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Trends in US emergency department visits and subsequent hospital admission among patients with inflammatory bowel disease presenting with abdominal pain: a real-world study from a national emergency department sample database

Zhijie Ding[a], Aarti Patel[b], James Izanec[a], Christopher D. Pericone[b], Jennifer H. Lin[b] and Christopher W. Baugh[c]

[a]Janssen Scientific Affairs, Janssen Pharmaceuticals, Horsham, PA, USA; [b]Janssen Scientific Affairs, Janssen Pharmaceuticals, Titusville, NJ, USA; [c]Department of Emergency Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, MA, USA

ABSTRACT

Background/Objective: This study evaluated emergency department (ED) visit trends, subsequent inpatient admissions for patients with inflammatory bowel disease (IBD) diagnosis and IBD-related abdominal pain (AP), and hospital-level variation in inpatient admission rates in the USA (US).

Methods: This population-based, cross-sectional study included data from Nationwide Emergency Department Sample (NEDS, 2006–2013) database. Patients ≥18 years of age with primary ED diagnosis of IBD/IBD-related AP were included. Variables included demographics, insurance information, household income, Quan-Charlson comorbidity score, ED discharge disposition, and length of hospital stay (2006, 2010, and 2013). Variation between hospitals using risk-adjusted admission ratio was estimated.

Results: Annual ED visits for IBD/100,000 US population increased (30 in 2006 vs 42 in 2013, p = 0.09), subsequent admissions remained stable (20 in 2006 vs 23 in 2013, p = 0.52). ED visits for IBD-related AP increased by 71% (7 in 2006 vs 12 in 2013; p = 0.12), subsequent admissions were stable (0.50 in 2006 vs 0.58 in 2013; p = 0.88). Proportion of patients with subsequent hospitalization decreased (IBD: 65.7% to 55.7%; IBD-related AP: 6.9% to 4.9%). Variation in subsequent inpatient admissions was 1.42 (IBD) and 1.96 (IBD-related AP).

Conclusions: An increase in annual ED visits was observed for patients with IBD and IBD-related AP; however, subsequent inpatient admission rate remained stable.

Introduction

According to a 2019 estimate from the Centers for Disease Control (CDC), approximately 1.3 million patients suffer from Inflammatory Bowel Disease (IBD) in the USA (US) [1]. Emergency department (ED) visits for patients with IBD are quite common and contribute to approximately 0.09% of all ED visits in the US, about 109,392 annually [2,3].

Overall treatment costs for patients with IBD are 3-fold higher than for similar patients without IBD [4]. Although healthcare utilization varies significantly across the globe owing to differences in sociodemographic characteristics and availability of healthcare facilities, studies have demonstrated that the overall treatment costs for IBD are 2–4 times higher in the US as compared with other Western countries [5,6]. The healthcare costs due to ED visits for IBD have also tripled in the US in <10 years ($194,773,824 in 2006 to 598,961,532 USD in 2014) [7,8].

Studies have shown a linear increase in ED visits for patients with IBD, however; the proportion of subsequent hospitalization in patients with IBD has decreased overtime [2,3]. This phenomenon has been driven by accessing alternative outpatient pathways, such as observation care and expedited clinic follow up for patients presenting to the ED with non-specific symptoms [9,10]. Abdominal pain (AP) is an early manifestation of inflammation and 50–70% patients with IBD experience AP during initial onset of an IBD flare [11]. Non-specific AP has also been ranked as the second most common reason for ED visits among all adults in the US and the most common reason for ED visits among patients with IBD [3,11].

Lack of standardized treatment algorithms for IBD contributes to varied decision-making for the treatment of patients with IBD presenting to the ED with AP. Approximately 40% of patients with IBD are hospitalized and most physicians believe that IBD-related

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hospitalizations occur due to ineffective disease management in the outpatient setting [12,13]. Optimizing treatment practices requires an understanding of the overall ED and hospitalization utilization pattern in patients with IBD.

Data illustrating national trends in the US population for ED visits and subsequent inpatient admissions among patients with IBD and especially in patients with IBD-related AP are scarce. The objective of the current study was to investigate trends in ED visits and subsequent inpatient admissions for patients with IBD and IBD-related AP. The study further evaluated ED encounters by patient characteristics and examined hospital-level variation in inpatient admission rates from the ED.

Methods

Data source

We obtained data from the Nationwide Emergency Department Sample (NEDS), the largest all-payer ED database in the US. NEDS is a Health Insurance Portability and Accountability Act compliant, statistically certified database sponsored by the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality (http://www.hcup-us.ahrq.gov/). NEDS comprises >30 million ED visits of patients from >900 hospitals representing roughly 20% of hospital-based ED data across the US. The database contains information regarding geographical region of ED visit, hospital and patient characteristics, and the nature of visits. It also contains the ED charge information for 87% of ED visits, regardless of the payer. NEDS promotes comparative studies of healthcare services, healthcare policy, and research across various areas including the use of and charges for ED services, medical treatment effectiveness, quality of ED care, impact of health policy changes, access to care, and utilization of health services by special populations.

According to the available data, NEDS contained 135 million ED visit related data in the year 2013. Data records available in NEDS are de-identified for public use and are protected through data use agreements. Therefore, analysis and publication by obtaining information from NEDS is exempt from institutional review board review.

Study design and study population

This US population-based cross-sectional study investigated ED visits and subsequent inpatient admissions among patients with IBD or IBD-related AP between Jan 2006 and Dec 2013.

We included patients of either sex, who were ≥18 years of age with a primary ED discharge diagnosis of IBD according to the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM codes for Crohn's Disease [CD]: 555.0, 555.1, 555.2, 555.9 and Ulcerative Colitis [UC]: 556.0, 556.1, 556.2, 556.3, 556.4, 556.5, 556.6, 556.8, 556.9). ICD-10 codes were not part of the NEDS dataset during the study time period.

We identified patients with IBD-related AP by a primary diagnosis of AP (ICD-9-CM: 789.0) and secondary diagnosis (DX2-DX15) of IBD (ICD-9-CM codes for CD and UC mentioned above), similar to previous studies [14,15]. In addition, we excluded patients if they had a secondary discharge diagnoses (DX2-DX15) of non-IBD outcomes that could have also correlated with a complaint of AP, including gall bladder disorders (ICD-9-CM: 575), cholelithiasis (ICD-9-CM: 574), acute and subacute necrosis of liver (ICD-9-CM: 570), chronic liver disease and cirrhosis (ICD-9-CM: 571), liver abscess and sequelae of chronic liver disease (ICD-9-CM: 572), other disorders of liver (ICD-9-CM: 573), other disorders of biliary tract (ICD-9-CM: 576), diseases of pancreas (ICD-9-CM: 577), gastrointestinal hemorrhage (ICD-9-CM: 578), appendicitis (ICD-9-CM: 540–543), hernia of abdominal cavity (ICD-9-CM: 550–553), intestinal obstruction without mention of hernia (ICD-9-CM: 560), diverticula of intestine (ICD-9-CM: 562), peritonitis and retroperitoneal infections (ICD-9-CM: 567), diseases of esophagus (ICD-9-CM: 530), gastric ulcer (ICD-9-CM: 531), duodenal ulcer (ICD-9-CM: 532), peptic ulcer site unspecified (ICD-9-CM: 533), gastrojejunal ulcer (ICD-9-CM: 534), gastritis and duodenitis (ICD-9-CM: 535), disorders of function of stomach (ICD-9-CM: 536), and complications of bariatric procedures (ICD-9-CM: 539).

Outcome measures

We collected demographic characteristics including age, sex, insurance information, household income, Quan-Charlson comorbidities index (CCI) score defined by all secondary discharge diagnoses, ED discharge disposition, and length of hospital stay (LOS) for the years 2006, 2010, and 2013. We report patient and hospital characteristics at the encounter level.

Statistical analysis

Patients with clinical and symptomatic conditions were categorized as per their demographic and clinical characteristics for the years 2006, 2010, and 2013. Outcomes

such as the number of annual ED visits and inpatient admissions were weighted to reflect national estimates from 2006 to 2013. We utilized a generalized linear regression model with a Poisson distribution and a Wald test to analyze the trend associated with ED visits and subsequent inpatient admissions over time, accounting for the US census population. We performed our analyses using SAS Enterprise Guide, version 7 (SAS Institute., Cary, NC) and considered two-tail p values <0.05 to be statistically significant.

Variation in subsequent admission rate was assessed with a hospital-based risk-standardized admission ratio (RSAR), i.e., the ratio of the number of predicted admissions to the number of expected admissions at a given hospital for each clinical outcome or symptom. We reported the ratio in RSAR as the ratio of the 75th percentile hospital to the 25th percentile hospital. A generalized linear mixed model that accounted for correlations among hospital encounters was used to estimate the RSAR for every hospital with ≥25 ED visits for each clinical outcome or symptom. The analytical model was adjusted for sex, household income, age, patient comorbidities (based on CCI), and insurance status. The coefficient of variation – defined as the ratio of the standard deviation to the mean – was also calculated.

Results

Baseline characteristics in patients with IBD

The mean age of patients who visited the ED was 40 years and the mean age of patients with subsequent inpatient admissions was 43 years. More than half of the patients in the study were women. Private insurance was most common among both patients with ED visits and those with subsequent inpatient admissions. A considerable proportion of patients with ED visits (2006: 16.8% and 2013: 20.0%) and subsequent inpatient admissions (13.8% and 16.0%) were uninsured. The proportion of ED visits and subsequent inpatient admissions did not vary significantly with household income across the three selected years. The regional distribution of ED visits and hospitalizations remained constant for the years 2006, 2010, and 2013. The CCI score remained mostly similar in patients who visited the ED (0.3 and 0.4) and in patients with subsequent inpatient admissions (0.4 and 0.5). The hospital length of stay was mostly similar over the study period (5.6 days and 4.9 days). The proportion of ED patients who were subsequently hospitalized reduced from 65.7% in 2006 to 55.7% in 2013 and most of the admitted patients were discharged home (85.4% and 84.6%) (Tables 1a and 1b).

Baseline characteristics in patients with IBD-related AP

The mean age of patients who were subsequently admitted was slightly greater than the patients who had visited the ED (Tables 2a and 2b). Patients with ED visits (37.2 years and 36.9 years, in 2006 and 2013, respectively) were comparatively younger than patients with subsequent inpatient admissions (40.6 years and 39.5 years, in 2006 and 2013, respectively). The majority of the ED visits(~60%) and subsequent inpatient admissions(~62%) for IBD-related AP were women. A greater proportion of patients with ED visits and those with subsequent inpatient admissions were privately insured. A considerable proportion of patients with ED visits (19.6% and 22.2%) and subsequent inpatient admissions (15.7% and 18.1%) were uninsured. Household income did not show an association with the extent of ED visits and subsequent inpatient admissions, however; ED visits increased in 2013 for patients with least household income (30.9%). The regional distribution of ED visits and hospitalizations remained constant for the years 2006, 2010, and 2013. The CCI score mostly remained the same for ED visits (0.1 and 0.2) and subsequent inpatient admissions (0.3 and 0.4) across the three selected years with a slight increase in 2013. Hospital length of stay mostly remained stable throughout the three selected years of the study (3.1 days and 3.0 days). The proportion of ED visits among patients with IBD-related AP who were subsequently hospitalized decreased from 6.9% in 2006 to 4.9% in 2013 and most of the admitted patients were discharged home (85.3% and 91.6%) (Tables 2a and 2b).

Trend Analysis of ED visits among patients with IBD

After accounting for US census population, annual ED visits among patients with IBD increased from 30.34 per 100,000 population in 2006 to 41.84 per 100,000 population in 2013 (p = 0.09). Annual subsequent inpatient admission from ED visits among patients with IBD were 19.93 per 100,000 population in 2006 and remained mostly stable with a minimal rise to 23.34 admissions per 100,000 population in 2013 (p = 0.52) (Figure 1).

Trend analysis of ED visits for IBD-related AP

After accounting for US census population, annual ED visits among patients with IBD-related AP increased from 7.28 per 100,000 population to 11.88 per 100,000 population in 2013 (p = 0.12) (Figure 2). For patients with IBD-related AP, the annual subsequent inpatient

Table 1a. Selected baseline demographic and clinical characteristics in patients with inflammatory bowel disease (IBD) visiting the ED in 2006, 2010, 2013.

	ED Visits			
	2006	2010	2013	Unadjusted OR (95% CI)[b]
Total number, N (%)	90,846 (100.0)	118,074 (100.0)	132,280 (100.0)	
Age (years), Mean± SD	40.8 ± 17.9	40.5 ± 17.4	40.3 ± 17.4	
Women (%)[a]	50,717 (55.8)	65,554 (55.5)	71,393 (54.0)	0.92 (0.91, 0.94)
Primary payer, N (%)[a]				
Insured, N (%)	75,341 (82.9)	94,842 (80.3)	105,647 (79.9)	0.81 (0.79, 0.83)
Private insurance	43,738 (48.1)	49,250 (41.6)	51,597 (39.0)	0.69 (0.67, 0.70)
Medicare	18,419 (20.3)	23,562 (20.0)	27,596 (20.9)	1.03 (1.01, 1.06)
Medicaid	13,184 (14.5)	22,030 (18.7)	26,454 (20.0)	1.47 (1.44, 1.50)
Uninsured, N (%)	15,251 (16.8)	22,909 (19.4)	26,470 (20.0)	1.24 (1.21, 1.27)
Median household income, N (%)[a]				
1st quarter ($1 – $37,999/year)	21,799 (24.0)	30,155 (25.5)	36,499 (27.6)	1.21 (1.18, 1.23)
2nd quarter ($38,000-$46,999/year)	21,716 (23.9)	31,682 (26.8)	35,933 (27.2)	1.19 (1.16, 1.21)
3rd quarter ($47,000 – $61,999/year)	22,317 (24.6)	27,366 (23.2)	31,487 (23.8)	0.96 (0.94, 0.98)
4th quarter ($62,000+/year)	23,234 (25.6)	26,388 (22.3)	25,919 (19.6)	0.71 (0.69, 0.72)
US region, N (%)				
Northeast	21,361 (23.5)	23,796 (20.2)	25,872 (19.6)	0.79 (0.77, 0.81)
Midwest	21,894 (24.1)	28,410 (24.1)	29,205 (22.1)	0.89 (0.87, 0.91)
South	32,225 (35.5)	45,724 (38.6)	54,908 (41.4)	1.29 (1.27, 1.31)
West	15,366 (16.9)	20,144 (17.1)	22,295 (16.9)	1.00 (0.97, 1.02)
Charlson Comorbidity Index Score, Mean± SD	0.3 ± 0.8	0.3 ± 0.9	0.4 ± 0.9	
Charlson Comorbidity Index Score, N (%)				
Score = 0	72,725 (80.1)	92,534 (78.4)	102,334 (77.4)	0.85 (0.83, 0.87)
Score = 1–3	17,146 (18.9)	23,979 (20.3)	28,112 (21.3)	1.16 (1.14, 1.18)
Score ≥4	975 (1.1)	1561 (1.3)	1835 (1.4)	1.30 (1.20, 1.40)
Discharge disposition, N (%)[a]				
Discharged, routine	28,222 (31.1)	45,911 (38.9)	56,966 (43.1)	1.68 (1.65, 1.71)
Admitted as an inpatient	59,682 (65.7)	70,771 (59.9)	73,784 (55.7)	0.66 (0.65, 0.67)
Other[c]	2453 (2.7)	569 (0.5)	446 (0.3)	0.35 (0.33, 0.37)

Numbers in parentheses indicate % unless otherwise stated. OR: odds ratio; CI: confidence interval; SD: standard deviation
[a]Numbers do not add up to 100% due to missing values or unreported categories. [b]Unadjusted odds ratio in 2013 relative to 2006 (95% confidence interval). [c]Other includes home healthcare, against medical advice, death, transfers to another type of facility, discharge destination unknown.

admissions remained stable between 2006 (0.50 per 100,000 population) and 2013 (0.58 per 100,000 population) with minimal rise (p = 0.88) (Figure 2).

Hospital-based risk standardized admission ratio

Based on the 398 hospitals with ≥25 ED visits for IBD, the ratio in RSAR between the 75th and 25th percentile hospitals was 1.42, with a coefficient of variation of 0.25, suggesting a notable variation in hospital admissions for IBD across hospitals. Similarly, based on the 81 hospitals with ≥25 ED visits for IBD-related AP, the ratio of RSAR for 75th-25th percentile hospitals was 1.96, with a coefficient of variation of 1.04, suggesting greater variation across hospitals in the rate of hospital admission for these type of visits (Figure 3).

Discussion

While patients with IBD showed an increase in ED visits during the study period, the rate of subsequent inpatient admissions remained stable. A similar trend was noted in patients with IBD-related AP for ED visits and subsequent inpatient admissions. The overall rate in ED visits and subsequent inpatient admissions across

different hospitals was similar for patients presenting with IBD-related issues, however; the rate of ED visits and subsequent inpatient admissions for patients specifically with IBD-related AP showed a greater variation.

A retrospective study evaluating the epidemiology of non-specific AP in patients with IBD reported that 31.5% of the ED visits among IBD patients were due to non-specific AP [16]. The present study showed that the ratio of patients visiting ED with IBD vs. IBD-related AP was approximately 3:1 to 4:1. The national-level numbers of ED visits and subsequent inpatient admissions by patients with IBD-related AP reported by the current study fill a data gap in the literature. We believe the current study captured a more complete picture of ED resource utilization by patients with IBD and its related symptom of AP. The percentage of subsequent inpatient admissions among patients who visited the ED was much higher (55.7%) when compared with patients visiting the ED for IBD-related AP (4.9%).

AP occurs due to sub-clinical inflammation, overgrowth of bacteria in the small intestine, food intolerances, and bowel dysmotility [17]. Weight loss, abdominal tenderness, depression, and nocturnal stools are significant predictors of IBD-related abdominal pain [18]. As such, AP is often left unresolved due to lack of

Table 1b. Selected baseline demographic and clinical characteristics in patients with inflammatory bowel disease (IBD) admitted to the hospital in 2006, 2010, 2013.

	Inpatient Admissions			
	2006	**2010**	**2013**	**Unadjusted OR (95% CI)[b]**
Total number, N (%)	59,682 (100.0)	70,772 (100.0)	73,784 (100.0)	
Age (years), Mean± SD	43.4 ± 19.2	43.2 ± 18.9	43.2 ± 19.0	
Women (%)[a]	33,160 (55.6)	39,426 (55.7)	39,257 (53.2)	0.91 (0.89, 0.93)
Primary payer, N (%)[a]				
Insured, N (%)	51,373 (86.1)	59,911 (84.7)	61,864 (83.8)	0.83 (0.81, 0.86)
Private insurance	29,859 (50.1)	31,177 (44.1)	30,454 (41.2)	0.70 (0.69, 0.72)
Medicare	14,028 (23.5)	16,759 (23.7)	18,423 (25.0)	1.08 (1.06, 1.11)
Medicaid	7486 (12.5)	11,975 (16.9)	12,987 (17.6)	1.49 (1.44, 1.54)
Uninsured, N (%)	8215 (13.8)	10,741 (15.2)	11,822 (16.0)	1.20 (1.16, 1.23)
Median household income, N (%)[a]				
1st quarter ($1 – $37,999/year)	13,314 (22.3)	16,495 (23.3)	19,311 (26.2)	1.24 (1.21, 1.27)
2nd quarter ($38,000-$46,999/year)	13,604 (22.8)	18,336 (25.9)	19,158 (26.0)	1.19 (1.16, 1.22)
3rd quarter ($47,000 – $61,999/year)	15,166 (25.4)	16,895 (23.9)	17,878 (24.2)	0.94 (0.92, 0.96)
4th quarter ($62,000+/year)	16,540 (27.7)	17,529 (24.8)	15,999 (21.7)	0.72 (0.70, 0.74)
US region, N (%)				
Northeast	15,294 (25.6)	16,452 (23.2)	16,194 (21.9)	0.82 (0.80, 0.84)
Midwest	14,313 (24.0)	16,101 (22.8)	15,182 (20.6)	0.82 (0.80, 0.84)
South	20,410 (34.2)	26,976 (38.1)	30,914 (41.9)	1.39 (1.36, 1.42)
West	9665 (16.2)	11,243 (15.9)	11,494 (15.6)	0.95 (0.93, 0.98)
Charlson Comorbidity Index Score, Mean± SD	0.4 ± 1.0	0.5 ± 1.0	0.5 ± 1.1	
Charlson Comorbidity Index Score, N (%)				
Score = 0	43,760 (73.3)	50,021 (70.7)	50,709 (68.7)	0.80 (0.78, 0.82)
Score = 1–3	14,958 (25.1)	19,273 (27.2)	21,393 (29.0)	1.22 (1.19, 1.25)
Score ≥4	964 (1.6)	1479 (2.1)	1682 (2.3)	1.42 (1.31, 1.54)
Length of stay (days), Mean± SD	5.6 ± 11.0	5.1 ± 9.1	4.9 ± 8.2	
Discharge disposition, N (%)[a]				
Discharged, routine	50,942 (85.4)	60,277 (85.2)	62,430 (84.6)	1.02 (0.99, 1.05)
Admitted as an inpatient	N/A	N/A	N/A	
Other[c]	3851 (6.5)	3886 (5.5)	3891 (5.3)	0.98 (0.95, 1.01)

Numbers in parentheses indicate % unless otherwise stated. OR: odds ratio; CI: confidence interval; SD: standard deviation; N/A: not available
[a]Numbers do not add up to 100% due to missing values or unreported categories. [b]Unadjusted odds ratio in 2013 relative to 2006 (95% confidence interval).
[c]Other includes home healthcare, against medical advice, death, transfers to another type of facility, discharge destination unknown.

effective treatment. Treatment of AP with analgesics and opioids provides pain relief without any improvement in disease course. Optimum therapy for patients must include pain management combined with effective IBD therapy [17].

An increasing prevalence of IBD is responsible for the rising direct and indirect treatment costs of the disease [8]. The aggregate national cost of ED visits has shown a substantial rise of 207.5% and the cost of individual ED visits increased by 102.5% from 2006 to 2014 in the US [7]. Although evidence evaluating the ED visit pattern in patients diagnosed with IBD is scarce, our findings were consistent with those in a recent study evaluating the ED utilization in US patients with IBD which reported 75.7 IBD-related ED visits per 100,000 ED visits in 2006 which increased to 100.1 IBD-related ED visits per 100,000 ED visits in 2014 [7]. In addition, our results showing a decrease in the proportion of inpatient admissions subsequent to IBD-related ED visits (65.7% in 2006 to 55.7% in 2013) were consistent with *Huh. et al*, who reported a decrease in hospitalization rates for IBD subsequent to an ED visit between 2007 (65.2%) and 2014 (51.6%) [3]. Regarding the possibility that these trends of decreasing hospital admission subsequent to ED visits

were not specific to IBD patients, a similar study using NEDS data from the same time period in contrast reported a decrease in both the rate of ED visits and subsequent hospital admissions among patients with coronary artery disease [14].

A significant variation in the rate of subsequent inpatient admissions was observed for patients with IBD (RSAR: 1.42) and for patients with IBD-related AP (RSAR: 1.96) [18]. Use of different treatment modalities, variation in demographic characteristics of the patients across geographies, and differences in hospital infrastructure have been associated with variation in hospitalization rates [19]. In particular, poor adherence to clinical practice guidelines has been reported as a contributing factor in high RSARs [20]. Consistent with this, a retrospective study reported that implementation of specialty inpatient IBD care can reduce the chance of disease remission [21]. Studies also report that implementation of a standardized treatment algorithm for patients with IBD can help reduce over-utilization of ED services and hospital length of stay [22]. Incorporating biologic agents into treatment algorithms for patients with IBD has also been shown to optimize patient outcomes, quality of life, and decrease healthcare costs [21,23,24].

Table 2a. Selected baseline demographic and clinical characteristics in patients with IBD-related abdominal pain visiting the ED in 2006, 2010, and 2013.

	ED visits			
	2006	2010	2013	Unadjusted OR (95% CI)[b]
Total number, N (%)	21,800 (100.0)	34,513 (100.0)	37,551 (100.0)	
Age (years), Mean± SD	37.2 ± 13.5	36.6 ± 13.1	36.9 ± 13.4	
Women (%)[a]	13,079 (60.0)	20,648 (59.8)	22,718 (60.5)	1.02 (0.98, 1.06)
Primary payer, N (%)[a]				
Insured, N (%)	17,465 (80.1)	26,536 (76.9)	29,150 (77.6)	0.85 (0.82, 0.89)
Private insurance	9230 (42.3)	11,905 (34.5)	12,642 (33.7)	0.69 (0.67, 0.71)
Medicare	3816 (17.5)	6168 (17.9)	7116 (18.9)	1.10 (1.05, 1.15)
Medicaid	4419 (20.3)	8463 (24.5)	9392 (25.0)	1.31 (1.26, 1.36)
Uninsured, N (%)	4276 (19.6)	7793 (22.6)	8329 (22.2)	1.17 (1.12, 1.22)
Median household income, N (%)[a]				
1st quarter ($1 – $37,999/year)	5763 (26.4)	9912 (28.7)	11,617 (30.9)	1.24 (1.20, 1.29)
2nd quarter ($38,000-$46,999/year)	5542 (25.4)	9985 (28.9)	10,612 (28.3)	1.15 (1.11, 1.20)
3rd quarter ($47,000 – $61,999/year)	5450 (25.0)	7887 (22.9)	8062 (21.5)	0.82 (0.78, 0.85)
4th quarter ($62,000+/year)	4608 (21.1)	6007 (17.4)	6641 (17.7)	0.80 (0.76, 0.83)
US region, N (%)				
Northeast	3488 (16.0)	4760 (13.8)	5819 (15.5)	0.96 (0.92, 1.01)
Midwest	6918 (31.7)	11,286 (32.7)	10,729 (28.6)	0.86 (0.83, 0.89)
South	8033 (36.9)	12,985 (37.6)	15,293 (40.7)	1.18 (1.14, 1.22)
West	3361 (15.4)	5482 (15.9)	5710 (15.2)	0.98 (0.94, 1.03)
Charlson Comorbidity Index Score, Mean± SD	0.1 ± 0.5	0.2 ± 0.5	0.2 ± 0.6	
Charlson Comorbidity Index Score, N (%)				
Score = 0	19,363 (88.8)	30,129 (87.3)	31,761 (84.6)	0.69 (0.66, 0.73)
Score = 1–3	2399 (11.0)	4238 (12.3)	5666 (15.1)	1.44 (1.37, 1.51)
Score ≥4	38 (0.2)	146 (0.4)	124 (0.3)	1.90 (1.32, 2.73)
Discharge disposition, N (%)[a]				
Discharged, routine	18,615 (85.3)	31,161 (90.3)	34,386 (91.6)	1.86 (1.76, 1.96)
Admitted as an inpatient	1496 (6.9)	2401 (7.0)	1840 (4.9)	0.70 (0.65, 0.75)
Other[c]	1255 (5.8)	145 (0.4)	243 (0.6)	0.44 (0.40, 0.47)

Numbers in parentheses indicate % unless otherwise stated. OR: odds ratio; CI: confidence interval; SD: standard deviation
[a]Numbers do not add up to 100% due to missing values or unreported categories. [b]Unadjusted odds ratio in 2013 relative to 2006 (95% confidence interval).
[c]Other includes home healthcare, against medical advice, death, transfers to another type of facility, discharge destination unknown.

Understanding the factors responsible for increased ED visits in patients with IBD is vital for optimizing management strategies among patients with IBD. Studies suggest that presence of psychiatric illness, low hemoglobin levels, age, and lack of access to gastroenterologists were significantly associated with higher rates of ED visits among patients with IBD [22,25]. The rise of ED visits among patients with IBD not only suggests an increase in the cost of overall IBD treatment, but also imply that the incidence of IBD has increased. Improving the quality of care for patients with IBD can reduce repeat ED visits. Although adequate clinical practice guidelines are available for the management of IBD, large variations in treatment patterns among practicing gastroenterologists/physicians have led to a gap in IBD management [26–28]. Translation of recommended best practices into the care patients with IBD actually receive is needed to achieve optimal control of the disease.

The gap in IBD management could be due to the lack of a widely accepted standard treatment algorithm in the ED and outpatient clinic settings. Disease complexity coupled with non-specific symptoms such as AP demand a patient centered treatment approach. Although AP is one of the most common symptoms

of IBD, it is under-researched and often inappropriately managed [13]. Access to hospitals equipped adequately for the management of IBD is essential to achieve treatment goals. Studies have shown that lack of early gastroenterology care in patients with IBD has impacted hospitalization rates for IBD and overall clinical outcomes associated with the treatment of IBD [29].

One of the prime strengths of this study was the utilization of the NEDS database, which is the most representative US sample of ED visits consisting of data from a wide geographical area and a large sample size for diverse disorders [30]. Subgroup estimates such as different age groups or different hospital settings were possible because this database offers detailed information regarding geographical, hospital and patient characteristics, nature of ED visits, and clinical and resource use in inpatient care. Furthermore, several factors potentially confounding the estimates of ED visit rates and inpatient admissions such as the patient and hospital characteristics were controlled in the present analysis.

Our findings are subject to several limitations. First, our approach was vulnerable to the possibility of coding bias, misclassification of diagnosis codes, and lack of coding heterogeneity. IBD-related AP was identified using ICD-

Table 2b. Selected baseline demographic and clinical characteristics in patients with IBD-related abdominal pain admitted to the hospital in 2006, 2010, and 2013.

	Inpatient admissions			
	2006	**2010**	**2013**	**Unadjusted OR (95% CI)[b]**
Total number, N (%)	1496 (100.0)	2401 (100.0)	1840 (100.0)	
Age (years), Mean± SD	40.6 ± 16.1	39.2 ± 15.2	39.5 ± 16.4	
Women (%)[a]	970 (64.9)	1547 (64.4)	1075 (58.4)	0.76 (0.66, 0.88)
Primary payer, N (%)[a]				
Insured, N (%)	1261 (84.3)	2064 (86.0)	1508 (81.9)	0.85 (0.70, 1.02)
Private insurance	585 (39.1)	903 (37.6)	608 (33.0)	0.77 (0.67, 0.89)
Medicare	350 (23.4)	561 (23.4)	507 (27.5)	1.24 (1.06, 1.46)
Medicaid	326 (21.8)	600 (25.0)	393 (21.4)	0.97 (0.83, 1.15)
Uninsured, N (%)	235 (15.7)	337 (14.0)	332 (18.1)	1.18 (0.98, 1.42)
Median household income, N (%)[a]				
1st quarter ($1 – $37,999/year)	340 (22.8)	642 (26.7)	466 (25.3)	1.16 (0.99, 1.37)
2nd quarter ($38,000-$46,999/year)	361 (24.1)	590 (24.6)	598 (32.5)	1.53 (1.31, 1.79)
3rd quarter ($47,000 – $61,999/year)	404 (27.0)	539 (22.5)	343 (18.7)	0.62 (0.52, 0.73)
4th quarter ($62,000+/year)	362 (24.2)	537 (22.4)	386 (21.0)	0.84 (0.71, 0.99)
US region, N (%)				
Northeast	356 (23.8)	458 (19.1)	340 (18.5)	0.73 (0.61, 0.86)
Midwest	507 (33.9)	910 (37.8)	613 (33.2)	0.97 (0.84, 1.13)
South	444 (29.7)	688 (28.7)	652 (35.5)	1.30 (1.22, 1.51)
West	189 (12.6)	345 (14.4)	235 (12.8)	1.01 (0.82, 1.24)
Charlson Comorbidity Index Score, Mean± SD	0.3 ± 0.7	0.3 ± 0.9	0.4 ± 1.0	
Charlson Comorbidity Index Score, N (%)				
Score = 0	1144 (76.5)	1837 (76.5)	1383 (75.2)	0.93 (0.79, 1.09)
Score = 1–3	347 (23.2)	527 (22.0)	429 (23.3)	1.01 (0.86, 1.18)
Score ≥4	5 (0.3)	37 (1.5)	27 (1.5)	4.44 (1.71, 11.56)
Length of stay (days), Mean± SD	3.1 ± 3.4	2.8 ± 2.8	3.0 ± 3.3	
Discharge disposition, N (%)[a]				
Discharged, routine	1110 (74.2)	1481 (61.7)	1073 (58.3)	0.69 (0.55, 0.86)
Admitted as an inpatient	N/A	N/A	N/A	
Other[c]	29 (1.9)	86 (3.6)	60 (3.3)	1.45 (1.17, 1.81)

Numbers in parentheses indicate % unless otherwise stated. OR: odds ratio; CI: confidence interval; SD: standard deviation; N/A: not available
[a]Numbers do not add up to 100% due to missing values or unreported categories. [b]Unadjusted odds ratio in 2013 relative to 2006 (95% confidence interval).
  [c]Other includes home healthcare, against medical advice, death, transfers to another type of facility, discharge destination unknown.
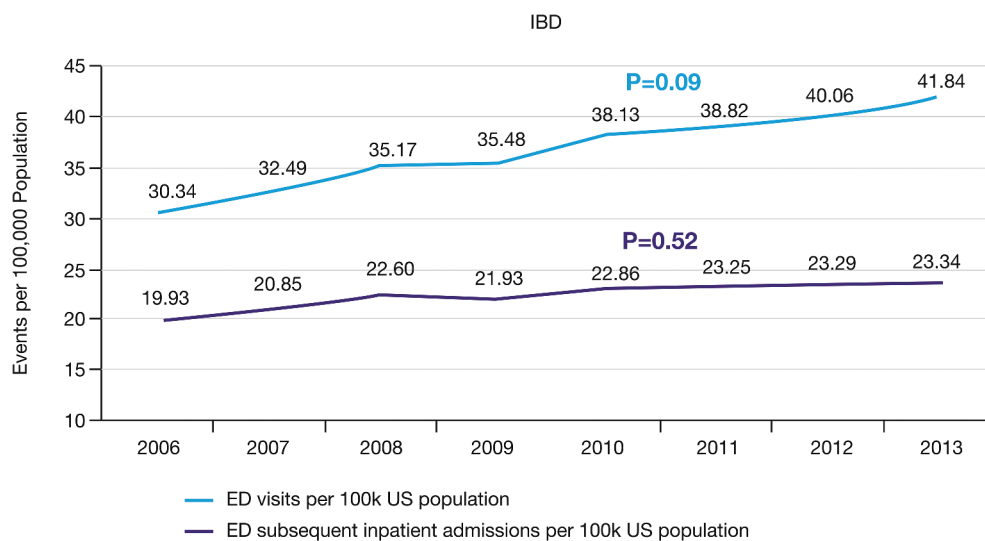

Figure 1. ED visits and subsequent inpatient admissions for IBD (2006–2013).
ED: emergency department; IBD: inflammatory bowel disease. IBD ICD-9-CM codes: Crohn's disease, 555.x; ulcerative colitis, 556.x. P value is unadjusted.

9-CM codes in the NEDS database rather than laboratory-confirmed diagnoses. Considering that the ICD-9-CM codes for IBD were not validated, misclassification or error in coding of IBD-related AP as a primary diagnosis with IBD as a secondary diagnosis may have contributed to a greater variation in hospital-based RSAR across different hospitals. Secondly, capture of data at encounter level rather than patient level might have presented
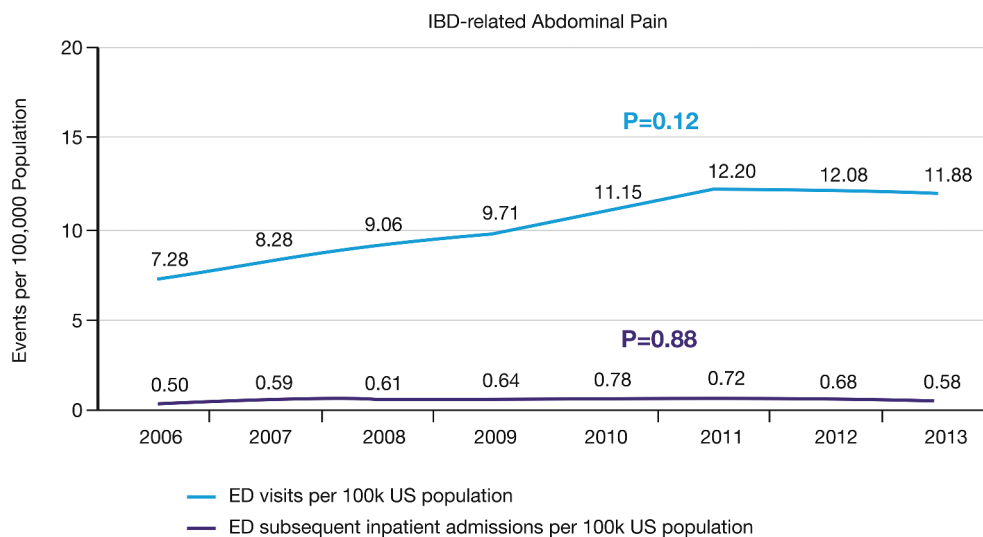
IBD-related Abdominal Pain

Figure 2. ED visits and subsequent inpatient admissions for IBD-related abdominal pain (2006–2013).

ED: emergency department; IBD: inflammatory bowel disease. IBD ICD-9-CM codes: Crohn's disease, 555.x; ulcerative colitis, 556.x; abdominal pain ICD-9-CM code: 789.0x. P value is unadjusted.
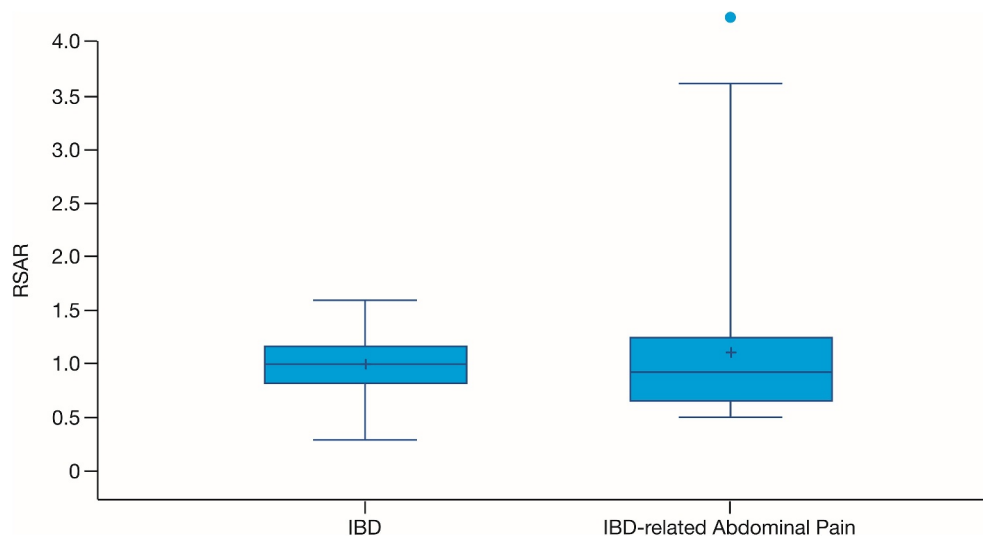

Figure 3. Hospital-based ED RSAR for IBD, IBD-related abdominal pain in 2013.

IBD: inflammatory bowel disease; RSAR: risk-standardized admission ratio

a challenge to identify multiple visits by the same patient. Lack of data regarding covariates that potentially influence hospitalization such as prior hospitalization, concomitant medications, and clinical data to define disease severity (including comorbidities) may also be considered as limitations. Lastly, conducting the trend test without adjusting for potential confounding factors was also a limitation of the study.

In conclusion, the present study detected a trend towards increased annual ED visits from 2006 to 2013 for IBD and for IBD-related abdominal pain. However, the rise in rate of subsequent inpatient admissions for both ED visit types was lower than the rise in visit rate,

suggesting increasing use of outpatient alternatives to care in the study population. The decision to admit a patient to the hospital was more variable for IBD-related AP, indicating a potential need for evidence-based research to improve translation of clinical practice guidelines into standard care.

Disclosure statement

design, data interpretation and drafting of the manuscript. CWB has worked as a consultant and advisory board member for Janssen Pharmaceuticals, Salix Pharmaceuticals and Vapotherm; has previously received research funding from Janssen Pharmaceuticals and Boehringer Ingelheim; and has also served as an advisory board member and as a paid speaker for Roche Diagnostics.

Author contributions

Data Availability Statement

Please refer the NEDS database website (https://www.hcup-us.ahrq.gov/) for data included in the present study.

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