

# Utilization of the Office, Hospital and Emergency Department for Adult Sickle Cell Patients: A Five-Year Study

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Sickle cell disease (SCD) is a hematological disorder that is manifested primarily by severe pain and chronic organ damage. Little normative data exists on what the usual healthcare utilization is of a population of SCD patients, especially adults.

Our study analyzed the office, emergency department (ED) and hospital use data for 142 patients who received care for three consecutive years. Relationships between health service use, patient age, gender and sickle cell phenotype were described. Multivariate analyses studied relationships between demographic and clinical characteristics and levels of office, independent ED and inpatient encounters over a five-year period (1997–2001).

We found female patients were older and had less ED and hospital admissions. The 20% highest inpatient utilizers accounted for 54% of the ED total visits, 52% of the ED independent visits, 54% of hospital bed days and 24% of office visits. The ED was a common place for utilization, with a mean of 7.4 visits per patient year, a third of which resulted in a hospital admission.

The healthcare utilization of our adult sickle cell population is very complex, with a subset of our patients accounting for a majority of the resources used and female patients living longer but with less ED and hospital admissions.

**Key words:** sickle cell disease ■ healthcare utilization

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## INTRODUCTION

Sickle cell disease (SCD) is a group of inherited disorders of red blood cells (RBCs) in which abnormal hemoglobin is produced. The most common form of SCD is sickle cell anemia (SS), in which the affected individual inherits the gene for hemoglobin S from both parents. In the United States, approximately 2,000 infants with SCD are identified annually.<sup>1</sup> Patients with SS and other types of SCD may suffer chronic anemia, frequent infections and multiorgan damage, including the lungs, liver, kidneys, brain and the musculoskeletal system.<sup>2</sup> The cardinal clinical manifestation of SCD, however, is the acute painful vasoocclusive crisis.

Management of this acute pain as well as chronic pain is the reason for the majority of interactions with the healthcare system. Although the bulk of this healthcare should occur in the outpatient office, acute painful episodes unresponsive to oral medications may result in visits to emergency departments (EDs) and inpatient hospitalization. Although the prevalence of SCD is low relative to more common disorders such as cardiovascular disease, diabetes or cancer, it is very expensive to governmental and private payers due to the high utilization of the ED and inpatient hospitalization.<sup>3,4</sup> Therefore, many payers monitor closely utilization of the patients with SCD. However, little normative data exist on what the usual healthcare utilization is of a population of SCD patients, especially adults. This information would be of value to healthcare systems, governmental and private payers, and healthcare planners.

The purpose of this study was to describe patterns of healthcare use for sickle cell patients admitted to a large, tertiary care hospital in an urban setting. We were particularly interested if there was a difference in healthcare use by sickle cell type. We therefore reviewed the office, ED and inpatient hospital utilization of a population of adult patients managed in a comprehensive multidisciplinary SCD program to determine the distribution of care of a population of patients with SCD.

## METHODS

The SCD program at Thomas Jefferson University Hospital provides primary and hematological care to patients in the three-state area of southeastern Pennsylvania, southern New Jersey and Delaware. The study included patients with homozygous-SS disease, SCD and sickle- $\beta$  thalassemia. During the period 1997–2001, the program provided care for 297 patients. In order to exclude patients who may have received care at our hospital but whose primary source of care was elsewhere, we limited our analysis to those patients who had received  $\geq 3$  consecutive years of care at our institution. A total of 142 patients met this criterion. Of these 142 patients, 30 patients were in the program for three consecutive years, 26 patients for four years and 86 patients were in the program for all five years of the study period.

All office, ED, and inpatient hospitalization utilization was determined for these 142 patients. Office utilization included visits to either the patient's internist, who served as the primary care physician, or to a hematologist. The majority of inpatient hospitalizations were on the general medical service. ED utilization was divided into total usage (ED total) and those visits that did not result in an admission (ED independent). ED utilization included only those visits to the ED at our hospital: ED visits to other institutions were not measured. Demographic information recorded included age, gender, SCD phenotype, number of consecutive years in program and health insurance coverage. In addition, we examined distributions of office, independent ED and inpatient encounters, and for each type of care aggregated patients into different levels of care use, identifying the 20% of patients who had the most visits per year in each type of care. The mean and median number of visits per year for different levels of care and their relationships to other utilization levels were calculated. Tabulations of healthcare service use were

normalized by the number of years in the program. Finally, multivariate analyses were performed which examined the relationships between demographic and other levels of healthcare use with office visits per year, independent ED use per year and inpatient admissions per year. All analyses were conducted using SAS version 8.1, 2001. Chi-squared tests were used to evaluate differences in proportions, and Student's *t* tests or analyses of variance were used to compare means. General linear models were used in multivariate models. We used R-squared to measure how well the variables in a multivariate model predict the outcomes. If the R-squared is 0.60, for example, then 60% of the outcome can be attributed to the variables listed. This study was approved by the institutional review board of Thomas Jefferson University.

## RESULTS

Table 1 shows the demographic breakdown of these 142 patients and the annual utilization of the office, ED and hospital. Ninety-seven (68.3%) patients had SS disease, 32 (22.5%) had SCD, and 13 (9.2%) had S- $\beta$  thalassemia. Ninety-two out of the 142 patients (65%) were females. The average age of the patients was 37.6. Seventy-six of the 142 patients had medical assistance as their primary payer, 36 patients had Medicare as primary payer, 28 patients had commercial insurance and two patients had no health insurance. Female patients were significantly older than the men, with females having an average age of 39.1 years, and the men averaging 34.7 years ( $p=0.02$ ). Of note, all 15 patients age  $>50$  were women, of which seven (47%) were SS, five (33%) were SC, and three (20%) were S- $\beta$  thalassemia.

For the 142 patients with between 3–5 years of continuous service use, there were a total of 4,874 ED visits, of which 1,607 (33%) resulted in a hospitalization and thus 3,267 (67%) were independent ED usage. Of note, there

**Table 1. Demographics of the studied patients with sickle cell disease**

	# Pts	% Pts	Mean Healthcare Use Per Year (Median)					
			Office	ED Total*	ED Independent**	Inpatient	LOS***	Total Days****
Total	142	100%	4.1 (3.5)	7.4 (2.5)	4.9 (1.0)	2.7 (1.6)	6.8 (5.9)	23.2 (12.8)
Age Group								
20–30	45	31.7%	3.0 (2.5)	5.4 (2.0)	2.9 (1.0)	2.7 (1.3)	7.4 (6.9)	26.3 (10.3)
31–40	46	32.4%	3.8 (3.2)	11.5 (4.8)	8.5 (1.2)	3.1 (2.2)	6.5 (5.8)	23.5 (14.3)
41–50	36	25.4%	5.1 (4.7)	6.9 (2.4)	4.3 (1.1)	2.7 (1.7)	6.9 (6.1)	23.6 (16.0)
$\geq 51$	15	10.6%	6.0 (5.6)	2.3 (2.0)	1.0 (0.4)	1.8 (1.5)	5.3 (3.9)	9.7 (5.8)
P value, age group			0.0003		0.0177	0.5455	0.4012	0.3147
Sickle Type								
SC	32	22.5%	4.0 (3.6)	7.2 (1.7)	5.4 (0.9)	2.0 (1.2)	6.0 (5.0)	14.8 (8.2)
SS	97	68.3%	4.1 (3.6)	8.0 (3.2)	5.2 (1.0)	2.9 (2.0)	6.9 (6.1)	24.9 (16.8)
S- $\beta$ thal	13	9.2%	4.4 (1.8)	4.1 (2.0)	1.8 (0.8)	2.9 (1.8)	7.8 (8.6)	29.8 (9.5)
P value, sickle type			0.9148		0.5192	0.2713	0.4059	0.1581
Females	92	64.8%	4.4 (3.8)	5.5 (2.0)	3.4 (0.8)	2.3 (1.4)	6.9 (5.8)	20.6 (9.6)
Males	50	35.2%	3.5 (3.2)	10.9 (4.4)	7.6 (1.3)	3.4 (2.5)	6.5 (6.2)	28.2 (18.4)
P Value, Gender			0.0872		0.0204	0.0341	0.5945	0.1264

\* ED total represents all emergency department visits; \*\* ED independent are those visits that did not result in an admission; \*\*\* LOS: length of stay; \*\*\*\* Total days represent total inpatient bed days

were 1,681 inpatient admissions and thus 95.6% of the hospitalizations originated from the ED (1,607/1,681).

The means and medians for healthcare utilization by gender, age and sickle cell type are also shown in Table 1. For the entire patient population, the means were 4.1 office visits per year, 7.4 total ED visits per year, 4.9 independent ED visits per year, 2.7 inpatient admissions per year and 23.2 total bed days per year. The median ED usage was only 2.5 total and 1.0 independent visits per year. The median admission rate was only 1.6 admissions per year that accounted for a median 12.8 total bed days per year. The average length of stay was 6.8 days, with a median of 5.9 days. The difference between the means and medians illustrates the skewed distribution of utilization, particularly in the ED and hospital settings, with a few patients having very high utilization (thus raising the means), and the majority of patients having much lower utilization (illustrated by the lower medians). By sickle cell type, there were no significant differences between the groups in patterns of care. However, SS patients had a trend towards higher ED usage and hospitalizations. Females had less independent ED ( $p=0.02$ ) and hospital admissions ( $p=0.034$ ), and had a trend towards more office visits ( $p=0.087$ ). Older patients used significantly more office visits ( $p=0.0003$ ) and less independent ED visits ( $p=0.017$ ).

Table 2 shows the relationships between different levels of office, ED and inpatient care with other healthcare use measures. Of the total sample, six (4.2%) had no office visits, 21 (14.8%) had no independent ED visits and 22 (15.5%) had no inpatient admissions. Twenty-six (18.3%) of the patients had  $\geq 7$  office visits per year;

27 (19.0%) had  $\geq 6$  independent ED visits per year; and 29 (20.4%) had  $\geq 5$  inpatient admissions per year.

For different levels of office use, there was a trend that showed a positive but not significant relationship between more office visits and more independent ED usage ( $p=0.19$ ). This relationship was closer to significance ( $p=0.052$ ) in our multivariate analysis (Table 3). Those with higher levels of inpatient admissions also had more independent ED use ( $p\leq 0.0001$ ) and more hospital bed days per year ( $p\leq 0.0001$ ). The 29 patients (20% of total) with  $>5$  inpatient visits a year accounted for 54% of the ED total visits, 52% of the ED independent visits, 54% of hospital bed days and 24% of office visits.

Table 3 illustrates multivariate modeling that explores concurrent relationships among all of our demographic, clinical and healthcare use variables. As noted above, since ED and inpatient utilization were so highly related (correlation at  $p=0.001$ ), we did not include this in the multivariate modeling. The R-squared of our office visits per year multivariate model was 0.1995,  $p=0.0002$ . In this model, older age groups (those age  $>41$  years) were significantly related to fewer office visits per year (age 41–50  $p=0.0009$ , age  $>51$ ,  $p=0.0005$ ). Higher levels of ED utilization per year had a trend that approached significance relating to more office visits per year ( $p=0.0527$ ). The R-squared of independent ED use per year was 0.4056,  $p\leq 0.0001$ . For independent ED use per year, those aged 31–40 were related to lower independent ED use per year, and inpatient utilization was significantly related to more independent ED use per year (age 31–40,  $p=0.0138$ ; inpatient visits per year,  $p\leq 0.0001$ ). For the model studying

**Table 2. Levels of utilization of the studied patients with sickle cell disease**

	Mean Healthcare Use Per Year (Median)							
	# Pts	% Pts	Office	ED Total*	ED Independent**	Inpatient	LOS***	Total Days****
<b>Office Use</b>								
Total	142	100.00%		7.4 (2.5)	4.9 (1.0)	2.7 (1.6)	6.8 (5.9)	23.2 (12.8)
0 visits	6	4.20%		6.0 (6.1)	2.5 (2.1)	3.6 (3.7)	6.3 (6.0)	22.3 (22.3)
Up to 6.9	110	77.50%		6.6 (2.0)	4.3 (0.8)	2.4 (1.3)	7.0 (6.2)	24.0 (12.4)
$\geq 7$ visits	26	18.30%		11.5 (5.6)	8.1 (1.6)	3.8 (2.9)	6.3 (4.8)	20.6 (14.4)
P values for use by office/year					0.1934	0.0691	0.7162	0.849
<b>Independent ED Use</b>								
Total	142	100.00%	4.1 (3.5)			2.7 (1.6)	6.8 (5.9)	23.2 (12.8)
0 visits	21	14.80%	3.5 (3.2)			0.5 (0.2)	6.3 (4.0)	13.4 (1.0)
Up to 5.9	94	66.20%	4.0 (3.4)			2.1 (1.4)	7.0 (6.2)	18.7 (9.6)
$\geq 6$ visits	27	19.00%	4.8 (4.2)			6.4 (6.8)	6.4 (5.5)	40.9 (31.8)
P values for use by indep ED			0.2826			$<0.0001$	0.7069	0.0001
<b>Inpatient Use</b>								
Total	142	100.00%	4.1 (3.5)	7.4 (2.5)	4.9 (1.0)		6.8 (5.9)	23.2 (12.8)
0 visits	22	15.50%	3.1 (2.2)	0.4 (0.3)	0.4 (0.3)			
Up to 4.9	91	64.10%	4.1 (3.8)	5.2 (2.2)	3.5 (0.8)		6.6 (5.5)	13.9 (8.7)
$\geq 5$ visits	29	20.40%	4.9 (4.0)	19.7 (13.5)	12.6 (6.6)		7.4 (7.1)	52.2 (39.7)
P values for use by inpt adm			0.0868		$<0.0001$		0.3147	$<0.0001$

\* ED total represents all emergency department visits; \*\* ED independent are those visits that did not result in an admission; \*\*\* LOS: length of stay; \*\*\*\* Total days represent total inpatient bed days

inpatient admissions per year, the R-squared was 0.3601,  $p \leq 0.0001$ . In this model, only independent ED visits were significantly related to more inpatient admissions per year ( $p \leq 0.0001$ ).

## DISCUSSION

An important finding in this study is that the women were significantly older than the men. Moreover, all patients age >50 years were women. The highest proportion of these 15 female patients were SS (47%), but this is <68% total proportion in our study, implying that relatively fewer SS patients live to age >50 years. This difference may be, in part, due to the fact that women in the general population have a greater life expectancy

than that of men. More importantly, however, is that within the context of SCD, women have higher levels of fetal hemoglobin (Hb F) than men.<sup>5,6</sup> The x chromosome seems to be a factor controlling the expression of Hb F.<sup>7</sup> Platt et al.<sup>8</sup> reported that small elevations in Hb F level have a salutary effect on the clinical picture of SCD.

We also found that men are admitted more frequently to the hospital than women, suggesting they have more severe disease in terms of frequency of acute painful episodes. This difference is most likely due to the fact that women are more anemic than men. A lower hemoglobin level renders the blood less viscous and, hence, less likely to cause vasoocclusion. Previous reports have shown that the milder the anemia in

**Table 3. Multivariate analyses: office visits per year, independent ED per year, inpatient admissions per year**

*Dependent Variable: Office Visits per Year; model  $p=0.0002$ ; model  $R^2=0.1995$*

**Mean Office Visits per Year=4.1**

Parameter	Estimate	SE	t Value	Pr >  t
Intercept	8.36487	1.58193	5.29	<0.0001
Type SC	0.20065	0.89575	0.22	0.8231
Type SS	-0.31444	0.81049	-0.39	0.6987
Female	-0.90208	0.50503	-1.79	0.0763
Age 31-40	-0.50303	0.57764	-0.87	0.3854
Age 41-50	-2.03946	0.60014	-3.4	0.0009
Age $\geq 51$	-2.96698	0.82553	-3.59	0.0005
ED Indep/year	0.05514	0.02820	1.96	0.0527
Inpatient/year	0.09058	0.09530	0.95	0.3436

*Dependent Variable: Independent ED per year; model  $p<0.0001$ ; model  $R^2=0.4056$*

**Mean Independent ED per Year=4.9**

Parameter	Estimate	SE	t Value	Pr >  t
Intercept	3.87729	5.26450	0.74	0.4627
Type SC	-4.87787	2.68258	-1.82	0.0713
Type SS	-2.34218	2.44977	-0.96	0.3408
Female	2.13152	1.53805	1.39	0.1681
Age 31-40	-4.28271	1.71624	-2.5	0.0138
Age 41- 50	-0.41807	1.89616	-0.22	0.8258
Age $\geq 51$	1.11669	2.61929	0.43	0.6706
Office/year	0.50668	0.25914	1.96	0.0527
Inpatient/year	1.81599	0.24335	7.46	<0.0001

*Dependent Variable: Inpatient Admissions per Year; model  $p<0.0001$ ; model  $R^2=0.3601$*

**Mean Inpatient Admissions per Year=2.7**

Parameter	Estimate	SE	t Value	Pr >  t
Intercept	-1.17376	1.57483	-0.75	0.4574
Type SC	1.52402	0.80161	1.9	0.0594
Type SS	0.70013	0.73287	0.96	0.3411
Female	0.37318	0.46229	0.81	0.421
Age 31-40	0.57172	0.52296	1.09	0.2763
Age 41-50	0.39208	0.56633	0.69	0.4899
Age $\geq 51$	0.63599	0.78217	0.81	0.4176
Office/year	0.07448	0.07836	0.95	0.3436
ED Indep/year	0.16252	0.02178	7.46	<0.0001

Using dependent variables of office visits, independent ED usage, and inpatient admissions, we compared the type of sickle cell disease (SS, ST, SC), gender (female), age groups, office visits, independent ED usage and inpatient admissions. The R-squared is an overall indication of how well all variables in a multivariate model predict the outcomes. If the R-squared is 0.60, for example, then 60% of the outcome can be attributed to the variables listed.

patients with SCD, the more frequent are the acute sickle cell painful episodes.<sup>9</sup>

The utilization of the ED and inpatient hospital were highly correlated. The interesting finding is that *independent* ED and inpatient hospital use were also highly correlated. The data revealing that one-third of ED visits resulted in a hospitalization may suggest that ED visits increase the likelihood of admission, some of which may be avoidable. Benjamin et al.,<sup>10</sup> in her report on the creation of a sickle cell anemia day hospital, noted that by caring for patients with acute pain in an alternative setting to the ED, that the admission rate could be reduced significantly. The 20% highest inpatient utilizers accounted for more than half of the ED total visits, ED independent visits and sum hospital days. This skewed distribution of utilization is also evident by the large difference between the means and medians. Particularly in the ED and hospital settings, a few patients have very high utilization, thus raising the means, and the majority of patients have much lower utilization, illustrated by the lower medians.

Another important finding in this study is that patients with the most office visits per year also had a trend for the highest utilization of the ED that approached statistical significance ( $p=0.0527$ ). This finding is contrary to the prevailing perception that the ED serves as a defacto site of primary care for certain patients who choose not to utilize the outpatient office. It has been our policy that prescriptions for analgesics can only be obtained in the office from the primary care physician and not in the ED. On weekends and holidays, ED physicians may give our patients a limited amount of analgesics to hold them until they are seen by their primary care physician on the next working day. Institutions where ED physicians write prescriptions for the patients on a regular basis will, obviously, have fewer patients seen in the office on a regular basis. Nevertheless, the pattern of utilization of office versus ED needs more exploration, as it suggests that patients with the greatest biomedical and/or psychosocial needs design their pattern of utilization to meet their immediate needs.

The type of SCD also affects healthcare utilization. There were no significant differences between the groups in patterns of care, yet SS patients had a trend towards higher ED usage and hospitalizations. The patients with S- $\beta$  thalassemia had the least amount of ED visits but, interestingly, the highest LOS.

Determining the pattern of utilization of healthcare facilities has several advantages. Most importantly, it would reveal the areas where improvement is needed. It would also provide a framework basis for the calculation of cost. In our institution, we have established a sickle cell day unit in an effort to treat patients who present with acute painful episodes promptly, thus obviating the need for ED and/or hospital admissions. The sickle cell day unit opened in 2002, after the five-year study period.

Some limitations include that we did not study ED and

hospital visits to other hospitals in Philadelphia. However, this study only includes those patients who were continuously enrolled in our program for three years and is therefore unlikely to include those who regularly sought care in other health institutions in the city. The location of study is in a large urban center, which may differ from other, rural centers. A study from Alabama found that compared to patients that lived in urban areas, the patients in rural areas had significant limitations of physical functioning and were less likely to use healthcare services.<sup>11</sup> We also have no measures of comorbidity and severity of illness comparisons, no correlation with clinical parameters or medication use, and no measures of psychosocial comorbidities. However, the majority of the sickle cell patients were admitted for sickle cell crisis, and the inclusion of this additional information would not be expected to significantly change our results. A follow-up study that addresses these issues would include data from patients who attended our day program as well as more detailed information regarding patients' comorbidities, severity of illness and medication use.

In conclusion, we report the healthcare utilization of an adult sickle cell population over a period of five years. We found that one-fifth of our patients accounted for 24% of office visits and over half of the ED total visits, ED independent visits and sum hospital days. The ED was a common place for utilization, with a mean of 7.4 visits per patient year, a third of which resulted in a hospital admission. Lastly, our descriptive statistics showed that females were older and had less ED and hospital admissions.

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