Florida Medicaid

Study of Enrollees with Sickle Cell Disease

Report to the Florida Legislature
February 1, 2023

Contents

SECTION 1. PURPOSE OF THE REPORT

The 2022 Florida Legislature passed the General Appropriations Act (HB 5001), which included the following language:

> *From the funds in Specific Appropriation 189, $250,000 in nonrecurring funds from the General Revenue Fund is appropriated for the Agency for Health Care Administration to conduct a review and provide a written report, to be published on their website, that identifies the total number of Medicaid enrollees diagnosed with sickle cell disease. The agency shall develop the review and written report in consultation with the Florida Medical School Quality Network and a dedicated sickle cell disease medical treatment and research center which maintains a sickle cell patient database and tracks sickle cell disease outcome measures. The agency shall identify enrollees within the general sickle cell patient population who have experienced two or more emergency room visits or two or more hospital inpatient admissions in 12-month period. For both of those populations, the Agency shall provide detailed information including: age and population demographics, health care utilization patterns and expenditures for all pharmaceutical and medical services provided, the number of clinical treatment programs available and contracted with managed care plans for the care of Medicaid enrollees that are specifically designed or certified to provide health care coordination and health care access for individuals with sickle cell disease. The agency shall submit the report to the Governor, the President of the Senate, the Speaker of the House of Representatives, Florida Department of Health Office of Minority Health and Health Equity and Rare Disease Advisory Council by February 1, 2023.*

SECTION 2. EXECUTIVE SUMMARY

The purpose of this review and report was to document the impact of sickle cell disease (SCD) in Florida Medicaid. Sickle cell disease is a genetic condition that causes misshaped red blood cells to occlude blood vessels and chronically infarct multiple organs, including bones, brain, spleen, eyes, and kidneys. The number of people with SCD in Florida Medicaid averages 7,328 people per year. The prevalence rate of SCD in Florida Medicaid is twice as high as the national average and Florida Medicaid has one of the highest numbers of SCD patients in the US, indicating a disproportionate impact from a national perspective. The Florida Medicaid SCD population was predominately female (58%), young (median age 18 years), and Black (63%). Geographically, the highest number of Medicaid SCD patients live in Central and South Florida.

In the last four years, nearly all Medicaid SCD patients were evaluated at least once by a physician, 85% were evaluated and treated in an outpatient clinic, 61% were in an ER, and 52% hospitalized. Stroke screening with transcranial doppler ultrasound in Medicaid children and adolescents with SCD was very low. SCD-relevant medications were prescribed and filled in 77% of Medicaid SCD patients. Guideline-recommend treatments with penicillin or hydroxyurea were observed in 58% or 22%, respectively, of Florida Medicaid SCD patients indicating a gap between use and evidence-based treatments. Newer therapies with L-glutamine, voxelotor, or crizanlizumab have been used in the Florida Medicaid SCD population, albeit at low utilization. Supportive care with iron chelating agents or opioids have also been used in the Florida Medicaid SCD population, at low utilization.

Among medical services in Florida Medicaid, the highest expenditure was inpatient hospitalization, although this amount has decreased each year for the past four years. The total expenditures for Florida Medicaid recipients with SCD in Calendar Year 2021 was over $91 million, which averaged approximately $4,500 per person with SCD. In comparison, this per capita Medicaid SCD spending was

below the amount spent on Medicaid recipients with diabetes in SFY20/21, despite SCD having higher morbidity and mortality. Within the Medicaid SCD population, 54% were determined high-utilizers of acute care facilities. Their expenditures made up 70% of the total cost of care for the SCD population. There was slightly higher prevalence of high-utilizers in West Florida compared to other regions. Clinical treatment centers specializing in SCD were identified in Florida and found predominantly in Central and South Florida. In 2023, it is anticipated that new gene therapies will be FDA approved for SCD and other hemoglobinopathies such as beta-thalassemia.

SECTION 3. CONSULTATIONS

On July 26, 2021, the Agency for Health Care Administration (Agency) contracted with the Florida Medical School Quality Network (FMSQN) to conduct a review of sickle cell disease. The FMSQN included as key personnel Lanetta Bronté-Hall, MD, MPH, MSPH, President and CEO of the Foundation for Sickle Cell Research and Chief Wellbeing Officer of the Sickle Care and Research Network, which is a dedicated sickle cell disease (SCD) medical treatment and research center headquartered in Hollywood, Florida and maintains a sickle cell patient database and tracks SCD outcome measures.

SECTION 4. BACKGROUND FUNDAMENTALS OF SICKLE CELL DISEASE

Human life depends on oxygen. Oxygen is captured by red blood cells in the lungs and carried into tissues throughout the body. Within red blood cells, hemoglobin is the key protein that catches and releases oxygen. Hemoglobin is made up of four interlocking protein chains – two alpha-globin chains and two beta-globin chains – each harnessing an iron atom with electrostatic attraction for oxygen. Daily, 200 billion red blood cells are made in the bone marrow to keep up with the body's need for 23 trillion red blood cells coursing through 60,000 miles of arteries and veins.[1]

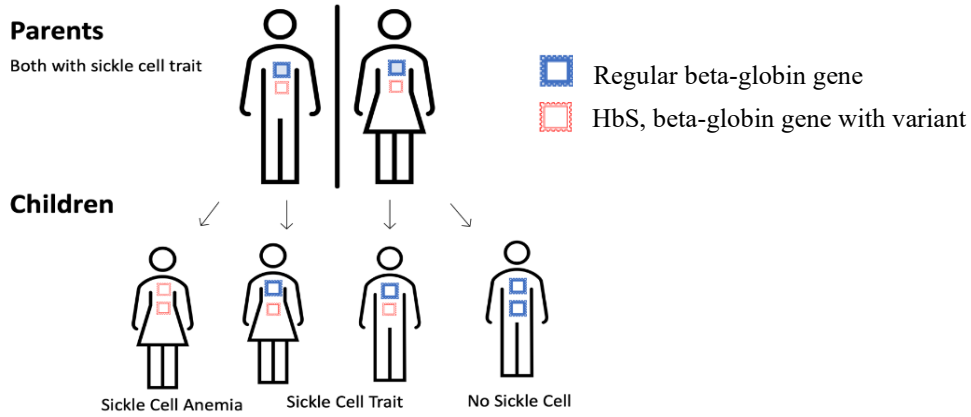
The instructions for making hemoglobin proteins are coded in hemoglobin genes – one set inherited from the mother and the other set inherited from the father. When a hemoglobin gene has a variation in spelling it is called a gene variant – historically termed a "mutation." Hundreds of hemoglobin gene variants have been found in humans, with most leading to no disease. However, when a beta-globin gene has one letter changed in the sixth word of the gene (A→T at codon 6), that misspelling leads to an altered hemoglobin protein called "HbS." If HbS is inherited from only one parent, then the person has sickle cell trait (Figure 1). People with sickle cell trait do not have sickle cell disease, may have resistance to malaria parasitic infections, [2] and have the same life expectancy as the general population.

When both parents have sickle cell trait, there is a 25% chance their child will have sickle cell disease, inhering both HbS genes (Figure 1). A child from those same parents, also has a 50% chance for inheriting sickle cell trait and a 25% chance of no sickle cell inheritance (trait or disease).

[1] 2.6x10e4 mcl of blood/pound x 180 pounds in average American x 5x10e6 red blood cells/mcl = 2.34x10e13 = 23.4x10e12 = 23.4 trillion

[2] In 1949, XXX.

Figure 1. Sickle Cell Trait and Sickle Cell Disease Inheritance.



With hundreds of hemoglobin gene variants in humans, there are a variety of inheritance patterns that lead to sickle cell disease (Table 1).

Table 1. Inherited Hemoglobin Gene Variants that Lead to Sickle Cell Disease.

Inheritance	Genetic Variants	Sickle Cell Disease Clinical Subtype
Both parents have the same gene variant.	Hemoglobin S + Hemoglobin S	Sickle Cell Anemia
Each parent has a different gene variant.	Hemoglobin S + Hemoglobin B0 thalassemia	Sickle Beta-Zero Thalassemia
	Hemoglobin S + Hemoglobin B+ thalassemia	Sickle Beta-Plus Thalassemia
	Hemoglobin S + Hemoglobin C	Sickle Cell Hemoglobin C Disease
	Hemoglobin S + (HbD, HbE, HbO)	Sickle Cell Hemoglobin D, E, or O Disease

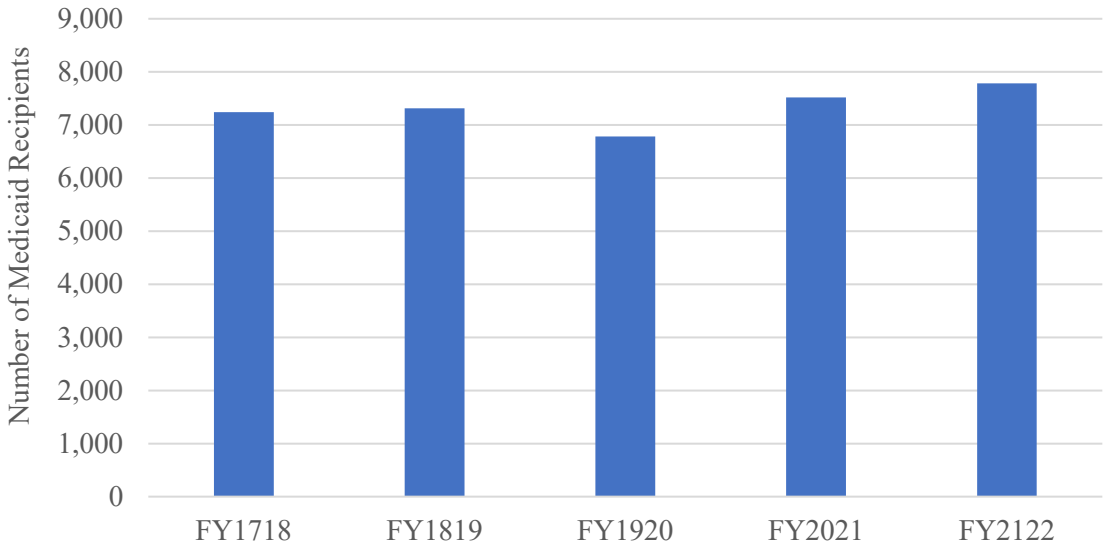
Inheriting HbS from both parents causes hemoglobin to form long fibers within red blood cells, which consequently buckle into a crescent-shaped farm tool – the sickle. These sickled cells are hard, sticky, and eventually pop. The bone marrow must work in overdrive to try to keep up with the constant shortage of red blood cells. Blood vessels clog because of the sticky sickles in episodes clinically referred to as vasco-occlusive crises. Repeated crises suffocate downstream tissues, such as bones, spleen, brain, eyes, and kidneys, causing wracking bone pain attacks, unguarded bacterial infections, stroke, blindness, and kidney failure among many other organ failures.

SECTION 5. FINDINGS

5.1 Total Number of Medicaid Enrollees Diagnosed with Sickle Cell Disease

On an annual basis, there was an average of 7,328 Medicaid recipients with sickle cell disease (Figure 2).

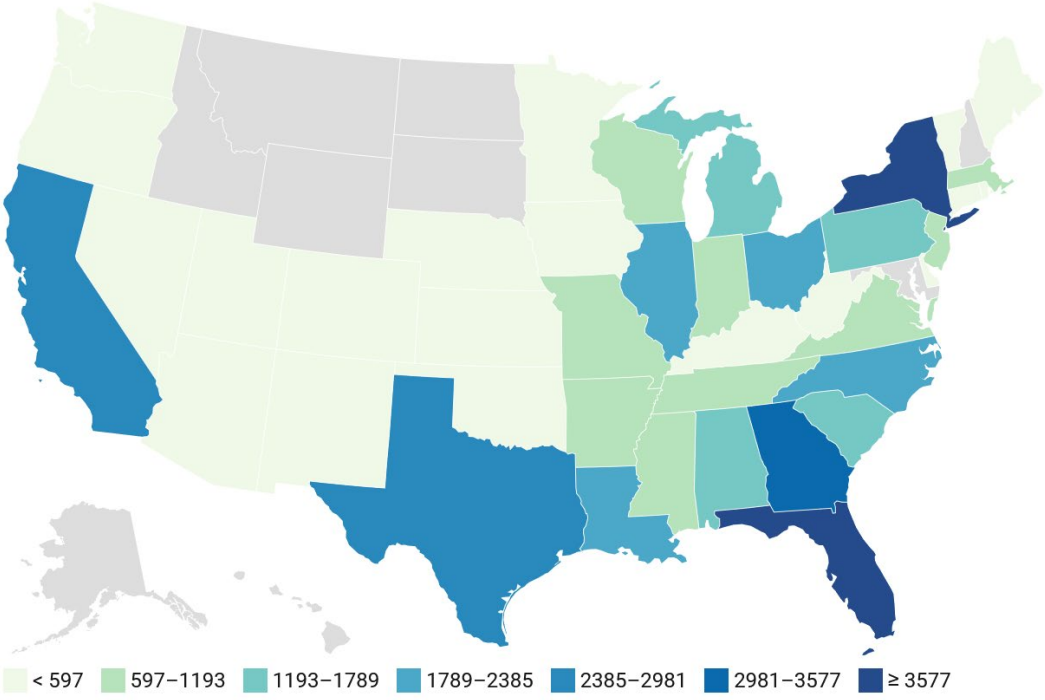
Figure 2. Sickle Cell Disease in Florida Medicaid. The number of unique Medicaid recipients with sickle cell disease are plotted with respect to fiscal year (FY).



The prevalence rate of sickle cell disease in the total Medicaid population was approximately 147 of 100,000 people. Florida's prevalence rate of SCD is twice as high as the national SCD prevalence of 74 per 100,000 Medicaid recipients and indicates a disproportionately high disease burden on the state.[3] Florida and New York also had the highest number of Medicaid recipients with SCD within the United States (Figure 3).

[3] Center for Medicaid and CHIP Services, Division of Quality and Health Outcomes. At a Glance: Medicaid and CHIP Beneficiaries with Sickle Cell Disease (SCD), T-MSIS Analytic Files (TAF) 2017. Centers for Medicare & Medicaid Services. Baltimore, MD. January 2021. https://www.medicaid.gov/medicaid/quality-of-care/downloads/scd-rpt-jan-2021.pdf

Figure 3. United States Map of Medicaid Recipients with Sickle Cell Disease. The Center for Medicare and Medicaid Services (CMS) analyzed state Medicaid data from 2017 in the transformed Medicaid statistical information system (T-MSIS). The numbers of Medicaid recipients per state are plotted in a geographic map of the United States. The number of cases is directly proportional to the darker color, such that the states with highest number of Medicaid recipients with SCD – Florida and New York – are darkest blue.



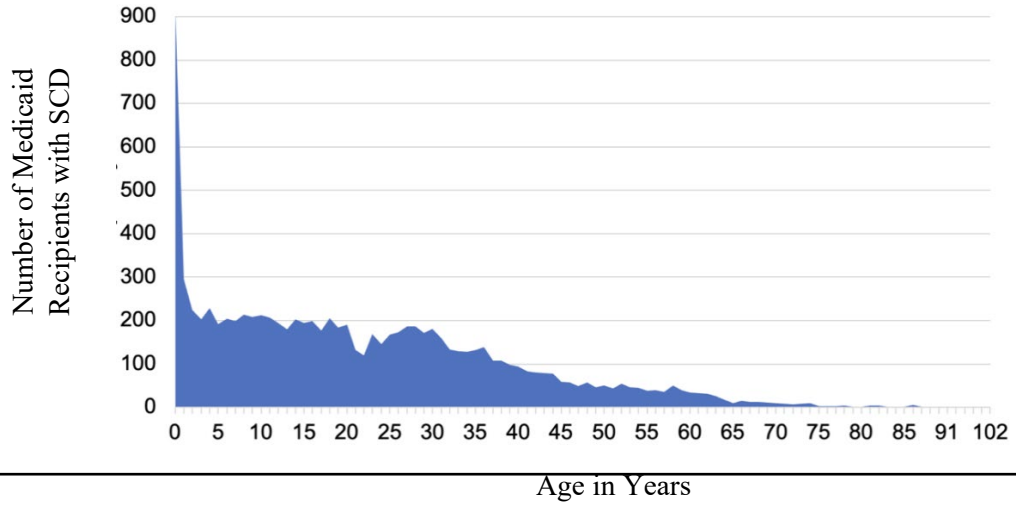
To report the details of SCD patient demographics and health care utilization, a study cohort was defined as any Medicaid recipient with continuous Medicaid enrollment for at least 12 of 12 months and a minimum of two health care encounters for sickle cell disease in calendar years 2018 through 2021 (Appendix A). Using this case finding approach, 9,206 Medicaid recipients were identified over the four-year study period.

5.2 Age and Population Demographics of People with SCD

The population of Florida Medicaid recipients with SCD were 58% female and 42% male, which is consistent with the slightly higher prevalence of females in the general Medicaid population. The age distribution of the Florida Medicaid SCD population showed skewing toward younger age (Figure 4), with the median at 18 years. This younger age distribution is consistent with the general Medicaid population demographics and a disease that is known to cause shortened lifespan because of vaso-occlusive episodes and multiple organ failure. Currently, the life expectancy of a person with SCD is approximately 20 years less than the general population at 54 years of age compared to 76 years for people without SCD.[4]

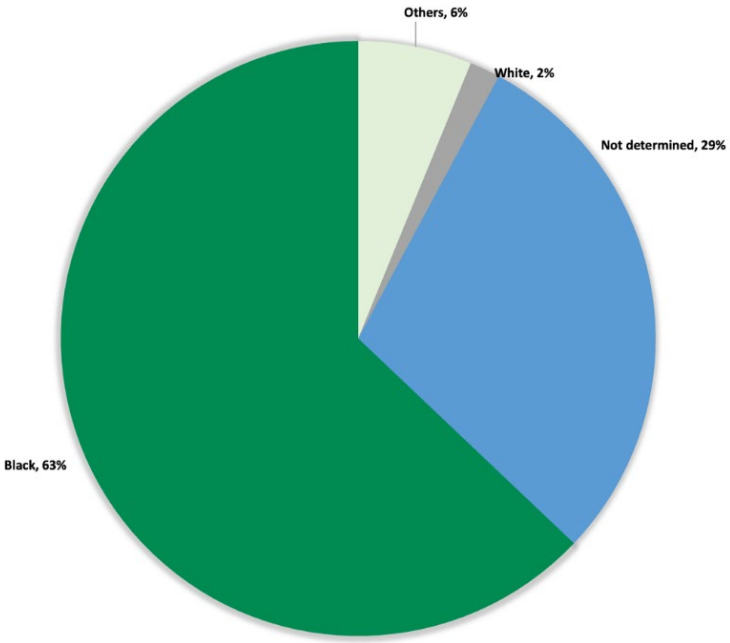
[4] Lubeck D, Agodoa I, Bhakta N, et al. Estimated life expectancy and income of patients with sickle cell disease compared with those without sickle celldisease. JAMA Netw Open. 2019;2(11):e1915374. doi:10.1001/jamanetworkopen.2019.15374

Figure 4. Age Distribution of Florida Medicaid Recipients with SCD. An age histogram of Florida Medicaid recipients with SCD during Calendar Years 2018 through 2021 show that most of the recipients in the four-year study period were in infancy, childhood, and adolescence. The histogram skews to the left indicating a younger population in part due to early death.



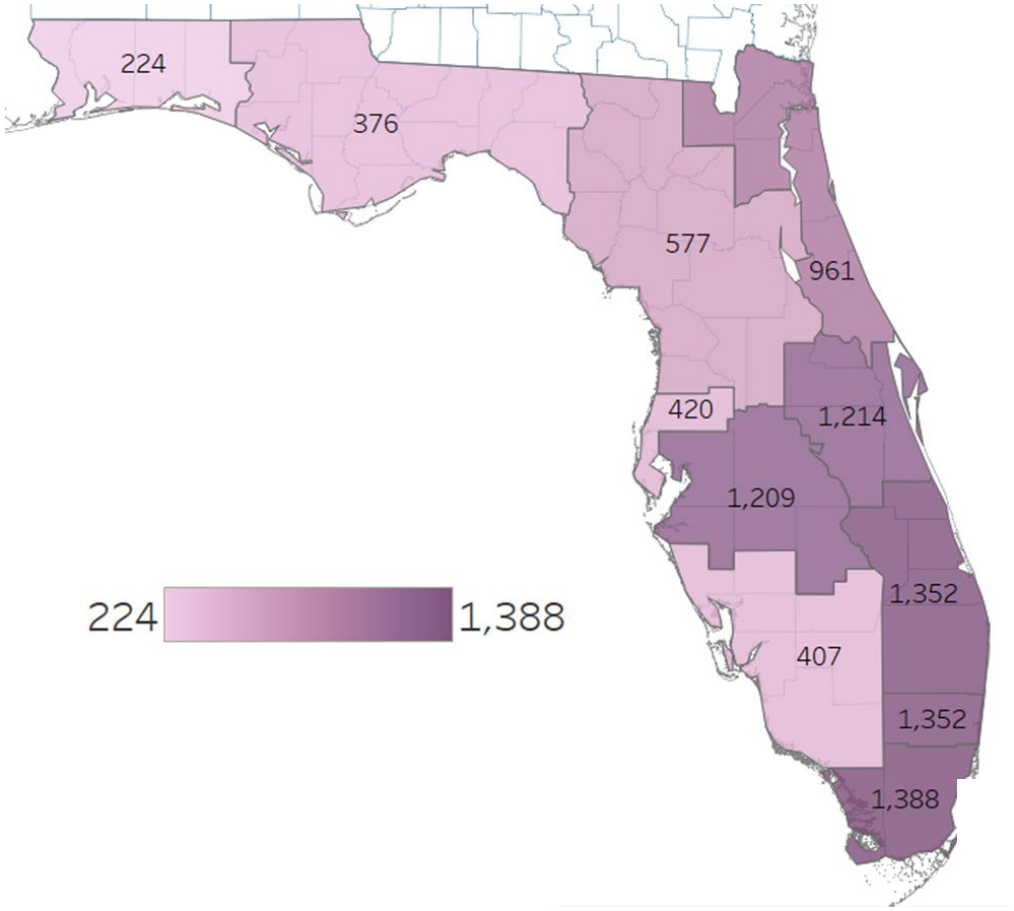
The majority of the Florida Medicaid SCD population were Black (63%) (Figure 5).

Figure 5. Florida Medicaid SCD Racial Background. The race of people with SCD who were enrolled in Florida Medicaid from 2018 through 2021.



Geographically, the highest number of Florida Medicaid recipients with SCD lived in Central Florida (AHCA Regions 6 and 7) and South Florida (AHCA Regions 10, and 11) (Figure 6). Each of these regions had over 1,000 Florida Medicaid recipients with SCD. Collectively, these 4 regions accounted for 57% of all Florida Medicaid recipients with SCD.

Figure 6. Geographic Distribution of Florida Medicaid Recipients with SCD.



5.3 Health Care Utilization Patterns of Florida Medicaid Recipients with SCD

5.3.1 Medical Services

5.3.1.1 Professional and Outpatient Clinic Utilization

Of those identified with SCD (N=9,206) from 2018 through 2021, nearly all were evaluated by a Florida physician at least once and approximately 85% were evaluated or treated in an outpatient clinic setting at least once.

5.3.1.2 ER Utilization

Of the Florida Medicaid SCD population, 61% were evaluated and treated in an ER at least once, while 39% did not seek ER care. SCD patients who visited an ER had an average of 4.5±12.9 visits (mean ±standard deviation) during the four-year study period.

5.3.1.3 Inpatient Hospital Utilization

The percent of Florida Medicaid recipients with SCD who were admitted to an inpatient hospital was 52%. The average number of inpatient admissions was 2.9±3.7 admissions (mean ±standard deviation).

5.3.1.4 Transcranial Doppler Utilization

National guidelines state that children with sickle cell anemia 2-16 years of age should have an annual transcranial Doppler ultrasound (TCD) to screen for stroke risk.[5] Of 2,906 Florida Medicaid children with sickle cell anemia, 1,068 (41%) had at least one TCD during the four-year study period. Children with sickle cell anemia had a median of two (2) TCD's, which was below the expected four TCD's in a four-year period.

5.3.2 Pharmaceutical Services

In the study population of Florida Medicaid SCD patients, 7,105 of 9,206 (77%) individuals had a pharmacy expenditure for a sickle cell disease-relevant medication, such as disease-modifying treatments, prophylactic antibiotics, opioids, or iron chelating agents. In contrast, 2,101 of 9,206 (23%) had no pharmacy expenditures for sickle cell disease-relevant medications. Utilization of medications pertinent to SCD are shown in Table 2.

Table 2. Medication Utilization in Eligible Individuals with SCD

Medication	Number of Patients Taking Medication	Number Eligible to Receive Medication	Percent Taking Medication of Eligible Population
Oral penicillin	1,197	2,054	58%
Hydroxyurea*	1,691	7,613	22%
L-glutamine	154	6,840	2%
Voxelotor	8	5,629	0.1%
Crizanlizumab	4	4,956	0.08%

*Hydroxyurea includes generic hydroxyurea, Droxia, and Siklos.

5.3.2.1 Penicillin

Oral penicillin is the standard of care for children with SCD because chronic damage to the spleen increases the risk of life-threatening pneumococcal bacterial infection. Penicillin reduces the risk by preventing bacterial infections in addition to a pneumococcal vaccine. Specifically, the National Heart, Lung, and Blood Institute (NHLBI) and the American Academy of Pediatrics recommends the use of penicillin prophylaxis in all children with SCD under the age of 5 years and in older SCD children who have had a previous severe pneumococcal infection or have functional/surgical asplenia. [6,7,8] Penicillin (i.e., penicillin VK) is on the Preferred Drug List (PDL) for Florida Medicaid. However, only 58% of the penicillin-eligible Florida Medicaid SCD population received oral penicillin (Table 2). Whereas the current rate (58%) of antibiotic prophylaxis is higher than previously reported (34%) in Florida Medicaid from 2005 through 2012, there exists a persistent gap between use and recommended care.

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[5] National Heart, Lung, and Blood Institute (NHLBI), Evidence-Based Management of Sickle Cell Disease: Expert Panel Report, 2014. https://www.nhlbi.nih.gov/sites/default/files/media/docs/sickle-cell-disease-report%20020816_0.pdf

[6] National Heart, Lung, and Blood Institute (NHLBI), Evidence-Based Management of Sickle Cell Disease: Expert Panel Report, 2014. https://www.nhlbi.nih.gov/sites/default/files/media/docs/sickle-cell-disease-report%20020816_0.pdf

[7] Sarah L. Reeves, Alison C. Tribble, Brian Madden, Gary L. Freed, Kevin J. Dombkowski; Antibiotic Prophylaxis for Children With Sickle Cell Anemia. Pediatrics March 2018; 141 (3): e20172182. 10.1542/peds.2017-2182

[8] When a person with SCD has a proven or suspected penicillin allergy, erythromycin is prescribed. Sometimes amoxicillin is prescribed instead of oral penicillin (Pen VK).

5.3.2.2 Hydroxyurea

Hydroxyurea is a standard of care for people as young as 9 months old with SCD because of strong track-record of evidence showing hydroxyurea as safe and effective in people with SCD.[9] The FDA initially approved the use of hydroxyurea for adults with SCD in 1998 and added pediatric SCD approval in 2017. Hydroxyurea is on the PDL for Florida Medicaid. However, only 22% of Florida Medicaid recipients with SCD received hydroxyurea from 2018 through 2021 (Table 2).

Although most people with SCD who take hydroxyurea have few or no side effects, major barriers to its use include fear of side effects, doubts about efficacy, lack of awareness of data, and high cost. A prior study showed that hematologists and SCD specialists were more aware of latest SCD care guidelines and more confident in managing care with hydroxyurea compared to non-hematology specialized physicians.[10] Recommendations have been made by health services researchers to invest more resources into updating physicians about the effectiveness of hydroxyurea in SCD as well as providing management guidelines to optimize its use.[11]

5.3.2.3 L-Glutamine

In SCD, the sickled red cells are under stress. To relieve the stress, the sickled cells need higher levels of the essential amino acid, L-glutamine. Oral L-glutamine has been shown in randomized clinical trials to reduce the number of pain crises and hospitalizations.[12,13] L-glutamine was approved by the FDA in 2017 for adults and children 5 years and older with SCD. L-glutamine is on the preferred drug list (PDL) for Florida Medicaid. Among eligible SCD patients in Florida Medicaid, only 2% received L-glutamine. Reasons for low usage among people with SCD may be related to physician and patient awareness of recent data and approval.

5.3.2.4 Voxelotor

Voxelotor is an oral medication that binds reversibly to oxygenated hemoglobin, thereby inhibiting HbS from forming long fibers within red blood cells and preventing sickling of red blood cells. Clinically, voxelotor was effective in reducing the destruction of red blood cells, reducing the number of pain crises, reducing hospitalizations, reducing blood transfusions, and reducing opioid use in people with severe forms of SCD aged 4 years and older. This medication was approved by the FDA in 2019 and is

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[9] Charache, S., Terrin, M. L., Moore, R. D., Dover, G. J., Barton, F. B., Eckert, S. V., McMahon, R. P., and Bonds, D. R. (1995). Effect of hydroxyurea on the frequency of painful crises in sickle cell anemia, The New England Journal of Medicine, 332(20), 1317-1322. http://doi.org/10.1056/NEJM199505183322001

[10] Smeltzer MP, Howell KE, Treadwell M, Preiss L, King AA, Glassberg JA, Tanabe P, Badawy SM, DiMartino L, Gibson R, Kanter J, Klesges LM, Hankins JS; Sickle Cell Disease Implementation Consortium. Identifying barriers to evidence-based care for sickle cell disease: results from the Sickle Cell Disease Implementation Consortium cross-sectional survey of healthcare providers in the USA. BMJ Open. 2021 Nov 17;11(11):e050880. doi: 10.1136/bmjopen-2021-050880.

[11] Zumberg MS, Reddy S, Boyette RL, Schwartz RJ, Konrad TR, Lottenberg R. Hydroxyurea therapy for sickle cell disease in community-based practices: a survey of Florida and North Carolina hematologists/oncologists. Am J Hematol. 2005 Jun;79(2):107-13. doi: 10.1002/ajh.20353.

[12] Niihara Y, Mh Eckman JR, Koh H, Cooper ML, Ziegler TR, Razon R, Tanaka KR, Stark CW, Johnson CS. L-Glutamine therapy reduces hospitalization for sickle cell anemia and sickle β°-thalassemia patients at six months – a phase II randomized trial. Clin Pharmacol Biopharm 2014; 3:116

[13] Niihara Y, Miller ST, Kanter J, Lanzkron S, Smith WR, Hsu LL, Gordeuk VR, Viswanathan K, Sarnaik S, Osunkwo I, Guillaume E, Sadanandan S, Sieger L, Lasky JL, Panosyan EH, Blake OA, New TN, Bellevue R, Tran LT, Razon RL, Stark CW, Neumayr LD, Vichinsky EP. Disease IotPTol-GiSC. A phase 3 trial of l-Glutamine in sickle cell disease. N Engl J Med 2018; 379:226–35

considered an added therapy to hydroxyurea or alterative if hydroxyurea is ineffective, not tolerated, or preferred by patients or parents. Voxelotor is currently not on the PDL for Florida Medicaid. However, Florida Medicaid managed care plans can pay for this this medication for their SCD patients. In Florida Medicaid, only 8 of 5,629 eligible SCD patients (0.1%) received voxelotor in the four-year study period.

5.3.2.5 Crizanlizumab

Crizanlizumab is an injected antibody that interferes with sickled red blood cells adhering to inflamed blood vessels and platelets, thereby decreasing acute blockages in blood vessels. Crizanlizumab was approved by the FDA in 2019 as a treatment option for people aged 16 years or older with SCD who have acute vaso-occlusive pain episodes that are unresponsive to hydroxyurea, L-glutamine or both. Currently, crizanlizumab is not on the Florida Medicaid PDL. However, Florida Medicaid managed care plans can pay for this this medication for their SCD patients. In Florida Medicaid, only 4 of 4,956 eligible SCD patients (0.08%) received crizanlizumab in the four-year study period.

5.3.2.6 Opioids

Acute vaso-occlusive episodes from sickled red blood cells cause recurrent, sharp, and stabbing pain attacks within the bones and organs of patients with SCD. Opioids are often required in the acute setting to palliate the pain. Oral opioids were used in 0.02% to 8% of Florida Medicaid SCD patients (Appendix B).

5.3.2.7 Iron Chelating Agents

Iron chelating agents are sometimes needed in SCD patients because of high rates of red blood cell destruction and blood transfusions. Iron chelating agents were used in 0% to 1.85% of Florida Medicaid SCD patients (Appendix B).

5.4 Expenditures for Florida Medicaid Recipients with SCD

5.4.1 Expenditures for Medical Services

During the 2018-2021 study period, the average (mean) yearly expenditure for professional/physician services ranged from $3,955.18 to $4,499.75 per SCD individual and increased incrementally across the four years (Appendix C). The average outpatient expenditure ranged from $2,062.99 to $2,242.01 per SCD individual and was stable (Appendix C). The average ER expenditures ranged from $888.28 to $968.82 per SCD individual and was stable (Appendix C). The average inpatient hospitalization expenditures ranged from $13,913.36 to $15,047.53 and decreased incrementally across the four years (Appendix C).

5.4.2 Expenditures for Pharmaceutical Services

In the four-year study period (2018-2021) of Florida Medicaid SCD patients, combined pharmaceutical expenses at the claim level ranged from $197.48 to $279.90 and increased incrementally by year (Table 3). At the SCD patient level, the total pharmacy expenditure ranged from $4,378.26 to $6,232.30 and also increased incrementally by year (Table 4). The median costs were lower than the average costs, which is indicative of a subset of SCD patients having larger expenses because of case-specific features, such as higher number of painful vaso-occlusive episodes requiring hospitalizations.

Table 3. Combined expenses of pharmaceutical claims per calendar year 2018-2021								
Year	N claims	Cost ($)	Mean cost/claim	SD	Lower-Upper 95% CI quartiles for mean	Median	Lower- Upper quartile median	Range
2018	126,242	$24,929,829.20	$197.48	$1,336.88	$190.10-$204.85	$7.82	$2.77-$20.71	0-$51,505.61
2019	126,138	$29,479,603.77	$233.71	$1,533.05	$225.25-$242.17	$6.74	$2.45-$19.92	0-$53,349.37
2020	131,451	$32,381,577.25	$246.34	$1,593.18	$237.73-$254.95	$6.43	$2.56-$18.64	0-$1,382,259.87
2021	130,481	$36,415,347.99	$279.09	$1,769.50	$269.48-$288.69	$7.02	$2.67-$21.65	0-$1,374,416.82

N, number; CI, confidence interval; SD, standard deviation

Table 4. Combined expenses, pharmaceuticals per calendar year 2018-2021 at patient level								
Year	N Patient	Cost ($)	Mean cost/pt	SD	Lower-Upper 95%CI for mean	Median	Lower-Upper quartile median	Range
2018	5,694	$24,929,829.20	$4,378.26	$17,461.41	$3,924.62-$4,831.90	$187.38	$44.75-$901.65	0-$273.422.36
2019	5,623	$29,479,603.77	$5,242.68	$21,731.90	$4,674.54-$5,810.82	$194.66	$43.11-$983.09	0-$549,170.41
2020	5,467	$32,381,577.25	$5,923.10	$22,723.17	$5,320.62-$6,525.57	$187.35	$41.07-$1,253.40	0-$619,644.18
2021	5,483	$36,415,347.99	$6,232.30	$24,659.75	$5,599.88-$6,864.73	$193.76	$46.84-$1,315.65	0-$772,907.70

5.4.2.1 Expenditures for SCD-Relevant Pharmaceuticals

The expenditure for oral antibiotic prophylaxis is estimated at an average (mean) cost per claim of $9.23 per person who received treatment (Appendix B). The expenditure for hydroxyurea is estimated at an average (mean) cost per claim of $32.86 per person who received treatment (Appendix B). The expenditure for L-glutamine is estimated at an average (mean) cost per claim of $2,270.13 per person who received treatment (Appendix B). The expenditure for voxelotor is estimated at an average (mean) cost per claim of $10,223.90 per person who received treatment (Appendix B). The expenditure for crizanlizumab is estimated at an average (mean) cost per claim of $8,924.31 per person who received treatment (Appendix B). The expenditure for opioids is estimated at an average (mean) cost per claim of $4.39 to $483.25 per person who received treatment (Appendix B). The expenditure for iron chelating agents is estimated at an average (mean) cost per claim of $56.10 to $10,090.04 per person who received treatment (Appendix B).

5.4.3 Total Expenditures for Pharmaceutical and Medical services

The total expenditures for 7,464 Florida Medicaid recipients with SCD in Calendar Year 2021 was $91,013,570.49. The average cost was $4,483.43±15,399.15 (mean ±standard deviation) per person. The median cost was $819.63 per person. Given that the average cost was higher than the median cost, this indicates that some individuals had higher costs of care likely rooted in specific case features. Although

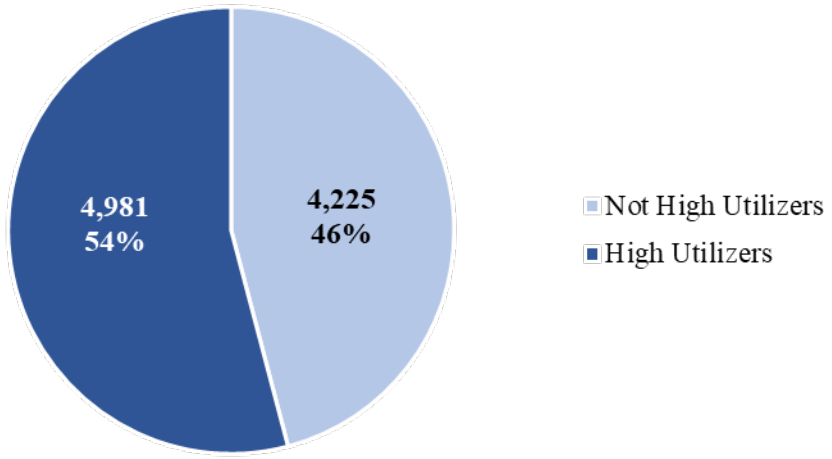
SCD has higher morbidity and mortality than diabetes, the per person expenditure for SCD was less than diabetes expenditures ($5,180 per person with diabetes).[14]

5.5 High-utilizers of Health Care Services

High-utilizers of health care services were defined as Florida Medicaid enrollees with SCD who had two or more emergency room (ER) visits or two or more inpatient admissions in a 12-month period. The nature of SCD leads to increased need for health care compared to people without SCD. In a prior publication, Medicaid recipients with SCD compared to Medicaid recipients without SCD had 2.8-times more outpatient health care visits, 5-times more ER visits, and 9-times the number of days admitted in a hospital.[15]

Of the Florida Medicaid SCD population enrolled between 2018 and 2021 (N=9,206), 4,981 people (54%) had two or more emergency room visits or two or more inpatient admissions in a 12-month period while 4,225 (46%) did not (Figure 7).

Figure 7. Florida Medicaid SCD Recipients Separated by Extent of Health Care Utilization. High-utilization of health care was defined as two or more emergency room visits or two or more inpatient admissions in a 12-month period. A little over half of the SCD population met definition for high-utilizers of acute health care



5.5.1 High Utilizer Age and Demographics

The population of SCD patients with high utilization of health care services was 57% female and 43% male, with a median age of 19 years. Their racial background of the high utilizer population was 59% Black and 4% Hispanic ethnicity. In comparison, the age and demographics of high-utilizers was similar to all SCD patients and low utilizers.

[14] Florida Diabetes Advisory Council 2023 Legislative Report
[15] Center for Medicaid and CHIP Services, Division of Quality and Health Outcomes. At a Glance: Medicaid and CHIP Beneficiaries with Sickle Cell Disease (SCD), T-MSIS Analytic Files (TAF) 2017. Centers for Medicare & Medicaid Services. Baltimore, MD. January 2021. https://www.medicaid.gov/medicaid/quality-of-care/downloads/scd-rpt-jan-2021.pdf

The geographic distribution of high utilizer SCD patients was predominantly in Central Florida (AHCA Regions 6 and 7) and South Florida (AHCA Regions 10 and 11). However, the percentage of high-utilizers among the SCD population was higher in West Florida (AHCA Region 1) with 61% of SCD patients as high-utilizers compared to the other regions of the state which had 49-56% of SCD patients as high-utilizers (Table 5). Together, these data indicate that SCD patients in West Florida and North Florida are more dependent on acute care facilities, which may reflect a lack of access to or utilization of outpatient and preventative care services in those geographies.

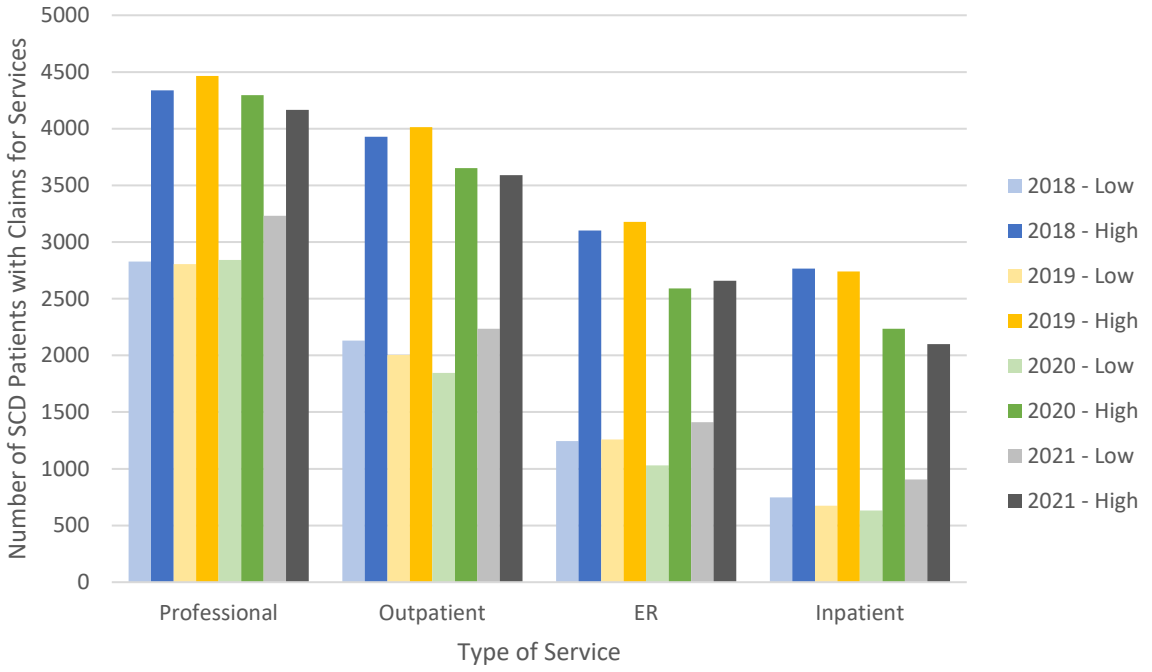
Table 5. Percent of High Utilizers in each AHCA Region

AHCA Region with Counties	N High Utilizers	N Total	Percent High Utilizers
1 Escambia, Okaloosa, Santa Rosa and Walton	137	224	61%
2 Bay, Calhoun, Franklin, Gadsden, Gulf, Holmes, Jackson, Jefferson, Leon, Liberty, Madison, Taylor, Wakulla, and Washington	196	376	52%
3 Alachua, Bradford, Citrus, Columbia, Dixie, Gilchrist, Hamilton, Hernando, Lafayette, Lake, Levy, Marion, Putnam, Sumter, Suwannee, and Union	336	577	58%
4 Baker, Clay, Duval, Flagler, Nassau, St. Johns, and Volusia	541	961	56%
5 Pasco and Pinellas	261	420	56%
6 Hardee, Highlands, Hillsborough, Manatee, and Polk	678	1,209	56%
7 Brevard, Orange, Osceola, and Seminole	656	1,214	54%
8 Charlotte, Collier, DeSoto, Glades, Hendry, Lee, and Sarasota	202	407	50%
9 Indian River, Martin, Okeechobee, Palm Beach, and St. Lucie	486	985	49%
10 Broward	739	1,352	55%
11 Miami-Dade and Monroe	708	1,388	51%

5.5.2 High Utilizer Health Care Utilization Pattern

When comparing the high-utilizer population to the low-utilizer population, there were consistent and incremental increases in professional/physician services, outpatient visits, ER visits, and inpatient hospitalizations from 2018 through 2021 (Figure 8). Overall, the number of patients with claims decreased from 2018 through 2021 in both low utilizers and high-utilizers. It is possible that COVID-19 was a factor in decreasing claims over the four-year study period of 2018 to 2021. Across the years, the difference between low and high-utilizers has been stable. The number of claims for professional fees was highest, followed by the number of outpatient visits, then ER visits and inpatient hospitalizations.

Figure 8. Number of Patients with Medical Services Over Time Separated by Low versus High-utilizers with SCD. Among four categories of services (professional, outpatient, ER, inpatient hospitalization) the numbers of patients with claims are plotted for Low versus High-utilizers of health care services.



5.5.3 High Utilizer Medical Service Expenditures

Expenditures were highest for inpatient hospitalizations followed by professional fees then outpatient visits and ER visits (Appendix D). Average (mean) expenditure for inpatient hospitalizations in 2021 for high-utilizers with SCD was $15,059.12±25,841.59 (mean ±standard deviation) per claim compared to $11,254.72±36,457.58 (mean ±standard deviation) per claim for low-utilizers. This level of spending was stable from 2018 to 2021.

5.5.4 High Utilizer Pharmaceutical Expenditures

Generally, the percent of high-utilizers on SCD-relevant medications was higher than the general SCD population. For oral penicillin, 70% of high-utilizers received treatment in comparison to 58% of the general SCD population. For hydroxyurea, 32% of high-utilizers received treatment compared with 22% of the general SCD population. For L-glutamine, 4% of high-utilizers received treatment compared with 2%. There were similar rates of treatment with voxelotor or crizanlizumab in the high-utilizer versus general SCD populations. It is more likely that high-utilizers were evaluated and treated by hematology or SCD specialists during ER visits and inpatient hospitalization compared to low-utilizers. When encountering a hematology or SCD specialist, it was more likely that medical optimization was performed with SCD-relevant medications and procedures.

Pharmaceutical expenditures in high- versus low-utilizers was higher, averaging $7,939.84 per high-utilizer compared with an average of $3,728.29 per low-utilizer in 2021. The average pharmaceutical expenditure increased incrementally in both utilizer categories from 2018 through 2021 (Appendix E).

5.5.5 Total Expenditures for Pharmaceutical and Medical Services in High-Utilizer SCD Population

The total expenditures for high-utilizers in Calendar Year 2021 was $63,527,205.19. It is noted that 54% of the SCD population (the high-utilizer population) was responsible for 70% of the total SCD population cost. This 1.3-fold higher spending rate is related to a combination of factors, including increased disease severity driven partly by genetics, variable access to hematology or SCD specialists, variable access to guideline-recommended medications (i.e., hydroxyurea, penicillin), and increased risk for conditions that incite vaso-occlusive episodes such as dehydration or lack of continuous medication availability.

5.6 Clinical Treatment Programs

Clinical treatment programs were identified by the FMSQN as available and contracted with managed care plans for the care of Medicaid enrollees that are specifically designed or certified to provide health care coordination and health care access for individuals with sickle cell disease (Table 6).

Table 6. List of Clinical Treatment Programs for SCD by Managed Care Plan.

Medicaid Managed Care Plan	Clinical Treatment Programs Contracted
Aetna Better Health Florida	• Foundation for Sickle Cell Disease Research (FSCDR)
AmeriHealth	• Foundation for Sickle Cell Disease Research (FSCDR) • University of Miami Pediatric Sickle Cell Clinic at Alexander Daly Family Clinic for Childhood Cancer & Blood Disorders • University of Miami Sylvester Comprehensive Cancer Center • Jackson Memorial Hospital • Memorial Regional Sickle Cell Day Clinic • Broward Health Sickle Cell Care • Shands Hospital at the University of Florida • Shands Jacksonville C.B. McIntosh Comprehensive Adult Sickle Cell Service Center • University of South Florida Comprehensive Sickle Cell Center (pediatrics) • Johns Hopkins All Children's Cancer and Blood Disorders Institute • Arnold Palmer Hospital Sickle Cell Disease Program • Nemours Children's Center for Cancer and Blood Disorders
Children's Medical Services – Sunshine	• Foundation for Sickle Cell Disease Research (FSCDR)
Community Care Plan	• Foundation for Sickle Cell Disease Research (FSCDR) • Memorial Health Care System • Broward Health Sickle Cell Care • Nicklaus Children's Hospital Sickle Cell/Hemoglobinopathies Care Program
Florida Community Care	• Foundation for Sickle Cell Disease Research (FSCDR)

	• Jackson Memorial Hospital • Memorial Healthcare System
Humana Healthy Horizons	• Foundation for Sickle Cell Disease Research (FSCDR) • University of Miami Pediatric Sickle Cell Clinic at Alexander Daly Family Clinic for Childhood Cancer & Blood Disorders • University of Miami Sylvester Comprehensive Cancer Center • Jackson Memorial Hospital • Memorial Regional Sickle Cell Day Clinic • Broward Health Sickle Cell Care • Shands Hospital at the University of Florida • Shands Jacksonville C.B. McIntosh Comprehensive Adult Sickle Cell Service Center • University of South Florida Comprehensive Sickle Cell Center (pediatrics)
Molina HealthCare of Florida	• University of Miami Pediatric Sickle Cell Clinic at Alexander Daly Family Clinic for Childhood Cancer & Blood Disorders • University of Miami Sylvester Comprehensive Cancer Center • Jackson Memorial Hospital • Nicklaus Children's Hospital Sickle Cell/Hemoglobinopathies Care Program • Memorial Regional Hospital Sickle Cell Day Center • Shands Hospital CB McIntosh Sickle Cell Center • University of South Florida Comprehensive Sickle Cell Center
Simply and Clear Health Alliance	• Foundation for Sickle Cell Disease Research (FSCDR) • Memorial Health Care System • University of Miami Pediatric Sickle Cell Clinic at Alexander Daly Family Clinic for Childhood Cancer & Blood Disorders • University of Miami Sylvester Comprehensive Cancer Center • Jackson Memorial Hospital • Memorial Regional Sickle Cell Day Clinic • Broward Health Sickle Cell Care • Shands Hospital at the University of Florida • Shands Jacksonville C.B. McIntosh Comprehensive Adult Sickle Cell Service Center • University of South Florida Comprehensive Sickle Cell Center • University of Miami

Sunshine Health	• Foundation for Sickle Cell Disease Research (FSCDR)
United Healthcare	• Shands Jacksonville Medical Center • Wolfson Children's Hospital • Shands at the University of Florida • AdventHealth Waterman • Baptist Medical Center • AdventHealth Ocala • Jackson Memorial Hospital • Halifax Health • Johns Hopkins All Children's Hospital • HCA Florida Memorial Hospital • HCA Florida North Florida Hospital • Winter Haven Hospital • Lakeland Regional Medical Center • AdventHealth Orlando • HCA Florida Orange Park Hospital • South Florida Baptist Hospital • Ascension St. Vincent's Riverside • Orlando Health Orlando Regional Medical Center • Memorial Hospital Miramar • Flagler Hospital • Nicklaus Children's Hospital • Nemours Children's Hospital • AdventHealth Altamonte Springs

In addition to these clinical treatment programs, hematopoietic cell transplant programs at the University of Miami, H. Lee Moffitt Cancer Center, the University of Florida, and others in Florida have transplanted autologous or allogeneic adult blood stem cells to patients with SCD to introduce a new blood system free of sickle shaped red blood cells. In 2023, these transplant centers may also offer new FDA approved gene therapies for people with SCD. In brief, autologous blood stem cells are collected from patients with SCD, treated in a laboratory to express regular hemoglobin or fetal hemoglobin, and then transplanted back into the patient who received a myeloablative conditioning regimen. Early data from these gene therapies show elimination of painful vaso-occlusive episodes, decreased hospitalizations, and elimination of need for blood transfusions.[16,17] Given that these benefits appear to be durable over years in follow-up, these therapies are considered potentially curative. These treatments are estimated to cost $1 million to $2 million per person and only available at a limited number of transplant centers.

[16] Kanter J, Walters MC, Krishnamurti L, Mapara MY, Kwiatkowski JL, Rifkin-Zenenberg S, Aygun B, Kasow KA, Pierciey FJ Jr, Bonner M, Miller A, Zhang X, Lynch J, Kim D, Ribeil JA, Asmal M, Goyal S, Thompson AA, Tisdale JF. Biologic and Clinical Efficacy of LentiGlobin for Sickle Cell Disease. N Engl J Med. 2022 Feb 17;386(7):617-628. doi: 10.1056/NEJMoa2117175.

[17] Frangoul H, Altshuler D, Cappellini MD, Chen YS, Domm J, Eustace BK, Foell J, de la Fuente J, Grupp S, Handgretinger R, Ho TW, Kattamis A, Kernytsky A, Lekstrom-Himes J, Li AM, Locatelli F, Mapara MY, de Montalembert M, Rondelli D, Sharma A, Sheth S, Soni S, Steinberg MH, Wall D, Yen A, Corbacioglu S. CRISPR-Cas9 Gene Editing for Sickle Cell Disease and β-Thalassemia. N Engl J Med. 2021 Jan 21;384(3):252-260. doi: 10.1056/NEJMoa2031054. Epub 2020 Dec 5.

APPENDIX A – METHODS

Cases of sickle cell disease were identified using a claim-based approach. An abstract of the Florida Medicaid Management Information System (MMIS) was queried for recipients that had two or more encounters with a sickle cell disease-related claim in Calendar Years 2018 through 2021 (Table 7). To be counted, recipients had to be enrolled in Medicaid 12 of 12 months per year.

Table 7. ICD-10 Codes Used for Finding Cases of Sickle Cell Disease

ICD-10 Code	Diagnosis Description
D57.0	Hb-SS with crisis
D57.00	Hb-SS with crisis
D57.01	Hb-SS with acute chest syndrome
D57.02	Hb-SS with splenic sequestration
D57.03	Hb-SS with cerebral vascular involvement
D57.09	Hb-SS disease with crisis with other specified complication
D57.1	Sickle-cell disease without crisis
D57.2	Sickle-cell/Hb C disease
D57.20	Sickle-cell/Hb C disease without crisis
D57.21	Sickle-cell/Hb C disease with crisis
D57.4	Sickle-cell thalassemia
D57.41	Sickle-cell thalassemia, unspecific, with crisis
D57.42	Sickle-cell thalassemia beta zero without crisis
D57.43	Sickle-cell thalassemia beta zero with crisis
D57.44	Sickle-cell thalassemia beta plus
D57.45	Sickle-cell thalassemia beta plus with crisis
D57.8	Other sickle-cell disorders
D57.80	Other sickle-cell disorders without crisis
D57.81	Other sickle-cell disorders with crisis

APPENDIX B – Pharmaceutical Utilization and Expenditures

Table 8. SCD-Related Pharmaceuticals with Expenditures, 2018-2021							
Medication category		Medication	N Claims	N Patients	% medication utilization from patient total	Total Cost	Mean cost ($) per claim
Oral antibiotic prophylaxis		Penicillin formulationsLiquidTablet	12,996 95.7 %4.3%	1,402	15.23%	$119,970.39	$9.23
Disease-modifying therapies	Hydroxyurea	Hydroxyurea	7,776	1,504	16.73%	$255,548.52	$32.86
		Droxia	1,259	243	2.64%	$52,614.97	$41.79
		Siklos	55	23	0.25%	$62,607.92	$1,138.33
	Oxbryta (voxelotor)	Voxelotor	40	9	0.10%	$408,956.11	$10,223.90
	Adakveo (crizanlizumab)	Crizanlizumab	29	4	0.04%	$258,805.04	$8,924.31
	Endari (L-glutamine)	L-glutamine	465	158	1.72%	$1,055,611.01	$2,270.13
Oral opioids		Oxycodone	465	82	0.89%	$196,296.72	$422.14
		Oxycontin (extended release oxycodone)	43	17	0.18%	$8,704.70	$202.43
		Oxycodone/acetaminophen	3,049	752	8.17%	$63,825.45	$20.93
		Hydrocodone	4	2	0.02%	$1,269.96	$317.49
		Hydrocodone/acetaminophen	1,288	503	5.45%	$12,028.11	$9.34
		Morphine	616	225	2.44%	$12,949.30	$21.02
		Acetaminophen with codeine	294	171	1.86%	$1,291.33	$4.39
		Buprenorphine	13	4	0.04%	$6,282.20	$483.25
		Methadone	217	33	0.36%	$2,570.84	$11.85
Iron chelators		Exjade (deferasirox dispersable tablet)	584	124	1.35%	$5,322,115.16	$9,113.21
		Jadenu (deferasirox tablet)	914	170	1.85%	$9,222,292.95	$10,090.04
		Jadenu (deferasirox sprinkle)	77	20	0.22%	$331,896.01	$4,310.34
		Deferiprone	0	0	0%	--	--
		Deferoxamine	179	11	1.85%	$10,057.88	$56.19

APPENDIX C – MEDICAL SERVICES UTILIZATION AND EXPENDITURES

Table 9. Expenditures per Claim Type for all SCD Beneficiaries in Dollar Amounts per Calendar Year 2018-2021								
Year	**Claim Type**	**N**	**Sum Expenditures**	**Mean ± SD**	**Lower-upper 95% CI for mean**	**Median**	**Lower and upper quartile**	**Range**
2018	Inpatient	3,514	$52,877,034.72	$15,047.53±27,403.55	$14,141.17-15,953.9	$6,510.93	$2,680-15,787.23	$0-455,219.31
	ED	4,347	$3,954,632.47	$909.74±2,750.46	$827.95-991.52	$359.96	$162.23-764.79	$0-59,020.44
	Outpatient	6,058	$13,582,113.85	$2,242.01±6,616.59	$2,075.36-2,408.66	$573.38	$145.82-1,743.09	$0-153,965.1
	Professional	7,167	$28,346,758.12	$3,955.18±11,536.57	$3,688.04-4,222.31	$1,243.80	$412.72-3,491.53	$0-348,153.9
2019	Inpatient	3,414	$49,319,995.15	$14,446.4±27,422.27	$13,526.21-15,366.58	$6,525.98	$2,728-15,393	$0-761,957.07
	ED	4,437	$3,941,307.28	$888.28±3,201.58	$794.05-982.51	$357.30	$169.65-783.57	$0-95,119.77
	Outpatient	6,015	$12,499,415.75	$2,078.04±5,840.02	$1,930.43-2,225.66	$560.36	$142.31-1,632.47	$0-183,836.45
	Professional	7,271	$29,193,043.84	$4,015±11,952.44	$3,740.22-4,289.77	$1,207.86	$389.04-3,325.78	$0-282,315.97
2020	Inpatient	2,867	$41,348,508.49	$14,422.22±27,957.68	$13,398.41-15,446.03	$6,106.69	$2,552.61-15,098.63	$0-430,296.2
	ED	3,623	$3,510,026.54	$968.82±3,712.82	$847.88-1,089.76	$357.53	$179.73-766.67	$0-85,409.81
	Outpatient	5,496	$11,651,524.46	$2,120±6,258.51	$1,954.5-2,285.5	$495.67	$133.34-1,505.15	$0-153,269.19
	Professional	7,138	$29,094,088.99	$4,075.94±12,850.39	3,777.78-4,374.1	$1,072.45	$342.26-3,266.71	$0-316,483.72
2021	Inpatient	3,005	$41,809,661.08	$13,913.36±29,489.65	$12,858.56-14,968.17	$6,133.88	$2,715.04-15,173.98	$0-902,990.02
	ED	4,071	$3,895,827.80	$956.97±4,627.03	$814.79-1,099.15	$373.35	$190.11-762.79	$0-164,205.03
	Outpatient	5,826	$12,018,956.61	$2,062.99±6,668.73	$1,891.71-2,234.26	$479.65	$122.54-1,439.1	$0-280,905.89
	Professional	7,398	$33,289,125.00	$4,499.75±14,254.59	$4,174.87-4,824.62	$1,252.40	$423.33-3,691.61	$0-390,690.03
N = sample at the patient level; CI = confidence interval; SD = standard deviation								

APPENDIX D – EXPENDITURES FOR MEDICAL SERVICES IN HIGH-UTILIZERS AND LOW UTILIZERS WITH SCD

Table 10. Expenditures per Claim Type for all SCD Beneficiaries in Dollar Amounts per Calendar Year 2018-2021 by High vs Low Utilization

Year	Utilization	Claim Type	N	Sum Expenditures	Mean ± SD	Lower-upper 95% CI for mean	Median	Lower and upper quartile	Range
2018	Low Utilization	Inpatient	749	$7,957,176.35	$10,623.73±28,895.01	$8,551.05-12,696.42	$3,172.52	$1,340-7,444.35	$0-358,812.77
		ED	1,244	$555,506.09	$446.55±1,104.86	$385.09-508	$224.45	$115.86-485.72	$0-30,358.84
		Outpatient	2,130	$3,417,663.00	$1,604.54±6,323.18	$1,335.85-1,873.22	$304.24	$75.01-1,000.2	$0-153,965.1
		Professional	2,828	$8,901,635.94	$3,147.68±14,160.48	$2,625.56-3,669.8	$633.99	$222.2-1,811.27	$0-348,153.9
	High Utilization	Inpatient	2,765	$44,919,858.37	$16,245.88±26,865.65	$15,244.06-17,247.7	$7,715.85	$3,330.13-17,909.37	$0-455,219.31
		ED	3,103	$3,399,126.38	$1,095.43±3,160.57	$984.18-1,206.68	$432.16	$206.29-922.01	$0-59,020.44
		Outpatient	3,928	$10,164,450.85	$2,587.69±6,746.02	$2,376.66-2,798.72	$780.51	$226.93-2,179.32	$0-119,901.72
		Professional	4,339	$19,445,122.18	$4,481.48±9,406.39	$4,201.51-4,761.44	$1,827.90	$697.69-4,437.24	$0-257,612.63
2019	Low Utilization	Inpatient	675	$6,935,467.76	$10,274.77±22,036.45	$8,609.37-11,940.17	$3,312.50	$1,364-8,793.25	$0-246,974.61
		ED	1,258	$545,624.77	$433.72±757.73	$391.81-475.64	$242.14	$123.81-468.04	$0-16,060.2
		Outpatient	2,003	$3,197,872.34	$1,596.54±4,590.74	$1,395.38-1,797.71	$305.85	$84.92-1,082.19	$0-55,707.9
		Professional	2,806	$9,329,852.82	$3,324.97±14,127.14	$2,802.03-3,847.9	$621.46	$212.12-1,778.77	$0-282,315.97
	High Utilization	Inpatient	2,739	$42,384,527.39	$15,474.45±28,504.04	$14,406.5-16,542.4	$7,487.56	$3,178.89-16,979.03	$0-761,957.07
		ED	3,179	$3,395,682.51	$1,068.16±3,737.15	$938.2-1,198.12	$434.79	$215.2-900.68	$0-95,119.77
		Outpatient	4,012	$9,301,543.41	$2,318.43±6,359.62	$2,121.58-2,515.28	$715.58	$203.83-1,895.76	$0-183,836.45
		Professional	4,465	$19,863,191.02	$4,448.64±10,332.86	$4,145.48-4,751.81	$1,735.56	$647.86-4,131.62	$0-216,527.09
2020	Low Utilization	Inpatient	633	$7,899,275.31	$12,479.11±32,652.64	$9,930.54-15,027.68	$3,251.12	$1,228.45-9,591.58	$0-430,296.2
		ED	1,031	$473,628.68	$459.39±904.98	$404.08-514.69	$244.02	$132.08-477.31	$0-16,325.61
		Outpatient	1,845	$3,028,213.39	$1,641.31±5,656.71	$1,383.02-1,899.59	$260.60	$79.84-873.22	$0-100,780.22
		Professional	2,843	$9,966,210.55	$3,505.53±15,243.64	$2,944.95-4,066.1	$620.56	$211.93-1,913.26	$0-316,483.72
	High Utilization	Inpatient	2,234	$33,449,233.18	$14,972.8±26,458.82	$13,875.03-16,070.57	$6,970.22	$3,015.01-16,158.58	$0-342,129.58
		ED	2,592	$3,036,397.86	$1,171.45±4,335.95	$1,004.45-1,338.45	$445.61	$227.2-907.77	$0-85,409.81
		Outpatient	3,651	$8,623,311.07	$2,361.9±6,529	$2,150.05-2,573.76	$628.49	$191.24-1,807.59	$0-153,269.19
		Professional	4,295	$19,127,878.44	$4,453.52±10,968.7	$4,125.39-4,781.65	$1,492.64	$517.16-3,985.81	$0-274,624.91
2021	Low Utilization	Inpatient	905	$10,185,518.43	$11,254.72±36,457.58	$8,876.27-13,633.16	$4,171.13	$1,531.63-9,758.27	$0-902,990.02
		ED	1,412	$773,564.24	$547.85±1,424.8	$473.47-622.23	$287.56	$148.59-584.87	$0-39,939.7
		Outpatient	2,235	$3,716,194.22	$1,662.73±7,746.91	$1,341.38-1,984.07	$297.68	$82.27-983.94	$0-280,905.89
		Professional	3,231	$12,811,088.41	$3,965.05±17,275.3	$3,369.16-4,560.95	$846.75	$291.59-2,437.77	$0-390,690.03
	High Utilization	Inpatient	2,100	$31,624,142.65	$15,059.12±25,841.59	$13,953.23-16,165	$7,680.82	$3,289.54-17,429.71	$0-539,535.34
		ED	2,659	$3,122,263.56	$1,174.22±5,618.61	$960.57-1,387.88	$431.14	$221.31-868.92	$0-164,205.03
		Outpatient	3,591	$8,302,762.39	$2,312.1±5,886.47	$2,119.51-2,504.7	$619.06	$189.74-1,758.14	$0-94,066.09
		Professional	4,167	$20,478,036.59	$4,914.34±11,358.02	$4,569.38-5,259.29	$1,650.93	$602.51-4,568.41	$0-222,689.72

N = sample at the patient level; CI = confidence interval; SD = standard deviation

APPENDIX E – EXPENDITURES OF PHARMACEUTICAL SERVICES IN LOW VERSUS HIGH UTILIZER POPULATIONS

Table 11. Comparison of Pharmaceutical Expenses between Low and High Utilizers Calendar Years 2018-2021

Year	Health Care Utilization	N patients	Total cost ($)	Mean cost	SD	Lower-Upper 95% CI	Median	Lower-Upper Quartiles	Ranges
2018	Low	2,025	$5,612,110.42	$2,771.41	$12,135.43	$2,242,54-$3,300.28	$121.42	$26.26-$500.52	0-$195,089.01
	High	3,669	$19,317,718.78	$5,265.12	$19,742.16	$4,626.10-$5,904.14	$235.87	$63.42-$1,194.94	0-$273,422.36
2019	Low	1,981	$6,189,747.61	$3,124.56	$13,695.47	$2,521.10-$3,728.02	$121.79	$22.89-$530.30	$0.41-$187,520.69
	High	3,642	$23,289,856.16	$6,394.80	$24,969.25	$5,583.60-$7,206.00	$250.77	$63.22-$1,472.84	0-$549,170.41
2020	Low	1,984	$6,905,682.36	$3,480.69	$19,271.53	$2,632.17-$4,329,20	$112.43	$24.59-$555.82	0-$619,644.18
	High	3,483	$25,475,894.89	$7,314.35	$24,366.07	$6,504.87-$8,123,84	$247.24	$58.64-$2,096.73	0-$563,861.02
2021	Low	2,369	$8,832,327.28	$3,728.29	$23,982.36	$2,762.07-$4,694.52	$114.00	$30.99-$521.99	$0.42-$772,907.70
	High	3,474	$27,583,020.71	$7,939.84	$24,971.01	$7,109.19-$8,770.50	$279.39	$66.35-$2,413.43	0-$357,363.86