National Inpatient Hospitalization Trends for Adult Patients with Cystic Fibrosis in the United States: A Retrospective Analysis

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Background

- Cystic fibrosis (CF) is a progressive, genetic disease affecting more than 40,000 people in the United States (US) and 105,000 people globally.[1]

- CF is a complex disorder that leads to decrease in lung function, recurrent respiratory infections, pancreatic insufficiency, intestinal obstruction, and liver diseases.

- Currently, there is no cure for CF. However, recent advances in early diagnosis of CF and CF therapies have resulted in improved survival with the median predicted age of survival increasing to 53 years old.[1]

- Patients with CF are living longer with a chronic disease, increasing treatment burden and costs.

Objective

- The aim of this study was to estimate the total hospital costs and charges in patients with CF, and to identify significant factors associated with them.

Methods

Dataset

- The study utilized the National Inpatient Sample (NIS) database developed by the Agency for Healthcare Research and Quality as part of the Healthcare Cost and Utilization Project.

- It is the largest, all-payer healthcare database that is designed to produce US regional and national estimates of inpatient utilization, access, cost, quality, and outcomes. The NIS approximates a 20% stratified sample of discharges from US community hospitals, excluding rehabilitation and long-term acute care hospitals. Weighted, it estimates 35 million hospitalizations nationally.[2]

- The 2018 dataset contains 7.1 million hospital inpatient records from 47 states and the District of Columbia, covering more than 97% of the US population.[2]

Approach

- A retrospective analysis of the NIS 2018 database was undertaken.

- Adults ≥18 years with a primary and secondary diagnosis of CF were identified using International Classification of Diseases, 10th Revision codes from E84.0-E84.9 and the hospital discharge records.

- The patient characteristics included in the analysis were age, sex, race and ethnicity, insurance payer (Medicare, Medicaid, private insurance, self-pay, no charge, other), length of stay, and number of procedures.

- Hospital characteristics included in the analysis were region of hospital (Northeast, Midwest, South, and West), bed size (small, medium, and large), and owner (government, private not-for-profit, and private investor-owned).

- Cube-root transformation was applied to hospital charges and costs to mitigate the right-skew in the data.

- Adjusted survey, univariate, and multivariate regression models were utilized to determine characteristics of patients who were significantly associated with total hospital costs and charges in patients with CF.

Results

- In total, 3,053 patients diagnosed with CF were identified from the 2018 NIS database, which was notably lower than those identified in 2013 (12,590) and in 2008 (8,328).[3-4]

- Most patients (2,408; 79%) were admitted with a diagnosis of pulmonary exacerbation.

- The baseline characteristics of patients are provided in Table 1.

- The mean (standard deviation) length of stay was 9.79 (0.23) days with a mean hospital cost of $27,212.15 ($1,075) and mean hospital charge of $108,367.60 ($6,991.86).

Table 1. Patient and hospital baseline characteristics

	Number of hospital discharges (unweighted)	Per of hospital discharges (weighted)
Patient characteristics		
Mean age (±SD) (years)	30.82 (±11.98)	-
Death	18	0.6%
Mean number of procedures (±SD)	1.31 (±2.31)	-
Mean length of stay (days)	9.79 (0.23)	-
Sex		
Female	1,653	46%
Male	1,400	54%
Race and Ethnicity		
White	2,528	85%
Black	123	4%
Hispanic	229	8%
Asian or Pacific Islander	18	0.6%
Native American	13	0.4%
Other	59	2%
Missing	83	-
Primary payer		
Medicare	677	22%
Medicaid	881	29%
Private insurance	1,310	43%
Self-pay	67	2%
No charge	4	<1%
Other	112	4%
Missing	2	-
Hospital characteristics		
Region		
Northeast	546	18%
Midwest	754	25%
South	1,073	35%
West	680	22%
Bed size		
Small	217	7%
Medium	473	16%
Large	2,363	77%
Ownership		
Government	640	21%
Private not-for-profit	2,300	75%
Private investor-owned	113	4%

Abbreviation: SD, standard deviation

- When analyzing the linear regression models, variables that were significant predictors (based on a p-value of <0.05) included:

  - Hospital charges: length of stay, number of procedures, race, hospital region, and bed size
  - Hospital costs: age, length of stay, number of procedures, race, hospital region, and ownership

- Length of stay and the number of procedures had the greatest impact on hospital charges and costs with an R-squared value of 68% that explains the variation in the outcomes.

Table 2. Predictors of hospitalization charges and costs for all discharges of patients with CF in 2018

	Hospital charges ($) exp β (p-value)	Hospital costs ($) exp β (p-value)
Patient characteristics		
Mean age	-0.01 (0.60)[a]	-0.03 (0.03)[a]
Number of procedures	0.94 (<0.01)	0.68 (<0.01)
Length of stay	1.20 (<0.01)	0.74 (<0.01)
Sex		
Female	Ref	Ref
Male	-0.48 (0.11)	-0.17 (0.33)
Race and Ethnicity		
White	Ref	Ref
Black	2.10 (<0.01)	0.63 (0.14)
Hispanic	2.99 (<0.01)	1.51 (<0.01)
Asian or Pacific Islander	1.22 (0.53)	0.03 (0.98)
Native American	-2.25 (0.32)	-0.81 (0.52)
Other	1.66 (0.13)	1.60 (<0.01)
Primary payer		
Medicare	Ref	Ref
Medicaid	-0.91 (0.05)	-0.37 (0.16)
Private insurance	-0.75 (0.07)	-0.22 (0.36)
Self-pay	-1.25 (0.27)	-0.96 (0.12)
No charge	1.47 (0.72)	0.88 (0.71)
Other	-1.52 (0.08)	-0.29 (0.55)
Hospital characteristics		
Region		
Northeast	Ref	Ref
Midwest	-1.41 (<0.01)	-0.08 (0.77)
South	-2.54 (<0.01)	-1.10 (<0.01)
West	2.82 (<0.01)	2.05 (<0.01)
Bed size		
Small	Ref	Ref
Medium	1.43 (0.04)	0.66 (0.10)
Large	3.56 (<0.01)	0.59 (0.09)
Ownership		
Government	Ref	Ref
Private not-for-profit	1.59 (<0.01)	-0.12 (0.57)
Private investor-owned	4.61 (<0.01)	-3.52 (<0.01)
Constant term	26.51	19.33

Notes: All costs are in 2018 US dollars; hospital charges and costs were cube-root transformed
[a]Results of univariate analysis; ref: reference

Discussion

- The majority of patients with CF discharged from hospitals were aged 30.8 years, White (85%), and used private insurance (43%). They received an average of 1.31 procedures during their stay, and only 0.6% of patients died. The mean length of stay was 9.79 days.

- Most of the hospitals that admitted patients with CF were private not-for-profit hospitals (75%) and had large bed size (77%).

- Primary payer and sex of patients with CF were not significant predictors of hospital charges and costs.

- Patients identifying as White, Black, or Hispanic had a significant impact on hospital charges compared with those who were Asian or Native American. However, this could be due to a lower proportion of Asian and Native American patients with CF being admitted to the hospital as seen in Table 1.

- While hospital ownership and age did not significantly impact the hospital charges in the univariate linear regression, they were significant in estimating hospital costs. However, each variable itself had an R-squared value of less than 2% that explains the variation in the outcomes.

- For both charges and costs, 68% of the variation can be attributed to the length of stay and number of procedures, and thereby are important predictors.

- These models also showed that only 66% and 71% of the variation in hospital charges and hospital costs, respectively, could be explained by including all parameters. This suggests that other important characteristics may impact CF-related charges and costs.

Conclusion

- The results of these analyses provided a better understanding of the socio-economic impact of CF hospitalization for adults with CF in the US.

- However, a gap still exists in understanding the entire set of predictors of the economic burden.

- Further patient-level analysis of predictors such disease severity, type of treatment and resource utilization will help in improving disease management, and in the decision-making process of evaluating new CF treatments.

References

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