Readmissions related to short bowel syndrome: a study from a national database

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ABSTRACT

While short bowel syndrome (SBS) is the leading cause of intestinal failure in children, little objective data are available regarding hospital readmissions for children with SBS. This study sought to investigate rehospitalizations related to SBS in young children. Data for study were obtained from the 2013 Nationwide Readmissions Database (NRD). Using data from the 2013 NRD, we identified a total of 1898 hospitalizations in children with SBS aged 1–4 years. A total of 901 index cases and 997 rehospitalizations were noted. Of these, 425 children (47.2%) underwent rehospitalizations. The most frequent diagnoses and procedures associated with readmission of children with SBS were related to infections and intravenous catheter placement. This is the first study to use US nationwide data to report on the incidence of readmissions in children with SBS. The results from this study indicate that improving central line care and providing home healthcare resources to families at discharge may help in preventing SBS-related rehospitalizations.

INTRODUCTION

Short bowel syndrome (SBS) is one of the most common causes of intestinal failure in the pediatric age group. It is clinically defined as the inability to maintain nutritional, fluid and electrolyte, or micronutrient balances while on a conventionally accepted, normal diet.[1] Consequently, many patients will require parenteral supplementation to prevent hydration and/or nutritional deficits.[1] The pediatric type of SBS is usually associated with massive intestinal resection resulting from congenital anomalies or necrotizing enterocolitis and leads to significant morbidity and mortality.[2] The prognosis of pediatric patients with SBS is largely dependent on variables such as the length, quality and anatomy of the remaining intestine.[3]

Recently, we used pan US data to report on the epidemiological burden of SBS and associated healthcare resource utilization of children during the first 3 years of life.[4] Our results demonstrated that hospitalized children with SBS usually have a higher burden of disease severity and also experience a more complicated hospitalization due to their associated illness. This work also highlighted the substantial healthcare burden imposed by this disease. In this context, it is important to consider hospital readmissions for children with SBS. Based on anecdotal evidence, these patients often experience frequent hospitalizations, especially in the initial years following diagnosis. Repeated hospitalizations in children with SBS have also been reported to be a significant cause of parental stress.[5] Unfortunately, there is little published objective data dealing with hospital readmissions in children with SBS and we are unaware of any large-scale investigation in this regard. Therefore, the goal of this study was to investigate rehospitalizations related to SBS in young children using a national pediatric hospital readmissions database.

METHODS

Data sources

For this study, we used the 2013 Nationwide Readmissions Database (NRD), Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality that is structured to provide information on hospital readmission rates in the USA. The NRD is an annual database, and contains data from community, specialty and public hospitals and academic medical centers including pediatric hospitals. The NRD is a 'discharge-level' file, wherein each individual record is representative of a single discharge corresponding to an inpatient stay. Should the patient have multiple hospital visits in a particular year, the NRD will include separate records corresponding to each inpatient stay. The NRD includes discharges on patients aged 1 year and older. Each of the discharge entries includes details related to patient demographics, one primary discharge diagnosis (based on International Classification of Diseases, Ninth Revision, and Clinical Modification (ICD-9-CM), diagnosis codes), 1–24 ICD-9-CM secondary diagnoses, 1–15 ICD-9-CM procedure codes, information related to hospitalization and hospital data. Discharge weights are available to generate national estimates; it estimates roughly 36 million discharges in the USA. We reported all data in this study as national-level estimates. The study was deemed exempt from institutional board review as it excluded any protected health information.

SBS definition

There is no unique ICD-9 code for SBS. Using our previously published methods,[4] we therefore used a combination of ICD-9 CM codes (diagnostic and procedural): 579.3 (other and unspecified postsurgical non-absorption) and 99.15 (parenteral infusion of concentrated nutritional substances). Hospital discharges that included both the ICD-9 CM codes were then defined as having SBS for the purpose of this study.

Demographics and readmissions

For each SBS case, we extracted demographics, associated diagnoses, procedures, information related to that hospitalization and disposition data. To assess patient severity of illness (minor, moderate, major, extreme), we also extracted the All Patient Diagnosis-Related Groups (APR-DRGs). Those patients with APR-DRG scores of 3 or 4 were identified as severe disease. Individual readmissions and the time to readmission were identified using a combination of variables specific to the database.

Primary and secondary outcome variables

The primary variables in this study were the incidence of admission and re-admissions in children with SBS aged 1–4 years. Secondary variables included length of stay (LOS) during the hospitalization and associated costs (calculated by multiplying cost-to-charge ratios by total charges and rounded to the nearest US$1000). Diagnosis and procedure codes associated with rehospitalization were also extracted. Specifically, ICD-9-CM diagnosis codes that occurred at a frequency of ≥10% and ICD-9-CM procedure codes that occurred at a frequency of ≥5% in children with SBS were extracted.

Statistical analyses

Statistical analyses were conducted using SAS V.9.2 (SAS Institute, Cary, North Carolina, USA). The normality of the data elements was determined using the Kolmogorov-Smirnov test. To compare differences in continuous and categorical variables, we used the Kruskal-Wallis test and X^2 test, respectively. The significance threshold for all data analyses was $p<0.01$.

RESULTS

The study population comprised children with SBS between 1 and 4 years of age. We chose these ages due to constraints of the NRD database (ie, does not contain patients <1 year of age) and more than two-thirds of the total number of SBS in the NRD database are <4 years of age and the incidence of SBS is much lower in older children.[4] Using data from the 2013 NRD, we identified a total of 1898 hospitalizations in children with SBS (table 1). This cohort of hospital admissions comprised 901 index cases and 997 rehospitalizations.

On further analysis of the index cases, we determined that 425 children (47.2%) underwent rehospitalizations, whereas 476 children (52.8%) were not re-hospitalized during the year under analysis. Of the 425 index cases who underwent readmission, there was a median of 3 rehospitalizations (IQR 2) and the median time to readmission was 41 days (IQR 69 days). Notably, 41.0% of all readmissions occurred within a 30-day period from the time of last hospital discharge. The median LOS during a readmission was 6 days (IQR 9 days) and the median hospital costs were US$10 000 (IQR US$18 000).

Table 1 Data relating to hospital admissions and readmissions in children with SBS 1–4 years of age from the Nationwide Readmissions Database 2013

Total number of SBS admissions in 2013	1898
Index admissions of SBS with no recorded readmissions	476
Index admissions of SBS with recorded readmissions	425
Total number of SBS readmissions in 2013	997
Median number of SBS readmissions (IQR)	3 (2)
Median time to readmission in days (IQR)	41 (69)
Total number of 30-day readmissions	409
Average hospital stay in days for readmission (IQR)	6 (9)
Average hospital costs for readmission (IQR)	10 (18)

SBS, short bowel syndrome.

In comparing index cases either with or without subsequent rehospitalizations, children without readmissions were significantly more likely to have private health insurance (36.6% vs 17.5%; $p<0.001$), a household income >50th percentile (37.9% vs 17.7%; $p<0.001$) and be discharged with home health services after their index admission (56.3% vs 41.4%; $p<0.001$). No significant differences between the two groups were observed regarding age, gender, severity of illness, number of co-existing chronic conditions or initial LOS.

The most common diagnoses and procedures that were associated with readmission of children with SBS (table 2) were primarily those related to infections and intravenous catheter placement.

DISCUSSION

To our knowledge, this is the first study to report on the incidence of individual admissions as well as readmissions in children with SBS using national-level US data. One of the major strengths of our study is the utilization of nationwide data and thus mitigating regional and population biases.[6 7] Also, the unique ability of the NRD to identify and analyze individual admissions and corresponding rehospitalizations enabled us to analyze data corresponding to readmissions in a population that appears to be vulnerable to experiencing multiple hospitalizations.

Although our study was confined to a period of 1 year, the data demonstrate that even in a limited period of time almost half of the children with SBS who were admitted to the hospital experienced at least one readmission. Significantly, the time to readmission appeared to be quite short with over 40% of readmissions occurring within a 30-day period from the time of the last hospital discharge. rehospitalizations were associated with significant hospital stays and costs. In an analysis of factors protecting children with SBS against rehospitalization, we found a positive association with higher income status, private insurance and the availability of home healthcare. Although speculative, we believe these factors may correlate the ability to provide a better degree of care in the home setting. Also, greater than two-thirds of the diagnoses associated with readmission were related to an infectious etiology with a majority directly linked to a central line infection. Furthermore,

Table 2 Data detailing the most frequent ICD-9-CM diagnosis and procedural codes associated with hospital readmission in children with SBS 1–4 years of age from the Nationwide Readmissions Database 2013

ICD-9-CM code description	n	% association in SBS readmission
Diagnosis code		
Bloodstream infection secondary to central venous catheter	278	27.83
Bacteremia	184	18.42
Feeding difficulties and mismanagement	150	15.02
Sepsis	150	15.02
Anemia unspecified	135	13.51
Dehydration	133	13.31
Diarrhea	129	12.91
Lack of normal physiological development	125	12.51
Iron deficiency anemia, unspecified	122	12.21
Other specified disorder of the liver	108	10.81
Infection due to central venous catheter	104	10.41
Diaper or napkin rash	104	10.41
Procedural code		
Enteral nutrition	226	22.67
Central venous catheter placement	173	17.35
Transfusion of packed cells	134	13.44
Venous catheterization	101	10.13
Foreign body or device removal from skin and subcutaneous tissue	96	9.63
Injection of antibiotic	93	9.33
Esophagogastroduodenoscopy	63	6.32

ICD-9-CM, International Classification of Diseases, Ninth Revision, and Clinical Modification; SBS, short bowel syndrome.

attendance to central line access and antibiotic administration were frequently performed procedures in this cohort of patients. Thus, suggesting prevention of catheter-related complications can lead to a decrease in hospitalizations. Indeed, central line-associated bloodstream infections are one of the leading indications associated with hospital admission in children with SBS,[4] and have been associated with failure to grow, liver disease including cholestasis and death.[8–10]

Our study has several potential limitations. First, we relied on ICD-9-CM diagnostic and procedural codes for identifying our cases. As there are no specific ICD-9-CM codes for SBS, we had to rely on surrogate codes that may potentially have included other surgical gastrointestinal conditions requiring total parenteral nutrition. We were forced to exclude children younger than 1 year of age due to constraints of the database. Since the database is limited to a single year, it is biased against patients admitted either at the beginning or the end of the year. Therefore, by including all patients over the course of 1 year, our estimates of readmission may be skewed. This also affected our ability to do a lengthier analysis.

CONCLUSIONS

Hospitalized children with SBS have a high incidence of readmission and a short duration to rehospitalization. In this context, rehospitalization is associated with significant hospital stays and costs. Higher economic status, private insurance and being discharged with home health appear to be protective against readmission. Infection-related complications specifically related to central line access are frequently associated with readmission. Meticulous attention to central line care as well as providing home healthcare resources at the time of discharge may help to prevent rehospitalizations in children with SBS.

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