variable: LOS_ED_ONLY

Conclusion

In section 3, I presented the results and findings of this study, including the data collection plan, data exclusion, data inclusions, descriptive statistics, and inferential statistics. The inferential statistics that were used included cross-tabulations with Chi-square test of association and effect size using the Cramer's V test for research question 1; and a paired sample t-test to answer research question 2.

Research question 1 (RQ1) answered the question: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017? The results from the Chi square analysis found that the null hypothesis was accepted. The results of the Cramer's V association and the Odds ratio noted a statistically significant association with ED utilization between pre and post-enrollment to the SCD clinic, indicating that after enrollment to the clinic the patients had less ED utilization.

Therefore, the null hypothesis for HO1 was rejected and the alternative hypothesis was accepted.

Research question 2 (RQ2) answered the question: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017? The results of the paired sample t-test found that there was no significant difference in ED LOS in the pre-enrollment to the sickle cell clinic group and the post-enrollment to the sickle cell clinic group. Therefore, the RQ2 results accepted the null hypothesis. Although no statistical significance was noted in both groups, the means table from the paired sample t-test did show a higher mean LOS in the before clinic enrollment group compared to the after-clinic enrollment group.

Research question 3 (RQ3) answered the question: Is there a correlation in ED utilization and age among adult sickle cell patients? The results of the linear regression analysis found that there was a significant correlation in ED utilization and age in adult sickle cell patients. Therefore, the RQ3 rejected the null hypothesis and accepted the alternate hypothesis.

Research question 4 (RQ4) answered the question: Is there a correlation in ED LOS and age among adult sickle cell patients? The results of the linear regression analysis found that there was no significant correlation in ED LOS and age in adult sickle cell patients. Therefore, the RQ4 accepted the null hypothesis. Section 4 includes the interpretation of the results, limitations of the study, recommendations, and implications for professional practice.

Section 4: Application to Professional Practice and Implications for Social Change

The purpose of this quantitative study was to examine the correlation in ED utilization and ED LOS among adult sickle cell patients who received care at an adult comprehensive sickle cell clinic pre- and post-enrollment to the center between the years of 2012 and 2017. Findings from the chi-square test showed that there was a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment, with a trend to have decreased ED utilization post-enrollment. The findings from the paired sample *t* test showed that there was no statistically significant difference in ED LOS among sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment. However, the mean ED LOS in the pre-enrollment group was greater than the mean ED LOS in the post-enrollment group. The results indicated that when SCD patients were enrolled in a comprehensive sickle cell center, their ED use was decreased significantly, which indicated improvement in patient care and a decrease in overall cost of care related to unnecessary ED utilization.

The results of this study demonstrated that there are administrative benefits, such as decreased ED utilization and possible decreased EDLOS, for patients attending comprehensive sickle cell clinics. Decreased ED utilization can decrease unnecessary costs by decreasing duplication of services and improve quality of care (Ho et al., 2017). It is in the best interest of hospital administrators to pay careful attention to ED optimization to improve performance and quality measures (Feinberg & Stone-Griffith, 2016). Feinberg and Stone-Griffith (2016) stated that hospitals are under regulatory pressure to reduce ED costs, improve efficiency, and increase throughput capacity, which

then ties to hospital reimbursement. Section 4 contains the interpretation of the findings, the limitations of this study, recommendations, the implications for professional practice and social change, and a conclusion.

Sickle Cell Centers

Fragmented care is a problem for all patients, but for fragile and complicated illnesses like sickle cell disease, fragmented care can result in poor outcomes and decreased quality of life due to frequent flair-ups and chronic pain (Blinder et al., 2015; Koch et al., 2014; Ter-Minassian et al., 2019). Simpson et al. (2017) and Powell et al. (2016) provided information on how a multidisciplinary approach affects ED utilization in the sickle cell population. The researchers found that monthly meetings, best practice advisories, and ED protocols helped to decrease ED visits, ED LOS, IP admissions, and IP LOS. The practice of monthly meetings, individualized pain plans for ED protocols, and best practice advisories are consistent with comprehensive sickle cell clinics' practices.

Adult sickle cell centers use a multidisciplinary approach of care, and Powell et al. (2016) and Simpson et al. (2017) reported that this improves overall outcomes and strengthens relationships with a medical practice that understands best practices for this condition. When there is a lack of sickle cell providers, patients with SCD tend to utilize ED services more than clinic services due to untreated pain and other symptoms (Blinder et al., 2015). The current study focused on a large, comprehensive sickle cell clinic associated with a teaching center to examine the association between ED utilization and ED LOS.

Interpretation of Results

RQ 1 Analysis

RQ1 asked the following: Is there a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017? The results indicated that there was a statistically significant difference in ED utilization in the pre-enrollment group and post-enrollment group, where the ED utilization was higher in the pre-enrollment group compared to the post-enrollment group. A chi-square test was used to analyze the data. A categorical value of 0 was used for nonemergency utilization, and 1 was used for emergency utilization. The alpha value was noted to be .000, which is less than *p* value of .05. Therefore, $H_o1$was rejected and $H_a1$was accepted. To assess the type of correlation between the groups, the Cramer's V test was used. The Cramer's V value was noted to be RR= 0.182, where RR < 1, which indicated a negative association between post-enrollment and ED utilization; however, the effect size was small or weak. The odd's ratio suggested that the counts in the post-enrollment group were 2.221 times more likely to use the nonemergency admit types, and less likely to use the Emergency admit type (*OR* = 2.221, 95% CI: 1.448, 3.406).

RQ2 Analysis

RQ2 asked the following: Is there a statistically significant difference in ED length of stay among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017? The results indicated that there was no statistically significant difference in ED LOS in the pre-enrollment and

post-enrollment groups. The test used here was a paired sample *t* test to assess two scale variables: the pre-enrollment to the clinic LOS and the post-enrollment to the clinic LOS within the same sample group. The findings of the paired sample *t* test indicated that the mean ED LOS of the pre-enrollment to clinic group, *m* = 28.01 hours, was higher than the mean ED LOS of the post-enrollment to clinic group, *m* = 19.45 hours. The mean difference between the before registration to clinic group and the after registration to clinic ED LOS group was *m* = 8.560, 95% *CI* (6.904, 24.024). However, *p* = .269 was *p* > .05; therefore, the null hypothesis was accepted, and the alternate hypothesis was rejected. The mean ED LOS in the post-enrollment group was less than the ED LOS in the pre-enrollment group. The results indicated that although there was no significant difference in ED LOS in the two groups, there was still a tendency to have a lower LOS in the post-enrollment clinic group compared to the pre-enrollment group.

RQ3 Analysis

RQ3 asked the following: Is there a correlation between ED utilization and age among adult sickle cell patients in patients between the years of 2012 and 2017? The results indicated that there was a significant correlation between ED utilization and age in these adult sickle cell patients. A linear regression analysis was used to analyze these data. The linear regression was run to predict ED utilization from age. Age statistically significantly predicted ED utilization, $F(1,410)= 6.012$, $p < .05$, *R* square = 0.014, indicating age added statistically significantly to the prediction of ED utilization, $p < 0.05$. *R* square of 0.014 indicated that 1.4% of the variability in ED utilization was due to age.

RQ4 Analysis

RQ4 asked the following: Is there a correlation between ED LOS and age among adult sickle cell patients in patients between the years of 2012 and 2017? The results indicated that there was no significant correlation between ED LOS and age in these adult sickle cell patients. A linear regression analysis was used to analyze these findings. Age did not statistically significantly predict ED LOS, $F(1,410)= 3.592$, $p > 0.05$, R square = 0.009, indicating age did not statistically significantly predict ED LOS, $p > 0.05$.

Interpretation of Findings to Literature

I investigated the correlation in ED utilization and ED LOS with SCD patients before they were enrolled in a sickle cell center compared to SCD patients after they were enrolled in the sickle cell clinic. The findings indicated that there was a statistically significant difference in ED utilization among adult sickle cell patients before enrollment in an adult sickle cell clinic and after enrollment between the years of 2012 and 2017 with ED utilization higher in the pre-enrollment group. The findings also indicated that there was no statistical difference in ED LOS among adults before or after enrollment to the sickle cell clinic. The literature review demonstrated the correlation between comprehensive sickle cell centers and ED utilization/ED LOS was mixed, with some studies suggesting increased ED utilization (Carden et al., 2016; Lavelle et al., 2018; Smeltzer et al., 2016) and some studies suggesting decreased ED utilization (Powell et al., 2016; Simpson et al., 2017).

Previous studies showed that a multidisciplinary approach to SCD care reduced the ED utilization and ED LOS (Powell et al., 2016; Simpson et al., 2017). Simpson et al.

(2017) found that using a targeted approach of patient-specific best practice advisories, an ED management protocol, and the formation of a medical home for high-utilizer sickle cell patients decreased ED utilization, decreased ED LOS, and decreased inpatient utilization. Simpson et al. (2017) used a pre-post design but only looked at confidence intervals, not statistical significance.

Additionally, Blinder et al. (2015) found that ED reliance increased in the transition-age group due to decreased access to primary care providers and decreased engagement with SCD patients. The findings of the current study aligned with previous multidisciplinary approaches and that utilizing best practice guidelines can help with reducing unnecessary ED utilization. However, no significant differences were noted in ED LOS. However, it is worthy to note that the mean LOS in the after enrollment to the sickle cell clinic was lower than the mean LOS in the before enrollment to the sickle cell clinic group.

Blinder et al. (2014) found that age and disease severity increased ED utilization. Blinder et al. found that between the age of 15 years and 22 years, ED reliance increased from 0.17 to 0.29 visits per quarter and remained high throughout adulthood. These findings are consistent with findings from the current study, which indicated that age increased ED utilization.

Interpretation of Findings to Theory

The conceptual framework for this study was the Donabedian framework. The Donabedian framework includes three categories: structure, process, and outcome (Donabedian, 1985). The structure consists of how care is organized, the process consists

of what is known to be the best evidence-based medicine, and the outcome is the quality measure that affects the result of care (Donabedian, 1985; Van Houdt et al., 2013). In the current study, the structure was the comprehensive sickle cell clinic; the process was the best practice standards already researched in sickle cell, which included multidisciplinary care and individualized care plans; and the outcome was the use of ED utilization and LOS in the ED. The findings from this study indicated that organized care at a comprehensive sickle cell clinic can improve patient outcomes such as ED utilization (see Figure 4). Although the ED LOS did not show a significant difference between the pre-enrollment group and post-enrollment group, there was a trend of shorter ED LOS in the post-enrollment group. Future studies with a larger sample for the paired sample *t* test should be considered.

Summary of Key Findings and Interpretations

The results of this study indicated that there was a statistically significant difference in ED utilization in the same group of adult sickle cell patients prior to enrollment in an adult sickle cell center and post-enrollment to the center, but no significant difference in the ED LOS in a paired sample of adult sickle cell patients was noted. The findings suggested that the ED utilization was significantly less in the SCD patients who were enrolled to the sickle cell clinic. Additionally, the findings also showed no significant differences in ED LOS in SCD patients before or after being enrolled in the sickle cell clinic. The results suggest the administrative benefits for patients who attend comprehensive sickle cell centers. Unnecessary ED utilization in the United States can be managed in physician offices and clinics at a savings of $4.4 billion

annually (Enard & Ganelin, 2014). Enard and Ganelin (2014) also reported that unnecessary ED utilization can lead to decreased efficiency of the hospital and the possibility for more uncompensated care. The current study provided additional evidence to support the development of more adult sickle cell clinics.

Limitations of the Study

The first limitation was a secondary data set was used to address the research questions. Using a secondary data set limits the generalizability of the results. Although this data set included a large sample size of 622 patient encounters, this data set included data from only one sickle cell clinic. The sickle cell clinic was in one state, which limited generalizability to all SCD patients and specialty clinics. Additionally, the data set included ED utilization and ED LOS data in only one major health care system rather than all of the health care systems in the area. Therefore, if a patient utilized another hospital system's health care ED, these data were not included. I assumed that the SCD patient would go to the health care system that the patient considered their medical home. Also, the data set included data from the time period of 2012 until 2017 rather than more recent data.

Recommendations

The limitations of the study indicated opportunities for future research. Future studies with data in a more current time frame and observing data for a longer period of time would be beneficial to understand changes that occur over time. It would also be advantageous to expand the study to multiple states/regions and to utilize data from multiple sickle cell centers. Researching more diverse populations may allow the results

to be more generalizable. Examining the cost-of-care data with each ED encounter could also reveal the potential savings that a sickle cell center could bring to a health care system.

Implications for Professional Practice and Social Change

The results of this study were intended to provide information for professional practice and social change relevant to the administrative benefits of sickle cell centers. The results of this study showed the administrative benefits of adult sickle cell patients attending a comprehensive sickle cell center, including significant decreased ED utilization and possible decreased ED LOS. The study could encourage primary care providers, pediatric sickle cell centers, and hematologists to transfer the care of adult sickle cell patients to adult sickle cell centers. The results could also encourage the adult sickle cell centers to use a multidisciplinary approach, best practice advisories, ED protocols, and a framework for treating adult patients with SCD. Additionally, this study could help administrators understand the potential savings on health care costs from these reduced ED visits, improved efficiency, and reduced ED LOS. The findings of this study may contribute to positive social change by-policymakers and administrators understanding the benefits of SCD centers and investing in more SCD centers in health care systems.

Conclusion

The study addressed the gap in the literature regarding the administrative benefits of adult sickle cell centers. My findings indicated that there was a significant reduction in ED utilization among adult sickle cell patients after enrollment in an adult sickle cell

center. Based on the findings of this study, hospital administrators and other providers may recognize the value of sickle cell centers. Hospital administrators may embrace the findings in support of sickle cell centers not only for improved patient outcomes but also for potential cost reduction.

References

Aisiku, I., Smith, W., McClish, D., Lewenson, J., Penberthy, L., Roseff, S., Bovbjerg, V. & Roberts, J. (2008). Comparisons of high versus low emergency departments utilizers in sickle cell disease. *Annals of Emergency Medicine, 53*(5), 587-93. https://doi.org/10.1016/j.annemergmed.2008.07.050

Allwright, J. (2019, July 16). *Chi square test in SPSS* [Video]. YouTube. https://www.youtube.com/watch?v=xpaT6scy9zM&feature=emb_title

Amendah, D. D., Mvundura, M., Kavanagh, P. L., Sprinz, P. G., & Grosse, S. D. (2010). Sickle cell disease–related pediatric medical expenditures in the U.S. *American Journal of Preventive Medicine*, *38*(4), S550–S556. https://doi.org/10.1016/j.amepre.2010.01.004

Artz, N., Whelan, C., & Feehan, S. (2010). Caring for the adult with sickle cell disease: Results of a multidisciplinary pilot program. *Journal of the National Medical Association*, *102*(11), 1009–1016. https://doi.org/10.1016/S0027-9684(15)30727-6

Binding, A., Valentine, K., Poon, M. C., & Savani, F. A., (2014). Adult sickle cell disease epidemiology and the potential role of a multidisciplinary comprehensive care center in a city with low prevalence. *Hemoglobin*, *38*(5), 312–315. https://doi.org/10.3109/03630269.2014.954048

Blinder, M. A., Duh, M. S., Sasane, M., Trahey, A., Paley, C., & Vekeman, F. (2015). Age-related emergency department reliance in patients with sickle cell disease.

Journal of Emergency Medicine, *49*(4). https://doi.org/10.1016/j.jemermed.2014.12.080

Bojanowski, J. (2010). Sickle cell disease. In Stacey Blachford. *The Gale Encyclopedia of Genetic Disorders.* Gale.

Carden, M. A., Newlin, J., Smith, W., & Sisler, I. (2016). Health literacy and disease-specific knowledge of caregivers for children with sickle cell disease. *Pediatric Hematology and Oncology*, *32*(2), 121–133. https://doi.org/10.3109/08880018.2016.1147108

Center for Sickle Cell Disease at UTHSC. (n.d.). http://uthsc.edu/sickle-cell/

Chappidi, M., Alfonso, Y. N., Bishai, D., & Lanzkron, S. (2013). Cost benefit analysis of a sickle cell infusion center for the treatment of vaso-occlusive crises. *Blood*, *122*(21), 1697–1698. https://doi.org/10.1182/blood.V122.21.1967.1967

Cline, D. M., Silva, S., Freiermuth, C. E., Thornton, V., & Tanabe, P. (2018). Emergency department (ED), ED observation, day hospital, and hospital admissions for adults with sickle cell disease. *Western Journal of Emergency Medicine*, *19*(2), 311–318. https://doi.org/10.5811/westjem.2017.9.35422

Cronin, R., Hankins, J., Byrd, J., Pernell, B., Kassim, A., Adams-Graves, P… & Treadwell, M. (2018). Modifying factors of the health belief model associated with missed clinic appointments among individuals with sickle cell disease. *Hemoglobinopathy, 23*(9), 683-691. Doi: 10.1080/10245332.2018.1457200.

Donabedian, A. (1966). Evaluating the quality of medical care. *Mil Bank Q*, *44(*1), 243–265. DOI: 10.1111/J.1468-0009.2005.00397.x

Donabedian, A. (1985). Twenty years of research on the quality of medical care: 1964-1984. *Evaluation & the Health Professions*, *8*(3), 243–265. https://doi.org/10.1177/016327878500800301

Enard, K., & Ganeline, D. (2013). Reducing preventable emergency department utilization and costs by using community health workers as patient navigators. *Journal of Healthcare Management*, *58*(6), 412–428.

Epstein, K., Yuen, E., Riggio, J., Ballas, S. & Moleski, S. (2006). Utilization of the office, hospital, and emergency department for adult sickle cell patients: A five year study. *Journal of the National Medical Association, 98*(7), 1109-13.

Faul, F., Erdfelder, E., Lang, A. & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *SCIP Conference, 39*(1), 175-191. doi: 10.3758/bf03193146.

Feinberg, M., & Stone-Griffith, S. (2016). *Emergent need of emergency department utilization*. Becker's Hospital Review, November 9, 2016. https://www.beckershospitalreview.com/healthcare-information-technology/urgent-need-for-emergency-department-optimization.html

Glassberg, J., Wang, J., Colen, R., Richardson, L. & DeBaun, M. (2012). Risk factors for increase ED utilization in a multinational cohort of children with sickle cell disease. *Acad Emerg Med, 19*(6), 664-72. https://doi.org/10.1111/j.1553-2712.2012.01364.x

Gray, W., Reed-Knight, B., Morgan, F., Holbrook, E., Kugathasan, S., Saeed, S., Denson, C. & Hommme, K. (2018). Multi-site comparison of patients, parent and pediatric provider perspective on transition to adult care in IBD. *Journal of Pediatric Nursing, 39*(1), 49-54 https://doi.org/10.1016/j.pedn.2018.01.008

Jane Hankins, MD, MS. (n.d.). *Center for sickle cell disease*. http://uthsc.edu/sickle-cell/faculty/hankins.php

Jeffrey A. G., Jason, W., Robyn, C., Lynne D. R., & Michael R. D. (2012). Risk factors for increased ED utilization in a multinational cohort of children with sickle cell disease. *Academic Emergency Medicine*, *19*(6), 664. https://doi.org/10.1111/j.15532712.2012.01364

Kauf, T., Coates, T., Huazhi, L., Moody-Patel, N. & Hartzema, A. (2009). The cost of health care for children and adults with sickle cell disease. *American Journal of Hematology*, *84*(6), 323. https://doi.org/10.1002/ajh.21408

King, B. M. (2010). Analysis of variance. In Peterson, P., Tierney, R., Baker, E. & McGaw, B. *International encyclopedia of education* (3rd edition, pp. 32–36). Elsevier Science.

Koch, K. L., Karafin, M. S., Simpson, P., & Field, J. J. (2015). Intensive management of high utilizing adults with sickle cell disease lowers admissions. *American Journal of Hematology*, *90*(3), 215–219. https://doi.org/10.1002/ajh.23912

Lanzkran, S., Carroll, C., & Haywood, C. The burden of emergency department use: An analysis of the national emergency department sample database. *American Journal of Hematology, 85*(10), 797-799. https://doi.org/10.1002/ajh.21807

Lavelle, T., Rose, A., Timble, J., Setodji, C., Wensky, S., Gluriceo, K., Friedberg, M., Maisberger, R. & Kahn, K. (2018). Utilization of health care services among medicare beneficiaries who visit federally qualified health center. *BMC Health Services Research, 18*(41). https://doi.org/10.1186/512913-018-2847

Lebensburger, J. D., Bemrich-Stolz, C. J., & Howard, T. H. (2012). Barriers in transition from pediatrics to adult medicine in sickle cell anemia. *Journal of Blood Medicine*, *2012(*default), 105–112. doi:10.2147/JBM.S32588

Lee, L., Smith-Whitley, K., Banks, S. & Packrein, G. (2019). Reducing health disparities in sickle cell disease: A review. *SAGE Journals, 134*(6). https://doi.org/10.1177/0033354919881438.

Hanideh, D. & Alvarez, O. Sickle cell disease related mortality in the United States (1999-2009). *Pediatr. Blood Cancer, 60*(9), 1482-2. Doi: 10.1002/poc.24557.

Hemker, B. G., Brousseau, D. C., Yan, K., Hoffmann, R. G., & Panepinto, J. A. (2011.). When children with sickle-cell disease become adults: lack of outpatient care leads to increased use of the emergency department. *American Journal of Hematology*, *86*(10), 863–865. doi:10.1002/ajh.22106

Ho, V., Metcalfe, L., Dark, C., Vu, L., Weber, E., Shelton, G., Underwood, H. (2017). Comparing utilization and costs of care in free standing emergency deparments and urgent care centers. *Annals of Emergency Medicine, 70*(6), 846-857. https://doi.org/10.1016/j.annemergened.2016.12.006

Mainous, A., Tanner, R., Harle, C., Baker, R., Snoker, N. & Hulihan, M. (2015). Attitudes toward management of sickle cell disease and its complications: A national survey of academic family physicians. *Anemia*, 2015. https://doi.org/10.1155/2015/853835

Martin, B. M., Thaniel, L. N., Speller-Brown, B. J., & Darbari, D. S. (2018). Comprehensive infant clinic for sickle cell disease: outcomes and parental perspective. *Journal of Pediatric Health Care, 32*(5), 485–489. doi: 10.1016/j.pedhc.2018.04.018

McHugh (2013). The chi-square test of independence. *Biochem Med (Zagreb)*, 2013, June 15. Doi: 10.11613/BM.2013.018.

Methodist-St. Jude Partnership will elevate care for adult sickle cell patients. (2017, June 15). Retrieved August 15, 2020, from https://www.methodisthealth.org/articles/methodist-st-jude-partnership-will-elevate-care-for-adult-sickle-cell-patients/

National Heart, Lung, and Blood Institute (n.d.). *Sickle Cell Disease*. Retrieved from https://www.nhlbi.nih.gov/health-topics/sickle-cell-disease

Ogu, U. O., & Billett, H. H. (2018). Comorbidities in sickle cell disease: Adult providers needed! *The Indian Journal of Medical Research*, *147*(6), 527–529. doi:10.4103/ijmr.IJMR_1019_18

Oliver-Carpenter, G., Barach, I., Crosby, L. E., Valenzuela, J., & Mitchell, M. J. (2011). Disease management, coping, and functional disability in pediatric sickle cell disease. *Journal of the National Medical Association*, *103*(2), 131-7.

Powell, R. E., Lovett, P. B., Crawford, A., McAna, J., Axelrod, D., Ward, L., & Pulte, D. (2016). A multidisciplinary approach to impact acute care utilization in sickle cell disease. *American Journal of Medical Quality, 33*(2), 127–131. doi: 10.1177/1062860617707262

Reich, J., Cantrell, M. A., & Smeltzer, S. (2019). Sickle cell disease in the young adult population: A historical review and implications for nurses. *Medsurg Nursing, 28*(4), 213- 218.

Shah, N., Bhor, M., Xie, L., Halloway, R., Arcona, S. Paulose, J. & Yuse, H. (2019). Treatment patterns and economic burden of sickle cell disease patients prescribed hydroxyurea: A retrospective claims-based study. *Health Qual Life Outcomes, 17*(155). https://doi.org/10.1186/s12955-019-1225-7

Simpson, G. G., Hahn, H. R., Powel, A. A., Leverence, R. R., Morris, L. A., Thompson, L. G.,… Allen, B. R. (2017). A patient-centered emergency department management Strategy for Sickle-Cell Disease Super-Utilizers. *The Western*

Journal of Emergency Medicine, 18(3), 335–339. doi:10.5811/westjem.2016.11.32273

Smeltzer, M. P., Nolan, V. G., Yu, X. , Nottage, K. A., Davis, B. A., Yang, Y. , Wang, W. C., Gurney, J. G. and Hankins, J. S. (2016), Birth prevalence of sickle cell trait and sickle cell disease in Shelby county, TN. *Pediatric Blood Cancer*, *63*(6): 1054-1059. doi:10.1002/pbc.25936

Sobota, A., Neufeld, E. J., Sprinz, P., & Heeney, M. M. (2011). Transition from pediatric to adult care for sickle cell disease. Results of a survey of pediatric providers. *American Journal of Hematology*, *86*(6), 512–515. doi:10.1002/ajh.22016

Stone, J. (2015). Sickle cell disease highlights racial disparities in healthcare. *Forbes,* June 19, 2015. Retrieved from https://www.forbes.com/sites/judystone/2015/06/19/sickle-cell-disease-highlights-racial-disparities-in-healthcare/?sh=5c0e906d3b75

Ter-Minassian, M., Lanzkron, S., Derus, A., Brown, E., & Horberg, M. A. (2019). Quality metrics and health care utilization for adult patients with sickle cell disease. *Journal of the National Medical Association*, *111*(1), 54–61. doi:10.1016/j.jnma.2018.05.003

Van Houdt, S., Heyrman, J., Vanhaecht, K., Sermeus, W., & De Lepeleire, J. (2013). An in-depth analysis of theoretical frameworks for the study of care coordination. *International Journal of Integrated care*, *13* (2). http://doi.org/10.5334/ijic.1068

Walden University Academic Skills (2020, April 15). *Paired sample t- test: An introduction* [YouTube]. https://www.youtube.com/watch?v=xpwFLawDsi0&feature=emb_logo

Appendix

IRB Approval Letter from Sickle Cell Center IRB Institution

THE UNIVERSITY OF TENNESSEE
HEALTH SCIENCE CENTER

Institutional Review Board
[redacted]

October 03, 2019

[redacted]

Re: 18-05880-XP
Study Title: The descriptive epidemiology (incl. disparities, utilization, readmissions, mortalities, comorbidities, cost-analysis, and geographic variation) and the study of risk factors of patients with sickle cell disease in the Memphis/Shelby County, TN area

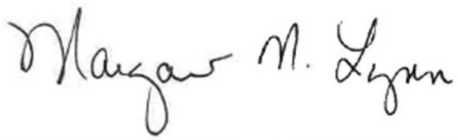
Dear Dr. Hankins:

The Administrative Section of the UTHSC Institutional Review Board (IRB) reviewed your application for revision of your previously approved project, referenced above.

The IRB determined that your application is eligible for **expedited** review under 45 CFR 46.110(b)(2). The attached revisions were approved as complying with proper consideration of the rights and welfare of human subjects and the regulatory requirements for the protection of human subjects.

In the event that subjects are to be recruited using solicitation materials, such as brochures, posters, web-based advertisements, etc., these materials must receive prior approval of the IRB. Any revisions in the approved application must also be submitted to and approved by the IRB prior to implementation. In addition, you are responsible for reporting any unanticipated problems, including reportable adverse events, involving risks to subjects or others in the manner required by the local IRB policy. Lastly, you must request to close your project when you have completed data analysis by submitting a study closure form to the IRB.

Sincerely,



Signature applied by Margaret M Lynn on 10/03/2019 02:03:46 PM CDT

Margaret M. Lynn, LMSW, RDN, CCRP, CIP
Senior Regulatory Specialist
UTHSC IRB

Attachment: Revisions

The study application was updated to Version 1.6 to incorporate:

- Sections 3.0 and (415): Molly Rolen was removed. Rushali Naik was added.

Letter of approval to use sickle cell centers data

September 22, 2020

Walden University
Center for Research Quality for the DHA Program

To whom it my concern:

I, Robin Womeodu, MD, gives Rushali Naik permission to access and utilize data collected from patients of **Methodist Comprehensive Sickle Cell Center** to use for her dissertation/capstone project with Walden University for achieving her DHA degree.

If you have any questions or need additional information, please do not hesitate to contact me at [redacted] Thank you.

Sincerely,

Robin Womeodu, MD
Chief Medical Officer
Methodist University Hospital

Email Communication to allow use of secondary data set

Good morning, Rushali:

It's really great to hear from you. Hope you're doing well.

Excited to hear that you're getting ready to begin your DHA dissertation (please remind me, are you getting your degree from UAB Birmingham?). I've assisted a couple of DHA dissertations and in the past and presented results of one of them at a National Conference earlier this year and getting ready to submit it to a top-tier Healthcare Management journal.

Appreciate your email about the use of the dataset towards your dissertation. Coming to the data set, could you please remind me the details of the data present within it? On the other hand, I'm really excited to hear that you're planning to use it towards your dissertation; and OK with your use of it towards your dissertation as long as it has: (a) approval of Jane, and (b) inclusion of Jane (hello! hope you're having a great summer), Anjelica, and myself on any subsequent presentations/publications that are based on this dataset as the development of this research dataset required a significant investment of volunteer time, efforts for data investigation/extraction/build. As mentioned, I've worked on DHA dissertations in the past, so let me know if I can be of any assistance.

I'm close to finishing my fellowship, and will be in Memphis for a few days (in September), so let's catch up then if that works for you.

Please let me know if you've any questions. Again, I greatly appreciate your email.

For future communications, would you mind cc'ing me at my current work email: [redacted] for an immediate response.

Best,
Pradeep
[redacted]

On Tue, Aug 6, 2019 at 8:44 AM Rushali Naik <[redacted]> wrote:

Re: Permission to use data set

Hankins, Jane S <[redacted]>
08/08/2019 at 11:47 AM

From: **Hankins, Jane S** <[redacted]>
Sent: 08/08/2019 at 11:47 AM
To: **Pradeep Podila** <[redacted]>
Cc: **Rushali Naik** <[redacted]>

3 Attachment(s) Total 16.6 KB View ^

image001.jpg (12.6 KB) image002.jpg (2.3 KB) image003.jpg (1.7 KB)

XT

Hi Pradeep ! All great points. Agree with them. I give permission to use the data, but will have to add her to the IRB submission to make it official. Will work on it . Thanks

Sent from my iPhone

On Aug 8, 2019, at 11:33 AM, Pradeep Podila <[redacted]> wrote:

—