Pediatric hospitalizations for inflammatory bowel disease based on annual case volume: results from the Kids' Inpatient Database 2012

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ABSTRACT

To study differences related to pediatric inflammatory bowel disease (IBD) care among hospitals that were stratified based on annual case volume. This is a cross-sectional study using data from the United States Healthcare Cost and Utilization Project Kids' Inpatient Database (KID). IBD-related hospitalizations were identified using International Classification of Diseases-9-Clinical Modification codes. Hospital volume was divided into low or high by assigning cut-off values of 1–20 and >20 annual IBD hospitalizations. We assessed a total of 8647 pediatric IBD discharges during 2012 from 660 hospitals in the USA. 107 of these hospitals were classified as high-volume centers (HVCs) for pediatric IBD care and 553 low-volume centers (LVCs). HVCs were more likely to be associated with an academic teaching status compared to LVCs (97.1% vs 67.6%, p<0.001). The incidence of transfer of medical care from LVCs to other hospitals was 5.5% but only 0.7% for HVCs (p<0.001). The median number of procedures (medical and surgical) performed on children admitted with IBD was higher at HVCs (2 vs 1, p<0.001). IBD admissions at HVCs were more likely to undergo surgical procedures compared to LVCs (17% vs 10%, p<0.001). The incidence of postoperative complications was not significantly different. There were significantly greater hospital costs (median US$11,000 vs US$6,000, p<0.001) and lengths of stay (median 5 days vs 4 days, p<0.001) associated with HVCs compared to LVCs. Pediatric admissions to HVCs for IBD undergo a greater number of medical and surgical procedures and are associated with higher costs and lengthier hospital stays.

INTRODUCTION

It has been previously demonstrated in adult patients that hospitals with a high annual inflammatory bowel disease (IBD) case volume have lower in-hospital mortality among surgical patients with IBD.[1] However, it is currently unknown whether similar disparities exist among pediatric patients. The aim of this study was to interrogate a national database and analyze demographic and clinical differences in pediatric IBD care after stratifying hospitals based on annual case volume.

METHODS

We obtained data for this study from the US Healthcare Cost and Utilization Project Kids' Inpatient Database (KID) sponsored by the US Agency for Healthcare Research and Quality for the year 2012. The KID includes patient demographic details, one primary discharge diagnosis (based on the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes), 1–24 ICD-9-CM secondary diagnoses, 1–15 ICD-9-CM procedural codes, and hospital-level data. Individual-level population weights are used to generate national-level estimates. For 2012, the KID contains 6,675,222 weighted total pediatric cases reported from 4179 hospitals in 44 states. Our study did not involve any protected health information and was deemed exempt from Institutional Board Review.

Children between 1 and 17 years were included in the study. The methods and specific ICD-9-CM codes are described in detail by Ananthakrishnan *et al*.[1] A discharge was considered to be IBD-related if it met one of the following criteria: (A) primary diagnosis was either Crohn's disease (CD) or ulcerative colitis (UC) or (B) a primary diagnosis of an IBD-related complication and a secondary diagnosis of CD or UC. The IBD-related complications included active fistulizing disease, intra-abdominal abscess, stricturing disease, bowel obstruction, perianal abscess, and unspecified lower gastrointestinal (GI) hemorrhage. Also included were systemic complications of hypovolemia, electrolyte imbalance, anemia, and malnutrition. The disease subtype was considered to be non-fistulizing, non-stricturing if the codes for active fistulizing or stricturing disease were absent. A very small number (<1%) of children were coded with a diagnosis of CD and UC; these patients were excluded.

Patient demographics, hospitalization data, and hospital information were obtained for the extracted cases. A comorbidity assessment was performed using the 29 disease states contained within the Elixhauser comorbidity index.[2] The median household income of residents in the

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patient's Zone Improvement Plan (ZIP) code was identified by values of 1 to 4, indicating the poorest to wealthiest populations.

ICD-9-CM codes were also used to examine the usage of lower GI endoscopy (flexible sigmoidoscopy or colonoscopy), upper GI endoscopy, and abdominal surgery as well as the incidence of postoperative complications and *Clostridium difficile* infection (CDI).[1] Abdominal surgery included ICD-9-CM codes for procedures involving incision, excision, and anastomosis of the intestine, large intestinal resection, other small bowel surgery, other large bowel surgery, rectal and perirectal surgery, and other abdominal surgery. Other extracted variables included mortality, hospital length of stay (LOS), hospitalization costs (obtained by multiplying total charges by cost-to-charge ratios and rounded to the nearest US$1000), and transfer of patient care to another medical facility.

Statistical analyses were performed using SAS V.9.3 (SAS Institute, Cary, North Carolina, USA). The χ^2 tests and the Mann-Whitney U test compared categorical and continuous variables, respectively. The threshold for significance for all analyses was set at $p<0.01$ given the large number of patients involved in the study.

RESULTS

We assessed a total of 8647 pediatric IBD discharges during 2012 from 660 hospitals in the USA. The number of annual IBD discharges in children ranged from 1 to 223 (median 47, SD 57). Hospital volume was stratified into low or high by assigning the threshold cut-off values of 1–20 and >20 annual IBD discharges. On the basis of this, 107 hospitals were classified as high-volume centers (HVCs) for pediatric IBD care and 553 as low-volume centers (LVCs).

There were no differences in gender or age between the two center types (table 1). Children of Hispanic ethnicity constituted a significantly greater proportion of patients with IBD who were admitted to LVCs compared to HVCs (12.9% vs 8.4%, p<0.001). Patients admitted to HVCs were more likely to have a higher household income than children admitted to LVCs (income quartile 3 or greater, 60.8% vs 51.2%, p<0.001) and less likely to have government insurance (26.6% vs 31.0%, p<0.001). There was a proportionately equal representation for admissions to the two types of centers in the Northeast, Midwest, and Southern regions of the USA. However, while the Western region accounted for 23.6% of nationwide admissions to LVCs, only 15.6% of the national HVC admissions occurred in this region (p<0.001). HVCs were more likely to be associated with an academic teaching status compared to LVCs (97.1% vs 67.6%, p<0.001).

We did not observe any significant differences in mode of presentation (elective vs emergent admit), CD phenotype, incidence of CDI, or comorbid disease burden among children admitted to the two different volume centers (table 2). The incidence of transfer of medical care from LVCs to other hospitals was 5.5% but only 0.7% for HVCs (p<0.001).

The total number of procedures (medical and surgical) performed on children admitted with IBD was higher at HVCs (median 2 vs 1, p<0.001). Both esophagogastroduodenoscopy (32.7% vs 23.2%, p<0.001) and colonoscopy (37.8% vs 32.1%; p<0.001) were performed more frequently at HVCs (table 2). Overall, the most frequent surgical procedure involved resection of the large intestine, accounting for 9.2% of surgeries combined for the two types of centers. This was followed by stoma surgery (7.6%), surgery involving incision, excision, and anastomosis of the intestine (6.3%), and surgery involving the rectum (4.7%). IBD admissions at HVCs were more likely to undergo a surgical procedure as compared to LVCs (17% vs 10%, p< table 2). However, no particular type of surgery was over-represented or under-represented between the two center types. The incidence of postoperative complications also was not significantly different between the center types (p=0.53).

There were significantly greater hospital costs (median US$11,000 vs US$6000, p<0.001) and LOS (median 5 vs 4 days, p<0.001) associated with pediatric IBD care at HVCs compared to LVCs. There was only one recorded death in the study cohort.

Table 1 Demographics of patients admitted for inflammatory bowel disease

Variable	Low volume (%)	High volume (%)	p Value
Gender			
Male	52.2	52.6	0.77
Female	47.8	47.4	0.77
Age (years)			
1–5	3.6	4.4	0.09
6–10	12.8	15.4	0.02
11–17	83.6	80.1	0.01
Race			
White	61.3	62.2	0.45
Black	11.3	12.9	0.04
Hispanic	12.9	8.4	<0.001
Other or missing	7.4	5.9	0.01
Income centile			
Quartile 1	23.5	17.2	<0.001
Quartile 2	23.6	20.9	0.01
Quartile 3	21.1	25.8	<0.001
Quartile 4	30.1	35.0	<0.001
Insurance			
Private	62.6	65.3	0.02
Medicaid	31.0	26.6	<0.001
US region			
Northeast	20.5	23.1	0.01
Midwest	23.1	25.9	0.01
South	32.5	35.3	0.02
West	23.6	15.6	<0.001
Hospital			
Teaching	67.6	97.1	<0.001

DISCUSSION

To the best of our knowledge, this is the first study to use case volume for the purpose of stratifying and studying pediatric IBD admissions on a US nationwide level. This type of investigation can be useful in optimizing healthcare resource usage, especially given the increasing number of pediatric IBD-related hospitalizations in the USA.[3 4]

Table 2 Clinical characteristics and outcomes of patients admitted for inflammatory bowel disease

Variable	Low volume	High volume	p Value
Admission type (%)			
Emergency	79.2	77.0	0.028
Transfer to other hospital (%)			
Transfer	5.5%	0.7%	<0.001
Crohn's phenotype (%)			
Non-fistulizing, non-stenosing	90.7	89.2	0.047
Procedures (all types) (median, IQR)	1 (2)	2 (3)	<0.001
Endoscopy (%)			
Esophagogastroduodenoscopy	23.2	32.7	<0.001
Colonoscopy	32.1%	37.8	<0.001
Abdominal surgery (%)	10	17	<0.001
Postsurgical complications (%)	3.8	4.1	0.53
Comorbidities (median, IQR)	1(1)	1(1)	
Cost (median, IQR)	US$6,000 (8,000)	US$11,000 (14,000)	<0.001
Length of stay (median, IQR)	4 (4)	5 (5)	<0.001

The impact of race and ethnicity on pediatric IBD remains incompletely studied. Our data demonstrate that children of Hispanic ethnicity have a disproportionately low proportion of admissions to HVCs when compared to their overall representation in the study cohort. Interestingly, over one-third of IBD-related admissions for Hispanic children occur in the Western USA (data not shown), which we found to have an overall low number of HVCs.

Children admitted to HVCs underwent an overall greater number of procedures during their hospitalization, manifested as both a higher rate of upper and lower endoscopies as well as abdominal surgical procedures. The disparate rate of surgeries was noted without a predilection for any particular type of procedure. The reasons for the higher rate of procedures performed at HVCs are unclear as we did not observe significant differences in disease phenotype, mode of presentation (elective vs emergent admit), incidence of CDI, or comorbid disease burden among children admitted to the two different types of centers. This observation differs from adult patients with IBD admitted to HVCs who have a higher incidence of complicated disease.[1] Thus, further pediatric studies are necessary to determine why this difference exists.

Children admitted to HVCs demonstrated higher costs and lengthier hospital stays. This might be at least partly related to the performance of a greater number of medical and surgical procedures in this group of patients.

LIMITATIONS

We relied exclusively on the use of ICD-9-CM codes for the identification of children with IBD. There is an absence of individual identifiers in the KID; thus, one patient may potentially account for several admissions. The cut-off for differentiating between HVCs and LVCs was set at 20 annual admissions. While arbitrary, this number stratified ~15% of the centers to high-volume status and enabled meaningful comparisons.

CONCLUSION

Our results indicate that racial and geographical disparities exist within the USA regarding pediatric IBD admissions to HVCs. Children admitted to HVCs for IBD undergo a greater number of medical and surgical procedures and admissions to HVCs are associated with higher costs and lengthier hospital stays. The incidence of postoperative complications does not significantly differ for the two types of centers. Further studies should be directed toward investigating access to IBD resources based on racial, income, and geographical differences.

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