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Factors that Predict Outpatient Department Utilization amongst Sickle Cell Disease Patients in the USA

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Abstract

Individuals with sickle cell disease (SCD) frequently present in the emergency room due to various complications that may arise from their condition. Optimal healthcare for people with SCD utilizes outpatient department (OPD) diagnostic and preventive care services. This paper investigates the factors associated with OPD visits compared to Emergency department (ED) visits in patients with SCD. SCD-related OPD visits and ED visits were obtained from the openly available National Hospital Ambulatory Medical Care Survey (NHAMCS) and National Ambulatory Medical Care Survey (NAMCS) data for the years 2009-2010. A total of 822,353 weighted visits by people with SCD were analyzed. Descriptive data include patient demographics, geographical location, and socioeconomic status associated with hospital OPD visits. Of the 812,366 weighted visits, 361,024 were made to the ED and 451,342 were made to the OPD. The median predicted probability of using the OPD amongst patients with SCD was 50%. We found that patients with SCD who had a below median probability of using OPD services were mostly female (66.12%), African-American (98.35%), Medicaid-insured (61.98%) and between the ages of 20-30 years old (42.98%). Individuals with SCD residing in neighborhoods with average income below $52,000 (96.69%), more than 10% below poverty level (86.55%) and less than 20% with a bachelor degree or higher (63.87%) made up the majority of people with below median probability of making OPD visits. This study suggests that there are socio-demographic differences in the utilization of outpatient services amongst people with SCD. Efforts at improving OPD use amongst patients with sickle cell disease should target these patients.

Keywords: Sickle cell disease; Outpatient department; Emergency department; Socioeconomics; Demographics

Introduction

Haemoglobinopathies, including sickle cell disease are the most common inherited blood disorders worldwide [1]. In the United States, an estimated 100,000 people are affected by sickle cell disease [2]. Patients with SCD have an increased risk of developing sickle-shaped red blood cells that occlude small vessels which can affect every major organ and gives rise to a severe acute pain termed a 'crisis' [3]. Crises are the most frequent cause of hospital ED visits in this patient population [4-6]. Other clinical manifestations of sickle cell disease include anemia, increased susceptibility to infections, acute chest syndrome, neurologic complications such as cerebral infarction and hemorrhage, avascular necrosis of the femoral and humeral heads, retinal detachment, pulmonary hypertension and heart disease [7].

Even though survival rates of people with SCD have improved significantly with the implementation of recommendations like newborn screening, prophylactic penicillin, and immunization with *Haemophilus influenza B* and *Streptococcus pneumonia* vaccine, morbidity, and premature mortality rates are still unacceptably high. The average age of death for SCD patients in California and Georgia between the years 2004-2008 was 43 years old, and the SCD population aged 5-74 years had substantially higher all-cause mortality rates than African Americans and other people in the general population of similar ages[8]. Public health statistics may underestimate SCD-associated mortality, as some patients with SCD do not have SCD as the cause of death listed on their death certificates [9].

As a result of the numerous complications that may arise from SCD, a multidisciplinary approach is recommended to improve survival [10]. However, health maintenance which prescribes the timely, age-specific, routine diagnostic and preventive care is key to the successful management of patients with SCD rather than simply waiting to intervene when crises occur [11]. Day hospitals where uncomplicated acute episodes can be managed outside the ED are also a useful intervention that has improved the quality of care for patients with SCD. For instance, Benjamin et al. found that patients managed in the day hospitals were five times less likely to be admitted to the hospital and spent on average 1.5 days less on admission than patients with SCD who were managed in the ED. Fewer admissions and shorter length of stays amongst patients with SCD managed in the day hospital resulted in an estimated $1.7 million savings over the 5-year study period [12]. Timely and appropriate outpatient management of patients with SCD is recommended to reduce complications associated with the disease [13]. Therefore, understanding the factors that are associated with the use of these health care services is key to improving health care delivery and reducing health care expenditures for patients with SCD.

Prior research has examined the influence of patient characteristics such as age, sex, ethnicity, source of payment, parent characteristics and distance of residence from hospital on health care services in

patients with SCD [6, 14-17]. Based on the Thomas Jefferson University Hospital data, Epstein et al. found that women had fewer hospitals ED visits but the difference between male and female office-based visits was not statistically significant [14]. Another study showed that 18-30-year-olds had the highest average annual ED utilization rates compared to other age groups [15]. Furthermore, studies have demonstrated a higher average number of ED visits for uninsured patients with SCD compared to those who are privately insured [6, 15]. However, there is limited information available about the influence of socioeconomic status on the use of health care services amongst patients with SCD. Understanding the socioeconomic characteristics of patients with SCD who visit OPD's will be useful in developing equitable interventions that can improve health care delivery and uptake of preventive services within this population. The purpose of this analysis is to examine the factors that influence OPD utilization by comparing patients with SCD who visit the OPD to those who visit the ED. We aim to examine the influence of socioeconomic status on the use of OPD services amongst patients with SCD in the United States.

Methods

The current study was a secondary analysis of the National Hospital Ambulatory Medical Care Survey (NHAMCS) and National Ambulatory Medical Care Survey (NAMCS) data. The data source is the free public-use version, available for download on the NCHS website. The National Center for Health Statistics conducts the NHAMCS and NAMCS under the directive of the Center for Disease control.

NAMCS data is obtained from non-federally employed physicians classified by the American Medical Association or the American Osteopathic Association as "office-based, patient care". The survey is carried out over a 1-week period. The NHAMCS data is obtained from nonfederal, general and short-stay hospitals. The survey is conducted over a random 4-week period. The surveys are annual, multistage, probability surveys carried out by sampling 1)112 geographic primary sampling units 2) approximately 480 hospitals within each sampling unit and 3) patient visits within hospital service areas [18]. Trained hospital staff workers extract data into a structured data entry form that includes patient and provider characteristics, the source of payment, the reason for the visit, vital signs and ICD-9-M codes for patient diagnosis, injury, procedures and diagnostic tests ordered. They also capture medication provided and disposition on the discharge of a patient. The dataset also includes socioeconomic variables that were obtained by linking census data to each patient to provide information about poverty, income and educational achievement within the patient's zip code. Socioeconomic factors included in this dataset represent the socioeconomic factors of the patient's zip code and not necessarily that of the patient.Sampling weights are used to extrapolate the survey sample visits to nationally representative estimates. The sample weights are obtained mathematically from 1) the inverse of the product of the sampling probabilities at each stage of the survey design. 2) An adjustment for non-response at the hospital stage and clinic stage 3) Sampling weights is included to adjust for non-response, geographic region, and urban/rural designations. Including sample weights in analysis produces unbiased estimates of national ED, OPD and office-based care visits.

This study combines the NHAMCS survey data collected from the hospital ED and OPD for the years 2009-2010 and NAMCS survey data for the years 2009-2010 to improve the reliability of estimates. Prior years were excluded because data was not collected on comorbidities in the ED surveys. Data from 2011 were excluded because they did not include socioeconomic variables. NHAMCS OPD and ED data sets for both years were merged and analyzed as one complete dataset to account for hospital clusters that may appear within the sample.

Utilization of the NHAMCS data is a cost-effective method of studying patient factors as they relate to the use of hospital OPD or ED services. The data comply fully with Health Insurance Portability and Accountability Act of 1996 and contains completely de-identified records, so IRB approval is not required.

Selection of participants and variable definitions

The study population was made up of all hospital visit records with any diagnosis of SCD as identified by the ICD-9-CM codes 282.6, which encompasses all sickle cell hemoglobinopathies and 282.41 and 282.42 for sickle cell thalassemia.

Some variables were recorded for the purpose of the analysis. The primary source of payment was coded as private insurance, Medicare, Medicaid, self-pay and 'other'. No charge, unknown and other was merged to represent 'other' sources of payment. Congestive heart failure, diabetes, and cerebrovascular disease were examined in this analysis as comorbidities. The three conditions were chosen as they were the only conditions collected uniformly across the various settings. However, due to very low numbers of individuals with each one of these conditions, they were combined to represent the variable 'comorbidities' as including them individually could produce unreliable estimates. The variable race was dichotomized with categories 'Black or African-American' and 'others or more than one race'.

Socioeconomic status was determined using three NCHS variables generated based on census data linked to the zip code provided by the patient at registration. The variable 'poverty' indicates the percent of the population in patient's zip code below the poverty level, 'education' refers to the percentage of individuals with a bachelor's degree or higher in the patient's zip code and 'income' indicates the median household income in patient's zip code and location refers to the urban-rural classification of the patient's zip code.

Statistical analyses

STATA survey procedures were used to account for the sampling error as a result of the complex sampling design. National estimates with corresponding confidence intervals and P values were derived by advanced STATA calculations after declaring survey design using the NHAMCS and NAMCS masked primary sampling unit, stratum marker, and patient weight design variables.

Bivariate analyses testing differences between the source of payment categories, demographic factors, socioeconomic factor categories, geographical location and comorbidities were carried out with the Pearson uncorrected chi2 test using weighted proportions. We used a logistic regression model to determine the independent effects of age, race, gender, income, poverty, education, the source of payment, the presence or absence of comorbidities and the geographical region on the utilization of OPD services. Based on the results of the logistic model, we generated the predicted probability of an OPD visit for all patient entries. We determined the median probability of an OPD visit and divided the sample of patients with sickle cell disease into patients with below median probability and above median probability for

making an OPD visit. All analysis was carried out using STATA 14.1 [19].

Results

In this sample, there were 116 unweighted visits to the ED and 141 unweighted visits to the OPD and office-based practices by patients with SCD in 2009-2010 on average. This represented 361,024 weighted visits to the ED and 461.329 weighted visits to the OPD over the study period. There were 178,888 weighted visits to the ED by patients with SCD in 2009 and 182,136 visits in 2010. We analyzed a total of 232,265 visits to the OPD in 2009 and 229,064 in 2010. Overall, 822,353 weighted visits were analyzed.

Table 1 provides information on sociodemographic characteristics of patients with sickle cell disease who presented at the ED and OPD. There was a significant difference in utilization of ED and OPD services across the various age groups. Interestingly, we noted that children under the age of 11 made the most (44.8%) visits to the OPD but the fewest visits to the ED (9%) over the study period. Conversely, adults between the ages of 20-30 made the fewest (13.1%) visits to the OPD but presented most frequently at the ED (43.2%). Individuals between the ages of 11-20 made about a quarter of the visits to the OPD (24.3%) and the ED (23.2%), while patients with SCD over the age of 30 made about 17.8% of visited reported at the OPD and 24.6% reported at the ED. Overall, the majority of patients with SCD were African American who recorded a higher proportion of visits in the ED (93.8% CI=77.3-98.5) compared to the OPD (83.4% CI=56.2-95.2). However, patients with SCD of other races had more visits to the OPD (16.6% CI=4.8-43.8) than the ED (6.2% CI=1.5-22.7). The most frequent source of payment was Medicaid at the OPD (61.7% CI=47.5-78.3) and ED (57% CI=44.6-68.7). In the OPD, the second most frequent source of payment was private insurance (19.1% CI= 9.0-36.0) followed by Medicare (10.6% CI= 3.9-25.9). For visits to the ED, the second most frequent source of payment was Medicare (21.6% CI=12.9-33.9) followed by private insurance (10.9% CI=6.0-19.2). More than half of visits to the OPD by patients with SCD were recorded in the South (54% CI=25.7-79.9), followed by the Northeast (26.8% CI= 9.9-55.0), the Midwest (18.3% CI= 6.1-43.3) and then the West (1% CI= 0.0-3.3). Over one-third of visits to the ED by patients with SCD were recorded in the South (38.6% CI=25.8-53.2), followed by the Midwest (30.1% CI=17.8-46.1), the Northeast (24.1% CI=14.8-36.7) and then the West (7.3% CI=3.1-16.3). The majority of people who visited the OPD and ED resided in neighborhoods with average incomes less than $52,000. However, patients with SCD who resided in neighborhoods with average incomes above $52,000 frequently attended the OPD (19.7 CI=9.3-37.1) compared to the ED (6.2 CI=2.6-14.3).

Variables	Emergency Department	Outpatient department	p-value for significance of difference across groups
Unweighted number of visits	116	141	
Weighted number of visits	361024	461329	
Percent	95% CI	95% CI	
Gender			
Male	34.9 [26.4, 44.5]	46.7 [31.8, 62.3]	0.192
Age			
<10	9 [4.3, 17.8]	44.8 [29.0, 61.7]	
11 to 20	23.2 [13.8, 36.3]	24.3 [11.1, 45.2]	
21 to 30	43.2 [30.1, 57.3]	13.1 [4.7, 31.4]	<0.001
>30	24.6 [16.1, 35.7]	17.8 [8.5,33.8]	
Race			
Black/African American only	93.8 [77.3, 98.5]	83.4 [56.2, 95.2]	
Other race	6.2 [1.5, 22.7]	16.6 [4.8, 43.8]	0.09
Source of payment			
Private insurance	10.9 [6.0, 19.2]	19.1 [9.0, 36.0]	
Medicare	21.6 [12.9, 33.9]	10.6 [3.9, 25.9]	
Medicaid	57 [44.6, 68.7]	61.7 [47.5, 78.2]	0.433
Uninsured	2.3 [0.8, 6.3]	3.6 [0.5, 20.8]	
Other/unknowna	8.1 [2.9, 20.8]	5 [1.6, 14.9]	
Geographic region			

Northeast	24.1 [14.8, 36.7]	26.8 [9.9, 55.0]	
Midwest	30.1 [17.8, 46.1]	18.3 [6.1, 43.3]	
South	38.6 [25.8, 53.2]	54 [25.7, 79.9]	0.246
West	7.3 [3.1, 16.3]	1 [0.3, 3.3]	
Percent poverty in patient's zip code			
<10%	67.4 [55.3, 77.5]	56.7 [36.1, 75.1]	
>10%	32.6 [22.5, 44.7]	43.3 [24.9, 63.9]	0.36
Percent population with bachelor's degree or higher in patient's zip			
<19.66%	65.3 [52.4, 76.3]	64.9 [49.3, 77.9]	
>19.66%	34.7 [23.7, 47.6]	35.1 [22.1, 50.7]	0.961
Median household income in patient's zip			
< $52,388	93.8 [85.7, 97.4]	80.3 [62.9, 90.7]	
< $52,388	6.2 [2.6, 14.3]	19.7 [9.3, 37.1]	0.047
Urban-rural classification of patient's zip			
Non-metro	8.1 [2.6, 22.6]	17.3 [9.0, 30.6]	0.446
Metro	91.9 [77.4, 97.4]	82.7 [69.4, 91.0]	
Comorbidities			
No	2 [0.6, 6.6]	85.5 [75.3, 91.9]	
Yes	98 [93.4, 99.4]	14.5 [8.1, 24.7]	<0.001

[a] Includes, charity, unknown and other

Table 1: Socio-demographic characteristics of patients with sickle cell disease.

The logistic regression model predicting OPD use adjusting for age, gender, race, region, method of payment, average neighborhood income, comorbidity and the year confirm the bivariate analysis findings and show that age, income and the presence or absence of comorbidities are most strongly associated with the use of OPD services amongst patients with SCD.

Table 2 presents the unadjusted and adjusted multivariable logistic regression model results. Children under the age of 11 were more likely than any other group to use OPD services based on both the adjusted and unadjusted models.

Compared to children under the age of 11, the odds of visiting the OPD was 87% less in individuals 11-20 years [aOR=0.13 CI=0.04-0.45], 95% less in individuals 21-30 years [aOR=0.05 CI=0.01-0.27] and 92% [aOR=0.08 CI=0.02-0.39] less in individuals older than 31 years.

Patients with comorbidities were far more likely to make OPD visits than those without comorbidities [aOR=14.59 CI=4.25-50.05].

Patients with SCD who resided in zip codes with average household incomes more than $52,000 were more likely to use OPD services compared to those who resided in neighborhoods with average household incomes below $52,000 [aOR=11.38 CI=1.93-67.06].

Variables	Unadjusted OR	Adjusted ORa
Year		
2009 (reference)	1	1
2010	0.97 [0.27-3.43]	0.42 [0.10-1.80]
Age		
<11 (reference)	1	1
11 to 20	0.21*** [0.09-0.51]	0.13*** [0.04-0.45]
21 to 30	0.06*** [0.02-0.24]	0.05*** [0.01-0.27]
31+	0.15*** [0.04-0.55]	0.08*** [0.02-0.39]
Race		
Others or more than one race (reference)	1	1
Black/African American	2.98 [0.80-11.06]	3.5* [1.14-10.74]
Gender		
Male (reference)	1	
Female	0.61 [0.29-1.28]	0.48 [0.17-1.33]

Average household income in patients zip code		
<$52000	1	1
>$52000	3.66 [0.95-14.07]	11.38* [1.93-67.06]
Comorbidities		
No (reference)	1	
Yes	8.44*** [2.26-31.45]	14.59*** [4.25-50.05]
Source of payment		
Private insurance (reference)	1	1
Medicare	0.28 [0.07-1.22]	1.29 [0.22-7.69]
Medicaid	0.62 [0.22-1.74]	0.68 [0.18-2.54]
Uninsured	0.89 [0.08-4.96]	1.12 [0.18-6.83]
Other	0.36 [0.04-2.92]	0.2 [0.01-3.21]
Region		
North east (reference)	1	1
Midwest	0.54 [0.139-2.123]	0.31 [0.06-1.71]
South	1.26 [0.301-5.243]	0.95 [0.28-3.20]
West	0.12 [0.022-0.702]	0.02** [0.002-0.32]

CI: Confidence Interval, OR: Odds Ratio

aAdjusted for all covariates in the table

***P<0.001

**P<0.01; P<0.001

*0.05<p<0.01

Table 3 shows the sociodemographic distribution of patients with SCD with below the median probability for an OPD visit. No patient less than 11 years had below median probability of an OPD visit.

Conversely, most of the patients with below median probability of an OPD visit were between the ages of 20-30 years old (41.2%), about 34.5% were over the age of 30 and 24.4% were between the ages of 11-19 years.

Overall, the majority of patients with below median probability of visiting the OPD were Black/African American (98.35%), female (66.12%) and publicly insured (80.99%).

Of those who were publicly insured, approximately 61.98% were Medicaid-insured and 19.01% were Medicare-insured. About 7.44% had private insurance and 4.13% were uninsured.

A very high percentage of patients with below median probability resided in neighborhoods with average household income below $52,388 (96.69%).

Four-fifths of patients with below median probability for visiting the OPD resided in neighborhoods with more than 10% of the population below poverty level, and about 58.82% of patients with below median probability for visiting the OPD were from neighborhoods with less than 19.66% of the population with a bachelor's degree or higher.

Variables	Percent (%)
Age	
11 to 19	23.97
20 to 30	42.98
31+	33.06
Sex	
Male	33.88
Female	66.12
Black/African American	98.35
Insurance	
Private insurance	7.44
Medicare	19.01
Medicaid	61.98
Uninsured	4.13
Other	7.44
Percent poverty in patient's zip code	
<10%	13.45
>10%	86.55
Percent population with bachelor's degree or higher in patient's zip	
<19.66%	86.55
>19.66%	36.13
Median household income in patient's zip	
< $52,388	96.69
>$52,388	3.31

Table 3: Demographic distribution of patients with SCD with below median probability of an OPD visit.

Discussion

This paper identified characteristics of patients with SCD with lower probabilities of utilizing outpatient services. The study provides evidence that patients with SCD who are older, female, African-American and from a lower socio-economic status are less likely to use outpatient services.

Our results show that young adults with SCD had lower probabilities of utilizing OPD services. On the other hand, the majority of ED visits were made by these groups of patients. This echoes what has been seen in previous studies [15, 20]. Access to care for this population transitioning out of pediatric care and early adulthood is a challenge [21, 22]. Research has shown higher emergency department reliance (EDR) for these age groups compared to other age groups [23].

EDR is calculated as the total number of ED visits divided by the sum of the total number of ED and OPD visits. The EDR helps distinguish between frequent ED users due to a higher need for care and those with a lower likelihood of access to primary care [23-25]. A

qualitative study found that provider-patient relationships, competing activities, forgetting clinic appointments and adverse clinic experiences were barriers to clinic attendance for adolescents (13-21 years) with SCD [26]. However, it still remains unclear whether improving access to OPD will result in lower EDR or reduce morbidity and mortality within this vulnerable group of patients with SCD.

Another strong predictor of low OPD utilization was neighborhood socioeconomic status. Often, the focus for improving the use of health care services in socioeconomically disadvantaged individuals is providing insurance but in this study, the majority of patients had insurance coverage [27]. Possible explanations for this finding include low Medicaid reimbursement for outpatient care limiting choices for outpatient services, lack of comprehensive adult sickle cell services for these individuals and indirect economic barriers such as taking time off work, transport and alternative childcare [27]. Future interventions should address these challenges of access to outpatient primary care amongst patients with SCD from more deprived neighborhoods.

This study examines a nationally representative sample of patients with SCD in the US but has a few limitations. Most notably, we were unable to examine differences in the clinical severity of disease of patients who visited the OPD compared to those who visited the ED and as such, we were unable to control for this factor in our analysis. Furthermore, socioeconomic status was defined using neighborhood-level poverty, education and income and not based on the actual status of the patient which may not capture similar associations with smaller component analysis [28].

Conclusion

As an observational study, this study cannot explain the root causes of the disparities observed because causality cannot be established. Finally, because the database represents health care visits with no unique identifiers, there is a likelihood of a patient being represented more than once.

Understanding factors affecting health care seeking and use enables us to understand diversity and disparities as they exist within the health care system and inform more patient-centered practitioners and health delivery systems [29]. Amongst sickle cell patients, variations exist in the utilization of OPD and ED services by age, the presence of other diseases and average family income. Further prospective studies are needed to examine the root causes and impact of these variations.

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O.O-wrote the manuscript, conducted analyses and edited the manuscript, O.A- conducted data analyses and edited the manuscript, RB supervised and critically reviewed the project, S.M.L - critically reviewed and edited the manuscript.

Conflict of Interest

The authors have no conflict of interest relevant to this article to disclose.

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