AHRQ Agency for Healthcare Research and Quality | H·CUP HEALTHCARE COST AND UTILIZATION PROJECT

Hospital Readmissions for Adult Patients with Sickle Cell Disease, 2016-2022

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Introduction

Sickle cell disease (SCD) is the most common inherited blood disorder.[1] In the United States more than 90 percent of the approximately 100,000 people who have SCD are Black non-Hispanic individuals.[2,3] The disease is characterized by an alteration in the structure of the red blood cell such that it becomes crescent or sickle-shaped in response to a stress such as an extreme physical exertion, infection, or injury. The altered cells travel less freely in the blood stream and become lodged in small vessels, causing acute painful sickle cell crises from the cutoff of blood and oxygen that can result in chronic pain as well as lasting damage to the brain from strokes, the spleen, and other organ systems.[3] These crisis episodes contribute to increased hospital utilization for people with SCD.[4,5] Each year, more than 90,000 hospital stays are for SCD and a majority of these are for patients aged 18-34 years experiencing a crisis episode.[6] Little is known about how frequently hospital readmissions occur nationally for people with SCD and how rates may differ for patients with and without an SCD crisis.

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief presents statistics on the rate of 30-day all-cause hospital readmissions following an index (initial) stay for SCD among patients aged at least 18 years. Using weighted estimates from the 2016-2022 HCUP Nationwide Readmissions Database (NRD), trends in the annual rate of readmissions are examined by SCD crisis status at the time of the index stay. A readmission is defined as a hospital admission for any cause within 30 days of an inpatient stay between January and November 2022. The number of index stays and rate of readmissions overall and by index stay SCD crisis status are presented followed by the median hospital cost and mean length of stay (LOS) statistics. Next, readmission rates by leading index stay comorbidities are presented. Finally, the top three reasons for readmission are listed overall and by index stay SCD crisis status.

Because of the large sample size of the NRD, small differences can be statistically significant but not clinically important. All differences noted in the text are greater than or equal to 10 percent.

Highlights

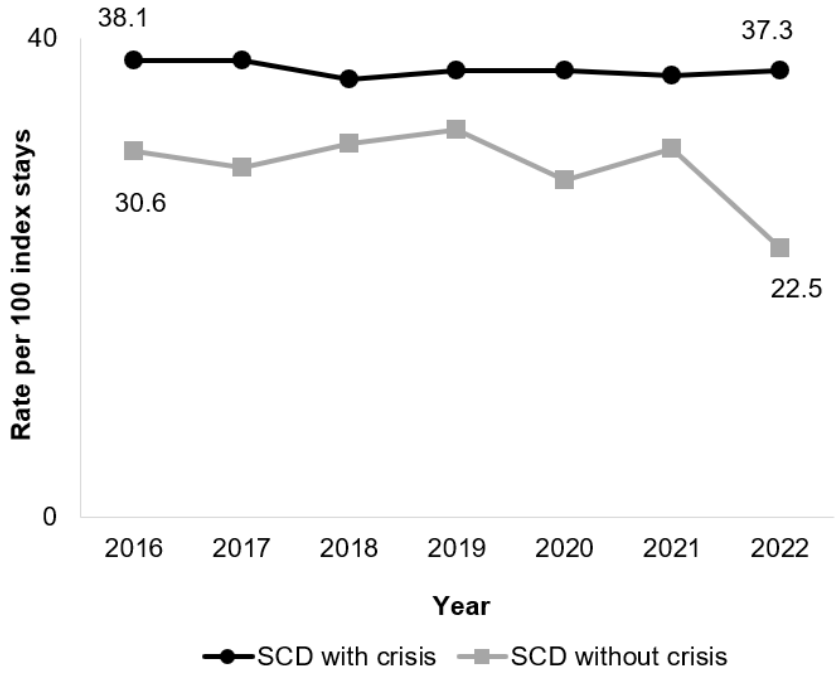
- Each year approximately 25,000, or about 1 in 3, adult index stays for sickle cell disease with crisis (pain) had a 30-day all-cause readmission during 2016-2022.
- The 30-day all-cause readmission rate among adult index stays for sickle cell disease with crisis was about 42 percent higher than adult index stays for SCD without crisis during 2016-2022.
- Readmission rates in 2022 were highest among adult index stays for sickle cell disease with the following characteristics (per 100 index stays):
  - discharged against medical advice (44.0)
  - billed to Medicaid (40.6)
  - aged 18-29 years (39.6)
- In 2022, the median hospital cost of adult index stays for sickle cell disease with crisis ($8,030) was 10 percent higher than index stays for those without crisis ($7,280).
- The most common comorbidities associated with adult index stays for sickle cell disease in 2022 were chronic pulmonary disease, hypertension, and depression.

Findings

Trends in 30-day readmission rates among adults with sickle cell disease (SCD)

Figure 1 presents the annual rate of 30-day readmissions following an adult index stay for SCD, by SCD crisis status during the index stay. A 30-day readmission is a subsequent hospital admission in the same or a different hospital within 30 days following a hospital admission (i.e., index stay). Every qualifying hospital stay is counted as a separate initial (starting point) admission. Thus, a patient can have multiple readmissions during the January through November observation period. See Appendix Table 1 for annual number of readmissions by crisis status at index stay and see the methodology section for additional details on readmissions and the observation period.

Figure 1. Rate (per 100 index stays) of 30-day all-cause readmissions following an adult (aged 18+ years) index stay for sickle cell disease (SCD), by SCD crisis status, 2016-2022



Abbreviations: SCD: sickle cell disease
Note: Crisis refers to acute pain episodes of blocked blood flow caused by sickle-shaped red blood cells.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2016–2022.

- From 2016-2022, more than 1 in 3 adult hospital stays for SCD with crisis had a readmission within 30-days of discharge, which was about 42 percent higher than adult index stays for SCD without crisis. Each year approximately 25,000 index stays for SCD with crisis had a 30-day all-cause readmission.
- All-cause readmission rates within 30-days of an adult index stay for SCD without crisis decreased 27 percent from 30.8 per 100 index stays in 2021 to 22.5 in 2022.

Characteristics of index stays for sickle cell disease (SCD) with 30-day all-cause readmissions, 2022

Table 1 presents the number of index stays (rounded to nearest 10) and rate of 30-day all-cause readmissions among adult (aged 18+ years) index stays for SCD (per 100 index stays), by index stay SCD crisis status and patient characteristics in 2022.

Table 1. Number of adult index stays for sickle cell disease (SCD) and rate of 30-day all-cause readmissions by patient characteristics, 2022

Characteristic*	All SCD		SCD with crisis*		SCD without crisis*	
	Number Index Stays	Readmission Rate[a]	Number Index Stays	Readmission Rate[a]	Number Index Stays	Readmission Rate[a]
Total	67,980	37.0	66,410	37.3	1,570	22.5
Days to readmission, mean (SD)	14.5 (12.3)		14.5 (12.3)		14.2 (11.6)	
Sex						
Male	30,300	36.4	29,530	36.8	760	21.1
Female	37,680	37.4	36,870	37.7	810	23.8
Age group, years						
18-29	30,110	39.6	29,670	39.7	440	28.4
30-44	28,290	36.5	27,680	36.9	610	20.2
45-64	8,670	31.1	8,270	31.5	400	22.9
65+	910	21.4	790	22.9	110	10.8
Race and ethnicity						
Black NH	62,740	37.3	61,310	37.6	1,430	21.5
Hispanic	2,700	33.9	2,640	34.1	60	27.1
White NH	340	25.1	330	25.4	-	-
Other NH^	1,180	34.3	1,150	34.3	-	-
Expected payer						
Medicaid	31,540	40.6	31,030	40.8	510	24.5
Medicare	21,390	38.3	20,730	38.8	660	24.2
Private insurance	11,720	26.9	11,410	27.2	310	18.4
Self-pay/No charge	2,110	25.9	2,060	26.2	-	-
Other**	1,170	35.6	1,130	36.4	-	-
Patient location						
Large metropolitan	46,580	37.3	45,490	37.7	1,090	22.9
Small/medium metropolitan	16,370	36.7	16,040	37.0	320	22.2
Nonmetropolitan	4,780	34.1	4,630	34.5	150	20.2
Community-level income						
Quartile 1 (lowest)	32,270	37.8	31,570	38.1	700	21.6
Quartiles 2 and 3	28,070	36.9	27,480	37.2	590	22.9
Quartile 4 (highest)	7,110	34.1	6,850	34.4	260	24.4
Discharge disposition						
Home/HHC	63,270	36.5	61,830	36.9	1,440	21.4
Left against medical advice	3,980	44.0	3,910	44.2	70	32.5
Other hospital	720	36.6	670	36.6	60	37.0
Hospital region						
Northeast	11,370	36.4	11,110	36.6	260	27.6
Midwest	10,670	36.5	10,330	37.3	340	13.3
South	41,060	37.1	40,230	37.3	830	24.0

West	4,880	38.5	4,740	38.9	140	27.0
Hospital location/teaching status						
Rural	6,830	36.2	6,710	36.5	130	18.6
Urban nonteaching	58,290	37.4	56,930	37.8	1,360	22.6
Urban teaching	2,850	29.7	2,770	29.8	80	26.0
Hospital ownership type						
Public non-Federal	9,600	36.2	9,420	36.6	180	17.3
Private not-for-profit	52,500	36.9	51,330	37.3	1,170	23.0
Private for-profit	5,870	38.6	5,650	39.2	220	24.0

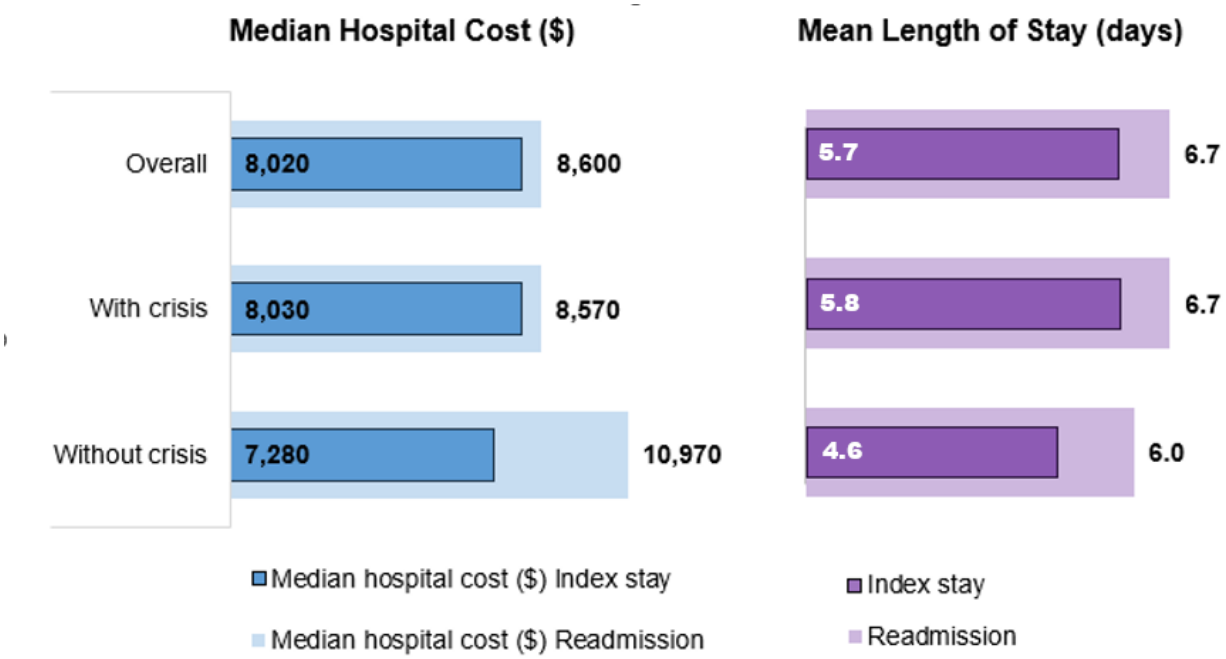
Abbreviations: NH: non-Hispanic; HHC: home health care
Notes: Number of readmissions are rounded to nearest 10. Numbers may not total across rows due to rounding or missing data. Rates are calculated on unrounded values. '-' denotes suppressed data with fewer than 11 readmissions. Crisis refers to acute pain episodes of blocked blood flow caused by sickle-shaped red blood cells.; *at index stay; a rate per 100 index stays, calculated using discharges from January through November to allow for a 30-day follow-up period; ^Other NH race/ethnicity includes Asian/Pacific Islander, American Indian/Alaskan Native, Multiple races, and other race categories. Race and ethnicity data were missing for 1.5% adult index stays for SCD in 2022; **Other includes other Federal and local government programs (e.g. TRICARE, CHAMPVA, Indian Health Service, Black Lung, Title V) and Workers' Compensation. Expected payer data was missing for 0.07% of adult index stays for SCD in 2022.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2022.

- In 2022, for every 100 adult index stays for SCD, 37 had a readmission within 30 days. The rate of readmission for adult index stays for SCD with crisis (37.3 per 100 index stays) was 66 percent higher than the rate of readmission among stays for SCD without crisis (22.5 per 100 index stays).
- On average, a readmission occurred two weeks after an adult index stay for SCD regardless of crisis status.
- All-cause 30-day readmission rates were highest among adult index stays for SCD with crisis with the following characteristics: left against medical advice (44.2 per 100 index stays), billed to Medicaid (40.8 per 100 index stays), and for patients aged 18-29 years (39.7 per 100 index stays).
- All-cause 30-day readmission rates were highest among adult index stays for SCD without crisis with the following characteristics: discharged to other hospital (37.0 per 100 index stays) or left against medical advice (32.5 per 100 index stays), and for patients aged 18-29 years (28.4 per 100 index stays).

Average hospital cost and length of stay (LOS) for index stays for sickle cell disease (SCD) and their readmissions, 2022

Figure 2 presents the median hospital cost of index stays for sickle cell disease (SCD) and the median cost of subsequent 30-day all-cause readmissions in 2022, overall and by index stay SCD crisis status. The mean LOS is also presented for index stays for SCD and subsequent 30-day all-cause readmissions, overall and by index stay SCD crisis status.

Figure 2. Median hospital cost ($) and mean length of stay (LOS) of 30-day all-cause readmission following an adult (aged 18+ years) index stay for sickle cell disease (SCD), by index stay SCD crisis status, 2022



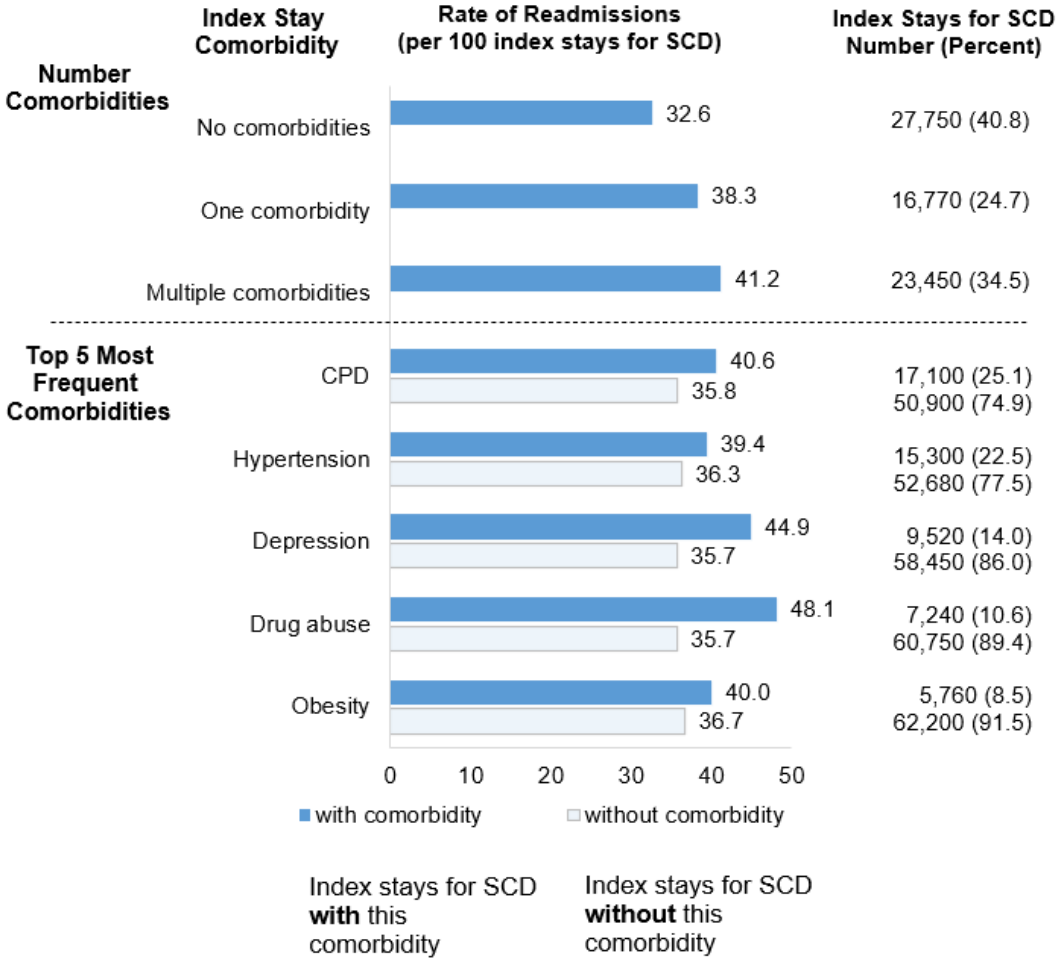
Note: Sickle cell disease crisis is based on the index stay and refers to acute pain episodes of blocked blood flow caused by sickle-shaped red blood cells. Median hospital cost is rounded to the nearest $10.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2022.

- Median hospital cost of adult index stays for SCD with crisis ($8,030) were about 10 percent higher than adult index stays for SCD without crisis ($7,280) in 2022. The median hospital cost of 30-day all-cause readmissions from adult index stays for SCD without crisis ($10,970) were 28 percent higher than adult index stays for SCD with crisis ($8,570).
- The mean length of stay (LOS) for index and readmission stays among adult index stays for SCD with crisis were about 25 and 11 percent higher than those for adult index stays for SCD without crisis, respectively.

Index stay comorbidity prevalence and readmission rates among index stays for sickle cell disease (SCD), 2022

Figure 3 presents statistics on the number and most frequent comorbidities indicated on an index stay. Comorbidities were defined by the Elixhauser Comorbidity Software Refined for the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM), v2023.1.[a]

Figure 3. Number of comorbidities among adult (aged 18+ years) index stays for sickle cell disease (SCD) and 30-day all-cause readmission rates* among five most common index stay comorbidities, 2022.



Abbreviations: CPD: chronic pulmonary disease; SCD, sickle cell disease
Notes: Number of index stays is rounded to nearest 10. Elixhauser Comorbidity hypertension measure includes complicated and uncomplicated hypertension.
* Rate per 100 index stays calculated using discharges from January through November to allow for a 30-day follow-up period.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2022.

- Nearly half (40.8 percent) of the 67,980 adult index stays for SCD in 2022 were for patients with no comorbidities and about one-third (34.5 percent) had multiple comorbidities.
- The 30-day all-cause readmission rate among adult index stays for SCD increased with the number of comorbidities. Adult index stays for SCD with multiple comorbidities (41.2 per 100 index stays) had a readmission rate that was 26 percent higher than the rate among index stays for SCD with no other comorbidities (32.6 per 100 index stays).
- Adult index stays for SCD with comorbid drug abuse had a readmission rate that was about 35 percent higher than index stays for SCD without drug abuse.

[a] Agency for Healthcare Research and Quality. Elixhauser Comorbidity Software Refined for ICD-10-CM. Healthcare Cost and Utilization Project (HCUP). October 2022. *http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp*.

Top reasons for readmission after an adult index stay for sickle cell disease, 2022

Table 2 presents the three most common specific principal diagnoses as defined by the Clinical Classification Software Refined (CCSR) among adult index stays for sickle cell disease (SCD) by index stay SCD crisis status, 2016-2022.

Table 2. Top 3 readmission principal diagnoses among adult (aged 18+ years) index stays for sickle cell disease (SCD) by SCD crisis status at index stay, 2016-2022

Readmission Principal Diagnosis	All SCD		SCD with crisis*		SCD without crisis*	
	Number (Percent)	Rank	Number (Percent)	Rank	Number (Percent)	Rank
SCD with crisis	150,670 (84.5)	1	149,170 (85.2)	1	1,500 (47.0)	1
Septicemia	4,330 (2.4)	2	4,210 (2.4)	2	130 (3.9)	3
SCD without crisis	2,240 (1.3)	3	1,830 (1.0)	3	410 (12.8)	2

Notes: Principal diagnoses are grouped using the Clinical Classifications Software Refined (CCSR) for ICD-10-CM Diagnoses except for those matching the sickle cell disease case definition for this brief (see Appendix Table 3). Number of index stays are rounded to nearest 10 and include only discharges from January through November to allow for a 30-day follow-up period. Crisis refers to acute pain episodes of blocked blood flow caused by sickle-shaped red blood cells.
***** at index stay; **^** the complete Clinical Classification Software Refined (CCSR) description is pneumonia (except that caused by tuberculosis)
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2016–2022

- Over seven years from 2016 to 2022, sickle cell disease (SCD) with crisis was the leading reason for readmission in 85 percent of readmissions for index stays with SCD with crisis and nearly 50 percent of readmissions for index stays for SCD without crisis. Septicemia and SCD without crisis were also leading causes of readmissions.

Appendix

Appendix Table 1. Number of adult index stays for sickle cell disease (SCD) and the percent with a 30-day all cause readmission by SCD crisis status at index stay, 2016-2022

Year	All		With crisis		Without crisis	
	Number	Percent readmitted	Number	Percent readmitted	Number	Percent readmitted
2016	71,840	37.9	70,070	38.1	1,770	30.6
2017	71,600	38.0	70,020	38.2	1,570	29.2
2018	69,190	36.5	67,750	36.6	1,440	31.2
2019	71,220	37.2	69,570	37.4	1,650	32.4
2020	62,420	37.2	61,060	37.4	1,370	27.8
2021	64,980	36.7	63,410	36.9	1,560	30.8
2022	67,980	37.0	66,410	37.3	1,570	22.5
All years	479,220	37.2	468,290	37.4	10,940	29.3

Note: Number of readmissions and subsequent ED visits are rounded to nearest 10. Rates are calculated on unrounded values and use only discharges from January through November to allow for a 30-day follow-up period. Crisis refers to acute pain episodes of blocked blood flow caused by sickle-shaped red blood cells.
Source: Agency for Healthcare Research and Quality (AHRQ), Healthcare Cost and Utilization Project (HCUP), Nationwide Readmissions Database (NRD), 2016–2022

References

[1] Piel FB, Patil AP, Howes RE, et al. Global distribution of the sickle cell gene and geographical confirmation of the malaria hypothesis. Nat Commun. 2010;1:104. doi:10.1038/ncomms1104

[2] Hassell KL. Population estimates of sickle cell disease in the US. Am J Prev Med. 2010;38(4 Suppl):S512-S521. doi:10.1016/j.amepre.2009.12.022

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[5] Brousseau DC, Owens PL, Mosso AL, Panepinto JA, Steiner CA. Acute care utilization and rehospitalizations for sickle cell disease. JAMA. 2010;303(13):1288–1294.

[6] Fingar KR (IBM Watson Health), Owens PL (AHRQ), Reid LD (AHRQ), Mistry K (AHRQ), Barrett ML (M.L. Barrett, Inc.). Characteristics of Inpatient Hospital Stays Involving Sickle Cell Disease, 2000-2016. HCUP Statistical Brief #251. September 2019. Agency for Healthcare Research and Quality, Rockville, MD. https://hcup-us.ahrq.gov/reports/statbriefs/sb251-Sickle-Cell-Disease-Stays-2016.pdf.

Data Source

This brief uses data from the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project (HCUP) 2016-2022 Nationwide Readmissions Database (NRD). For additional information about the HCUP NRD, please visit: https://hcup-us.ahrq.gov/db/nation/nrd/nrddbdocumentation.jsp.

Population Studied

All inpatient stays for patients aged 18 years and older were included in the analysis. Index admissions at acute care nonfederal hospitals were those with principal diagnosis of sickle cell disease (SCD) (Appendix Table 2). Admissions with both any-listed SCD 'with crisis' and 'without crisis' diagnosis were considered 'with crisis' for this brief. An admission to an acute care nonfederal hospital that occurred within 30 days after discharge of the index stay was considered a readmission. That is, when patients are discharged from the hospital, they are followed for 30 days in the data. If any readmission to the same hospital or a different hospital occurs during this period, the admission is counted as a readmission. No more than one readmission is counted within the 30-day period because the outcome measure assessed is the "percentage of index stays that are readmitted." If a patient was transferred to a different hospital on the same day or within the same hospital, the two events were combined as a single stay and the second event was not counted as a readmission; that is, transfers were not considered readmissions. In the case of admissions for which there was more than one readmission in the 30-day period, the data presented in this brief reflect the characteristics and costs of the first readmission.

Every qualifying hospital stay is counted as a separate initial (starting point) admission. Thus, a single patient can be counted multiple times during the January through November observation period. In addition, initial admissions do not require a prior "clean period" with no hospitalizations; that is, the initial admission may be a readmission for a prior stay. Admissions were disqualified from the analysis as initial admissions if they could not be followed for 30 days for one of the following reasons: (1) the patient died in the hospital, (2) information on length of stay was missing, or (3) the patient was discharged in December.

Appendix Table 2. Identification of sickle cell disease (SCD) and SCD crisis I

ICD-10-CM code	Description	Presence of crisis
D57.00	Hb-SS disease with crisis, unspecified	With crisis
D57.01	Hb-SS disease with acute chest syndrome	With crisis
D57.02	Hb-SS disease with splenic sequestration	With crisis
D57.09	Hb-SS disease with crisis with other specified complication	With crisis
D57.211	Sickle-cell/Hb-C disease with acute chest syndrome	With crisis
D57.212	Sickle-cell/Hb-C disease with splenic sequestration	With crisis
D57.218	Sickle-cell/Hb-C disease with crisis with other specified complication	With crisis
D57.219	Sickle-cell/Hb-C disease with crisis, unspecified	With crisis
D57.411	Sickle-cell thalassemia with acute chest syndrome	With crisis
D57.412	Sickle-cell thalassemia, unspecified, with splenic sequestration	With crisis

D57.418	Sickle-cell thalassemia, unspecified, with crisis with other specified complication	With crisis
D57.419	Sickle-cell thalassemia, unspecified, with crisis	With crisis
D57.431	Sickle-cell thalassemia beta zero with acute chest syndrome	With crisis
D57.432	Sickle-cell thalassemia beta zero with splenic sequestration	With crisis
D57.438	Sickle-cell thalassemia beta zero with crisis with other specified complication	With crisis
D57.439	Sickle-cell thalassemia beta zero with crisis, unspecified	With crisis
D57.451	Sickle-cell thalassemia beta plus with acute chest syndrome	With crisis
D57.452	Sickle-cell thalassemia beta plus with splenic sequestration	With crisis
D57.458	Sickle-cell thalassemia beta plus with crisis with other specified complication	With crisis
D57.459	Sickle-cell thalassemia beta plus with crisis, unspecified	With crisis
D57.811	Other sickle-cell disorders with acute chest syndrome	With crisis
D57.812	Other sickle-cell disorders with splenic sequestration	With crisis
D57.818	Other sickle-cell disorders with crisis with other specified complication	With crisis
D57.819	Other sickle-cell disorders with crisis, unspecified	With crisis
D57.03	Hb-SS disease with cerebral vascular involvement	Without crisis
D57.1	Sickle-cell disease without crisis	Without crisis
D57.20	Sickle-cell/Hb-C disease without crisis	Without crisis
D57.213	Sickle-cell/Hb-C disease with cerebral vascular involvement	Without crisis
D57.40	Sickle-cell thalassemia without crisis	Without crisis
D57.413	Sickle-cell thalassemia, unspecified, with cerebral vascular involvement	Without crisis
D57.42	Sickle-cell thalassemia beta zero without crisis	Without crisis
D57.433	Sickle-cell thalassemia beta zero with cerebral vascular involvement	Without crisis
D57.44	Sickle-cell thalassemia beta plus without crisis	Without crisis
D57.453	Sickle-cell thalassemia beta plus with cerebral vascular involvement	Without crisis
D57.80	Other sickle-cell disorders without crisis	Without crisis
D57.813	Other sickle-cell disorders with cerebral vascular involvement	Without crisis

Abbreviations: Hb-C, hemoglobin C; Hb-SS, hemoglobin sickle cell

Definitions

Diagnoses

The principal diagnosis is that condition established after study to be chiefly responsible for the patient's admission to the hospital. Secondary diagnoses are conditions that coexist at the time of admission that require or affect patient care treatment received or management, or that develop during the inpatient stay. Any-listed diagnoses include the principal diagnosis plus all secondary diagnoses.

ICD-10-CM Coding System

ICD-10-CM is the International Classification of Diseases, Tenth Revision, Clinical Modification. There are over 70,000 ICD-10-CM diagnosis codes.

Reporting of race and ethnicity

Data on Hispanic ethnicity are collected differently among the States and also can differ from the census methodology of collecting information on race (White, Black, Asian/Pacific Islander, American Indian/Alaska Native, Other [including mixed race]) separately from ethnicity (Hispanic, non-Hispanic). State data organizations often collect Hispanic ethnicity as one of several categories that include race. Therefore, for multistate analyses, HCUP creates the combined categorization of race and ethnicity for data from States that report ethnicity separately. When a State data organization collects Hispanic ethnicity separately from race, HCUP uses Hispanic ethnicity to override any other race category to create a Hispanic category for the uniformly coded race/ethnicity data element, while also retaining the original race and ethnicity data. This brief reports race and ethnicity for the

following categories: Black NH, Hispanic, White NH, and other NH race and ethnicity (including Asian/Pacific Islander, American Indian/Alaskan Native, Multiple races, and other race categories).

Primary expected payer

To make coding uniform across all HCUP data sources, the primary expected payer for the hospital stay combines detailed categories into general groups:

- Medicaid: includes fee-for-service and managed care Medicaid
- Private insurance: includes commercial nongovernmental payers, regardless of the type of plan (e.g., private health maintenance organizations [HMOs], preferred provider organizations [PPOs])
- Self-pay/No charge: includes self-pay, no charge, charity, and no expected payment
- Other payers: includes Medicare (fee-for-service and managed care Medicare) and other Federal and local government programs (e.g., TRICARE, CHAMPVA, Indian Health Service, Black Lung, Title V) and Workers' Compensation

Hospital stays that were expected to be billed to the State Children's Health Insurance Program (SCHIP) are included under Medicaid.

For this brief, when more than one payer is listed for a hospital discharge, the first-listed payer is used.

Location of patient residence

Place of residence is based on the urban-rural classification scheme for U.S. counties developed by the National Center for Health Statistics (NCHS) and based on the Office of Management and Budget (OMB) definition of a metropolitan service area as including a city and a population of at least 50,000 residents. For this brief, we collapsed the NCHS codes into the following three categories:

Large metropolitan (metro) area:

- Large Central Metropolitan: Counties in a metropolitan area with 1 million or more residents that satisfy at least one of the following criteria: (1) containing the entire population of the largest principal city of the metropolitan statistical area (MSA), (2) having their entire population contained within the largest principal city of the MSA, or (3) containing at least 250,000 residents of any principal city in the MSA
- Large Fringe Metropolitan: Counties in a metropolitan area with 1 million or more residents that do not qualify as large central metropolitan counties

Medium/small metropolitan area:

- Medium Metropolitan: Counties in a metropolitan area of 250,000–999,999 residents
- Small Metropolitan: Counties in a metropolitan area of 50,000–249,999 residents

Nonmetropolitan area:

- Micropolitan: Counties in a nonmetropolitan area of 10,000–49,999 residents
- Noncore: Counties in a nonmetropolitan and non-micropolitan area

Community-level income

Community-level income is based on the median household income of the patient's ZIP Code of residence. Quartiles are defined so that the total U.S. population is evenly distributed. Cut-offs for the quartiles are determined annually using ZIP Code demographic data obtained from projections of the U.S. Census Bureau data. The value ranges for the income quartiles vary by year. Patients in the first quartile are assigned to the *lowest income* category, patients in the middle two quartiles are assigned to the *middle income* category, and patients in the highest quartile are assigned to the *highest income* category. The income quartile is missing for patients who are homeless or foreign.

Region

Region is one of the four regions defined by the U.S. Census Bureau. Division corresponds to the location of the

hospital and is one of the nine divisions defined by the U.S. Census Bureau.

- Northeast:
  - New England: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut
  - Middle Atlantic: New York, New Jersey, Pennsylvania
- Midwest:
  - East North Central: Ohio, Indiana, Illinois, Michigan, Wisconsin
  - West North Central: Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas
- South:
  - South Atlantic: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida
  - East South Central: Kentucky, Tennessee, Alabama, Mississippi
  - West South Central: Arkansas, Louisiana, Oklahoma, Texas
- West:
  - Mountain: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada
  - Pacific: Washington, Oregon, California, Alaska, Hawaii

Hospital ownership and teaching status

Data on hospital ownership and status as a teaching hospital was obtained from the American Hospital Association (AHA) Annual Survey of Hospitals. Hospital ownership/control includes categories for government nonfederal (public), private not-for-profit (voluntary), and private investor-owned (for-profit, proprietary). Teaching hospital is defined as having a residency program approved by the Accreditation Council for Graduate Medical Education, being a member of the Council of Teaching Hospitals, or having a ratio of full-time equivalent interns and residents to beds of 0.25 or higher.

Hospital cost

Total hospital charges were converted to cost using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare & Medicaid Services. Cost reflects the actual expenses incurred in the production of hospital services, such as wages, supplies, and utility cost; charges represent the amount a hospital billed for the case. For each hospital, a hospital specific cost-to-charge ratio is used. Hospital charges reflect the amount the hospital billed for the entire hospital stay and do not include professional (physician) fees. Further information on the Cost-to-Charge Ratio can be found at https://hcup-us.ahrq.gov/db/ccr/costtocharge.jsp.

Cost is reported as the average (median) hospital cost of index stays for SCD and their readmissions.

Elixhauser Comorbidity Software Refined for ICD-10-CM Diagnoses

The Elixhauser Comorbidity Software Refined for ICD-10-CM, v2023.1, was used to identify comorbidities. The AHRQ comorbidity measures identify coexisting medical conditions that are not directly related to the principal diagnosis, or the main reason for admission, and are likely to have originated prior to the hospital stay.[3] These comorbidities can make a hospital stay more expensive and complicated. There are 38 comorbidities, 20 of which do not use present on admission (POA) indicators because the condition is assumed to be pre-existing and not a result of hospital care. The additional 18 measures are based on whether the secondary diagnosis was POA. Since the NRD does not include POA indicators, comorbidities presented in this analysis are limited to the 20 that do not rely on a POA indicator. The AHRQ comorbidity measures were developed originally as one of the HCUP tools. Complete documentation on the comorbidity measures is available on the HCUP User Support Website under Tools & Software (*http://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp*).

For this brief, related comorbid conditions for hypertension with and without complications were considered as one hypertension comorbidity. Similarly, diabetes with and without chronic complications were considered as one diabetes comorbidity.

Calculations

Readmission rate

Readmission rate per 100 index stays was calculated as follows:

- Numerator is the number of stays for which there was at least one subsequent hospitalization within 30 days
- Denominator is total number of stays from January through November of the same year

Percentage change

Percentage change between groups were calculated using the following formula:

$$\text{Percentage change} = \frac{\text{Group 1 value} - \text{Group 2 value}}{\text{Group 2 value}} * 100$$

The percentage change was based on unrounded values.

About HCUP

The Healthcare Cost and Utilization Project (HCUP) is a family of healthcare databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of State data organizations, hospital associations, and private data organizations (HCUP Partners) and the Federal government to create a national information resource of encounter-level healthcare data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health services, medical practice patterns, access to healthcare programs, and outcomes of treatments at the national, State, and local market levels. For more information about HCUP, see: https://hcup-us.ahrq.gov/

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Alaska Department of Health
Arizona Department of Health Services
Arkansas Department of Health
California Department of Health Care Access and Information (HCAI)
Colorado Hospital Association
Connecticut Hospital Association
Delaware Department of Health and Social Services
District of Columbia Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Laulima Data Alliance
Hawaii University of Hawai'i at Hilo
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi State Department of Health
Missouri Hospital Industry Data Institute
Montana Hospital Association
Nebraska Hospital Association
Nevada Health Authority
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Health Authority
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Revenue and Fiscal Affairs Office
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Office of Shared Administration
Wisconsin Department of Health Services
Wyoming Hospital Association

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For More Information

The HCUP-US website also offers readily available statistics in the form of reports, downloadable tables or interactive data visualizations. Examples include the following:

- AHRQ HCUP Statistical Briefs present simple, descriptive reports on a variety of specific, healthcare related issues
- AHRQ HCUPnet is a free, online query system that provides statistics and data tables based on AHRQ HCUP data
- AHRQ HCUP Summary Trend Tables provide downloadable tables containing State-specific monthly trends in hospital utilization derived from the AHRQ HCUP State Inpatient Databases (SID) and State Emergency Department Databases (SEDD)
- AHRQ HCUP Fast Stats is an online query tool that uses visual displays to compare national or State statistics on a range of healthcare topics
- AHRQ HCUP Methods Series Reports feature a broad array of methodological information on the HCUP databases and software tools
- AHRQ HCUP Topical Reports provide information on various priority populations
- AHRQ HCUP Infographics provide a visual representation of HCUP Statistical Briefs and other data
- AHRQ HCUP Findings-At-A-Glance provide snapshots covering a broad range of issues related to hospital use and costs

AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of healthcare in the United States. We also invite you to tell us how you are using this HCUP Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please email us at hcup@ahrq.gov or send a letter to the address below:

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