Insights into Sickle Cell Disease Hospitalizations and Outcomes: A Tale of 2 HCUP Databases

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Background

- Sickle cell disease (SCD) is a genetic blood disorder that affects approximately 100,000 individuals in the United States, making it the most prevalent inherited blood disorder in the country[1]
- This condition poses substantial health challenges and financial burdens for patients and healthcare systems alike due to its chronic nature and associated complications[2]
- We aimed to delve into the intricacies of hospitalization outcomes associated with SCD by leveraging two datasets from the Healthcare Cost and Utilization Project (HCUP): National Inpatient Sample Survey (NIS) and Nationwide Readmissions Database (NRD) for 2019
- The HCUP NIS and NRD databases included in HCUP have diverse functionality and can be used to inform different study objectives. According to AHRQ,
  - The NIS database is an all-payer US database based on in-patient hospital admissions that can identify and analyze HCRU, costs, and outcome trends[3]
  - NRD includes all-payer as well as uninsured lives that can be utilized to study readmission trend aggregated over 1-year period[3]

Objective

- The objective of this study is to analyze variations in hospitalization outcomes among individuals with sickle cell disease (SCD) using NIS and NRD databases within the HCUP datasets, to analyze total charges (ToC) among both aiming to provide insights into healthcare disparities and inform strategies for improving care delivery and resource allocation for SCD patients. The study also aims to understand the differences and benefits of NIS and NRD datasets

Methods

- Data Sources:
  The 2019 HCUP data, specifically the NIS and the NRD databases from HCUP were used for this research. These datasets were selected for their comprehensive coverage of hospital admissions and readmissions across the United States.
- Study Sample:
  Patients/Hospitalizations included in the analysis were identified based on International Classification of Diseases, Tenth Revision (ICD-10) code D57, corresponding to the SCD.
- Data Extraction:
  We extracted relevant variables from the NIS and NRD datasets, including patient demographics, admission characteristics, length of stay (LOS), readmission rates, readmission rate, and associated charges.
- Statistical Analysis:
  Descriptive statistics were used to summarize patient demographics and hospitalization characteristics. Comparative analyses between the NIS and NRD datasets were conducted to assess variations in hospitalization outcomes for SCD patients.
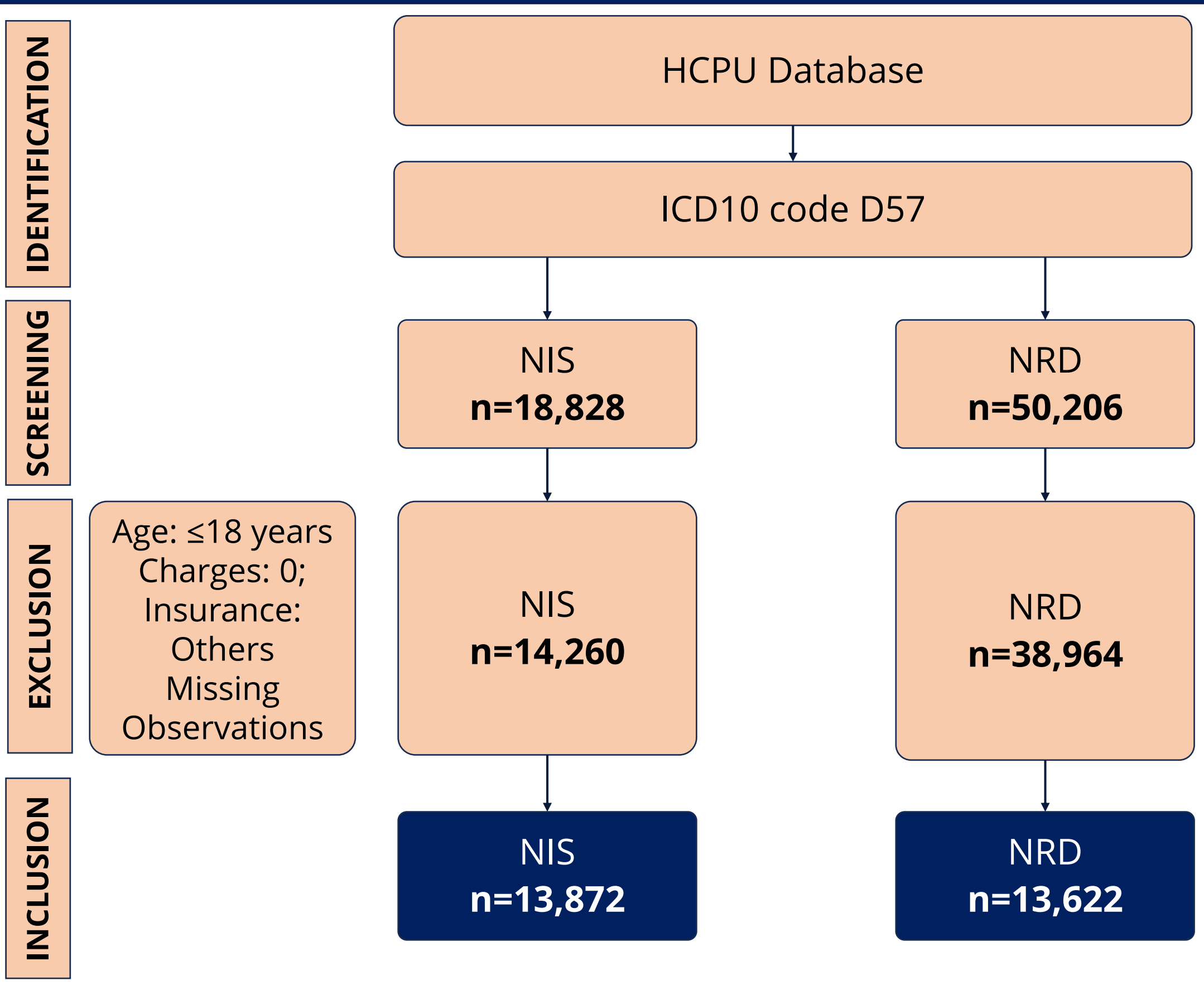
Figure 1. Study Design

Table 1. Benefits of NIS and NRD

NIS	NRD
Records in-patient hospitalizations as independent events	Records in-patient hospitalizations across multiple hospital stays for unique patients within 1-year period
Includes various descriptive variables viz., race and regional hospital data	Includes linked patient records aiding in calculation of readmissions
Effective in studying hospitalization trends, in-patient HCRU, factors associated with LOS, in-patient mortality, total costs per visit per patient in targeted disease conditions	Effective in studying rates and patterns of hospital readmissions, 30-day readmissions and readmission risks in targeted disease conditions

Results

- From the initial sample of 18,828 NIS observations and 50,206 NRD observations, 13,872 unique hospitalizations and 13,622 unique patients were included in the final analysis **(Figure 1)**
- The average age of patients hospitalized for SCD was 32.5 and 34.1 years in NIS and NRD, respectively with a mean LOS od 5.2 days and 14.8 days **(Table 1)**
- The mean cost of SCD-related hospitalization was higher in females (40,749 ± 58,856) compared to males (38,730 ± 72,157) **(Table 2)**
- As the NRD data links patient records across multiple hospital stays, it aided in computing the per-patient per year (PPPY) costs. The mean PPPY cost for SCD-related hospitalization was 118,016 ± 178,447 in females and 111,507 ± 180,505 in males. Both NIS and NRD data observed similar trends of total charges across gender, age and payer type
- Patient demographics like age, gender, quartile income, insurance, hospital demographics across both databases were similar **(Table 3)**
- Analysis of readmission data reported 46% of patients have 1 SCD-related hospital admissions in 2019 while 36% patients have 2-4 admissions, 15% have 5-10 admissions. Only 3% od patients have more than 10 SCD-related admissions **(Figure 2)**

Table 1. Hospitalizations across NIS & NRD

	NIS		NRD	
	Mean	SD	Mean	SD
Age (years)	32.5	10.7	34.1	12.1
Total charges	$39,842	$65,169	$115,114	$179,390
Length of Stay (days)	5.2	5.1	14.8	20.4
Number of Procedures	0.6	1.2	1.7	3.3
Number of diagnosis	9.2	5.3	9.0	5.1

Table 2. Total Charges across NIS & NRD

	NIS		NRD	
	Mean	SD	Mean	SD
Gender				
Male	$ 38,730	$ 72,157	$ 111,507	$ 180,505
Female	$ 40,749	$ 58,856	$ 118,016	$ 178,447
Age				
18-34	$ 38,320	$ 66,040	$ 116,273	$ 179,508
35-44	$ 41,168	$ 52,819	$ 122,224	$ 194,294
45-64	$ 44,622	$ 77,839	$ 107,237	$ 166,662
65 Plus	$ 48,803	$ 51,034	$ 78,414	$ 102,116
Payer				
Medicare	$ 40,618	$ 54,239	$ 127,700	$ 193,103
Medicaid	$ 38,336	$ 58,495	$ 123,064	$ 189,392
Private	$ 42,471	$ 95,033	$ 84,245	$ 132,545

Table 3. SCD-Related Characteristics across NIS & NRD

	NIS		NRD	
	N	%	N	%
Age Category				
18-34	9,086	65%	8116	60%
35-44	2,817	20%	2922	21%
45-64	1,804	13%	2243	16%
65 Plus	165	1%	341	3%
Gender				
Male	6,227	45%	6,074	45%
Female	7,645	55%	7,548	55%
Family Income based on Zip				
Less than $45,999	7,084	51%	6,429	47%
$46,000- $58.999	3,022	22%	3,123	23%
$59,000-$78,999	2,348	17%	2,475	18%
Greater than $79,000	1,418	10%	1,595	12%
Patients Metro size				
Population >1M	9,645	70%	9435	69%
Population 50k-1M	3,341	24%	3249	24%
Population <50k	886	6%	938	7%
Payer				
Medicare	4,730	34%	4,381	32%
Medicaid	6,701	48%	5,928	44%
Private	2,441	18%	3,313	24%
Hospital Region				
Northeast	2,833	20%		
Midwest	2,515	18%		
South	7,367	53%	Data Not Reported	
West	1,157	8%		
Hospital Size				
Small	2,515	18%	1,989	15%
Medium	3,547	26%	3,178	23%
Large	7,810	56%	8,455	62%
Hospital Type				
Rural	489	4%	599	4%
Urban Non-Teaching	1,641	12%	1,784	13%
Urban Teaching	11,742	85%	11,239	83%
Hospital Ownership				
Government, nonfederal	2,430	18%	2378	17%
Private Non-Profit	10,154	73%	9707	71%
Private Investor	1,288	9%	1537	11%

Figure 2. SCD-related Rehospitalization by NRD
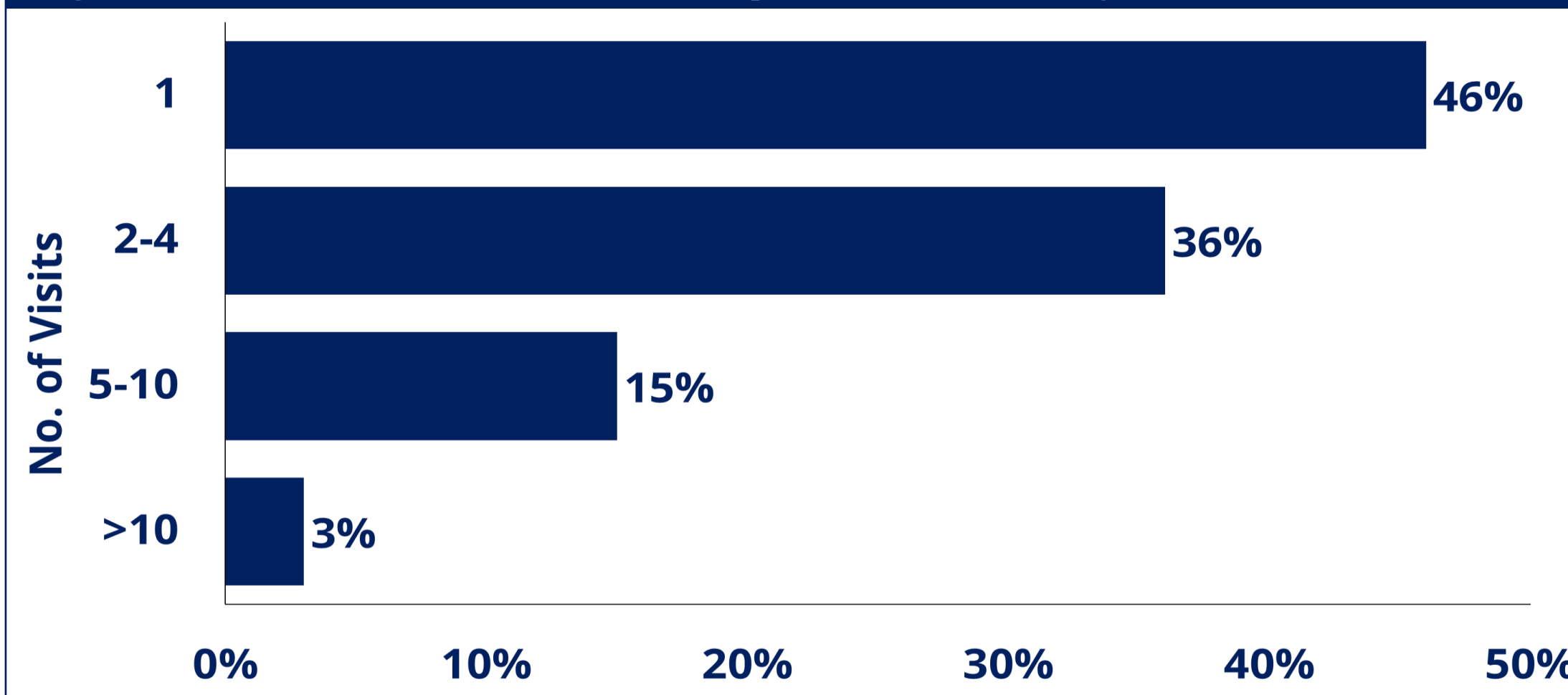
- Regression analysis across both databases highlighted that effect of gender, age, and private insurance type is distinct on SCD-related total in-patient charges
- In NIS, females have 3% higher SCD-related total costs compared to men, while patients with private insurance have 5% higher total costs compared to patients with Medicare
- Age was a significant variable affecting total costs in NRD. Younger patients had higher SCD-related total hospitalization costs

Table 4. Regression for Total Costs across NIS & NRD

Variable	NIS [log(ToC)]	NRD [log(ToC)]
Female	*0.0305***	*0.003433*
Age	*0.0004*	*-0.0041****
Quart Income: $46k-$58.9k	-0.0063	0.045567
Quart Income: $59k-$78.9k	-0.0251	-0.00472
Quart Income: >$79k	-0.0252	-0.03187
Medium Metro	0.0018	-0.01981
Large Metro	0.1108***	0.183148***
Medicaid	-0.0022	-0.00476
Private Insurance	*0.0502****	*-0.01313*
Medium Hospital	0.1258***	0.15524***
Large Hospital	0.1606***	0.309777***
Urban Non-teaching Hospital	0.2234***	0.202844***
Urban Teaching Hospital	0.1991***	0.218541***
Private Non-Profit Hospital	0.0676***	-0.02889*
Private Investor-owned Hospital	0.6240***	0.493251***
No. of diagnoses codes	0.0159***	0.041067***
No. of procedures	0.0661***	0.038536***
LOS	0.0887***	0.021676***

Limitations

- Since the study evaluates 2 databases with different functionalities that are built for distinct purposes, a direct 1:1 comparison between the included patient population is not possible

Conclusions

- NRD data provides a better picture of Hospitalization outcomes **(~15 days LOS) and costs (~$115,00)** for SCD due to its patient level data than the NIS
- NRD data demonstrates that >50% of the patients had multiple annual hospitalizations for SCD
- Multivariate analysis demonstrated congruence insignificant explanatory variable for Hospitalization charges

References

1. CDC. Data & Statistics on Sickle Cell Disease. Centers for Disease Control and Prevention. Published August 31, 2016.
2. National Academies of Sciences E, Division H and M, Practice B on PH and PH, et al. Societal and Structural Contributors to Disease Impact. National Academies Press (US); 2020.
3. AHRQ. Healthcare Cost and Utilization Project (HCUP) | Agency for Healthcare Research & Quality. Ahrq.gov. Published December 2022.