Modifiable Risk Factors for Hospital Readmission Among Patients with Inflammatory Bowel Disease in a Nationwide Database

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Background: Previous studies suggest that disease activity alone does not reliably predict hospital readmission among patients with inflammatory bowel diseases (IBDs). Using a national database, we aimed to further describe the burden of readmissions for IBD and identify modifiable risk factors.

Methods: We performed a retrospective cohort study using 2013 data from the Nationwide Readmission Database (NRD). Using *International Classification of Diseases, ninth Revision, Clinical Modification (ICD-9-CM)* codes, we identified adult patients with discharge diagnoses of ulcerative colitis or Crohn's disease and ascertained diagnoses of anxiety, depression, chronic pain, tobacco use, and other comorbidities during index admission. Logistic regression was used to estimate factors associated with hospital readmission.

Results: Among 52,498 hospitalizations of patients with IBD (63% Crohn's disease and 37% ulcerative colitis), 12,407 (24%) were readmitted within 90 days of the index hospitalization, resulting in roughly $576 million in excess charges. In multivariable analysis of patients with Crohn's disease, anxiety (odds ratio [OR] 1.31, 95% confidence interval [CI], 1.21–1.43), depression (OR 1.27, 95% CI, 1.07–1.50), chronic pain (OR 1.31, 95% CI, 1.18–1.46), and tobacco abuse (OR 1.13, 95% CI, 1.06–1.22) were associated with a significant increase in odds of readmission. Among patients with ulcerative colitis, anxiety (OR 1.28, 95% CI, 1.14–1.45), depression (OR 1.35, 95% CI, 1.07–1.70), and chronic pain (OR 1.44, 95% CI, 1.21–1.73) were associated with a significant increase in odds of readmission.

Conclusions: Readmission occurs frequently in patients with IBD and is costly. Anxiety, depression, and chronic pain may represent targets for interventions to prevent 90-day hospital readmission in this population.

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Key Words: anxiety, depression, Crohn's disease, ulcerative colitis, readmission

Hospital readmissions are a key metric associated with quality of health care in the United States (US).[1] Furthermore, hospital readmissions place a great burden on the health care system and patients.[1] In the US, an estimated 1.2 to 1.4 million patients have chronic inflammatory bowel disease (IBD); including both ulcerative colitis (UC) and Crohn's disease (CD).[2,3] These disorders are characterized by recurring gastrointestinal symptoms often requiring gastrointestinal procedures, intravenous fluid and medication support, hospitalization, and/or surgery. Thus, those with IBD represent a significant portion of patients with gastrointestinal disorders who are hospitalized.[4]

Many studies evaluating readmissions in IBD have been focused on the identification of factors associated with readmission in the postoperative period, including the need for emergent surgery during the index admission and preoperative comorbidities.[5–8] The existing literature on IBD readmissions after nonsurgical hospitalizations in the US includes single-center experiences, where generalizability may be limited. However, these studies have suggested that poorly controlled pain and depression,[9] and lack of compliance with outpatient follow-up[4] were associated with a higher likelihood of readmission. Previous work has also demonstrated that disease activity was not related to readmission within 90 days,[9] suggesting the role of other, potentially modifiable factors, such as psychiatric disease, tobacco abuse, and chronic pain.

To date, there has not been an assessment of national data to assess the factors associated with readmission in patients with IBD. Our objective was to use the Nationwide Readmissions Database (NRD) to describe the overall disease burden of readmission in patients with IBD and analyze the factors

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associated with hospital readmission within 90 days, with a specific interest in the role that modifiable risk factors play in readmission.

MATERIALS AND METHODS

Data Source

We conducted a retrospective cohort study using 2013 data from the NRD, a resource of the Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases. The NRD is a publicly available all-payer inpatient database from the US that includes data from 14,325,172 hospitalizations. Using data from 21 states, the NRD is designed to be nationally representative of readmission rates for all payers and the uninsured. The NRD contains more than 100 clinical and nonclinical variables,[10] up to 15 diagnostic and procedure codes based on *International Classification of Diseases, ninth Revision, Clinical Modification (ICD-9-CM)* coding, hospital characteristics, and outcomes, including hospital length of stay (LOS), readmission, and total charges. Because of the deidentified nature of the data, this study was determined exempt from review by the University of North Carolina Institutional Review Board.

Study Sample

We examined discharge data from patients age 18 years and older. Any patient with an *ICD-9-CM* diagnosis code indicating CD (555.xx) or UC (556.xx) was eligible for inclusion in this study. To minimize misclassification of subgroups of IBD (CD or UC), we excluded patients with discharge codes for both CD and UC (n = 557). The index admission was defined as the first admission where an *ICD-9-CM* diagnosis code for CD or UC was recorded as one of the first 3 diagnosis codes. Given our interest in evaluating 90-day readmissions, only those patients with a full 90 days between the date of discharge from their index admission and December 31, 2013 were included in these analyses.

Outcomes of Interest

The primary outcome of interest, the first readmission within 90 days of the index hospitalization, was determined by linking discharge data of individual patients using a unique identifier specified within the NRD. We also evaluated the designated reason for readmission, as defined by the primary *ICD-9-CM* diagnosis code and the total charges and LOS associated with readmission.

Covariates

During the index admission, multiple covariates associated with a patient's underlying IBD or perceived risk of readmission were evaluated. Patient demographics including age, sex, and primary insurance/payer for the index hospitalization were assessed. *ICD-9-CM* diagnosis codes were used to identify additional clinical factors suggested to be independent predictors or confounders of the relationship between IBD and hospital readmission. These included the components of the Deyo modification of the Charlson comorbidity index, which has been validated for use as a marker of comorbid illness in studies using large administrative databases.[11] Given our specific interest in the role that modifiable risk factors such as depression (*ICD-9-CM* 296.2, 296.3, 298.0, 300.4, 311), chronic pain (338.2 or 338.4), tobacco abuse (305.1), and anxiety (300, 300.2) play in readmission we made the a priori decision to include these covariates in our analyses. For the definition of anxiety and depression, we used *ICD-9-CM* definitions that have previously been validated in IBD using administrative data.[12] Similarly, we used diagnosis coding for *Clostridium difficile* infection (CDI) that has previously been used in HCUP databases.[13] All *ICD-9-CM* codes used in our analyses are detailed in the Supplementary Table, Supplemental Digital Content 1, http://links.lww.com/IBD/B497.

We also evaluated hospital-specific factors including hospital location/teaching status, as well as IBD-related hospital volume. For the evaluation of IBD-related hospital volume, we used previously identified cutoffs from the Nationwide Inpatient Sample (NIS) of low, medium, and high centers ($\leq$50 admissions annually, 51–150, and $>$150 admissions, respectively).[14] Because of high correlation between location/teaching status and hospital volume, only hospital location/teaching status was included in our final models. IBD-related surgery was included in the models for CD but not UC, given that patients with UC undergoing colectomy could have a scheduled readmission for repeat operation within the 90-day follow-up for readmission, with the ultimate plan for ileal pouch–anal anastomosis or other pouch operation.

Statistical Analysis

All analyses were performed using survey procedures in SAS version 9.4 (SAS Institute, Cary, NC) to account for the complex survey design. Data were weighted to reflect estimates of the national population, including the mean and proportions presented. Chi-square test and Student's *t* test were used to compare proportions and continuous variables, respectively. We used logistic regression modeling to estimate the unadjusted odds of a readmission within 90 days of the index hospitalization for the covariates of interest. Based on clinical knowledge and previously reported risk factors for readmission, multivariable logistic regression models were then constructed to evaluate the association between risk factors and readmission within 90 days, adjusting for potential confounders. All factors were included in the model because of their clinical relevance, including payer and hospital-specific factors, and all factors included in the final models were identified a priori. A 2-tailed *P*-value of 0.05 was chosen as the threshold for statistical significance for all tests. Odds ratios (ORs) and 95% confidence intervals (CIs) are presented.

RESULTS

Among 52,498 patients with a diagnosis of IBD in the NRD (63% CD and 37% UC), 12,407 (24%) required readmission within 90 days of their index hospitalization. In univariate analysis, patients requiring readmission were younger, had higher

Charlson comorbidity index scores, were more likely to be admitted to metropolitan teaching hospitals, and were more likely to have Medicare or Medicaid insurance (Tables 1 and 2). In addition, patients requiring hospital readmission were more likely to have a diagnosis of anxiety, depression, chronic pain, tobacco abuse, or CDI. Among patients with CD, those requiring readmission were more likely to have a diagnosis of a fistula (Table 1).

Readmission resulted in an additional 74,059 hospital days for those affected. The median LOS for the first readmission for patients with CD was 3.45 days (interquartile range: 1.93–6.07) compared with a median LOS of 4.14 days (interquartile range: 2.40–7.03) for patients with UC ($P = 0.181$). The 5 most frequent primary diagnoses for readmissions among patients with CD were CD (47%), intestinal obstruction (560.81, 560.89, 560.9, 1.7%) septicemia (*ICD-9-CM* 038.9, 1.2%), anal and rectal abscess (566, 0.4%), and acute kidney failure (584.9, 0.3%). The 5 most frequent primary diagnoses for readmissions among patients with UC were UC (60%), septicemia (3%), intestinal obstruction (1.4%), CDI (1.2%), and acute kidney failure (0.6%).

Among patients with IBD who were readmitted within 90 days, the median total charges for the first readmission were $27,162 (interquartile range: $15,159–$50,606). The median total charges for the first readmission for patients with UC were significantly greater than patients with CD ($29,881 versus $25,862,

TABLE 1. Baseline Clinical and Demographic Characteristics of Patients with CD in the 2013 NRD

	No Readmission, n = 24,076 (%)	Readmission, n = 8267 (%)	*P*
Age			<0.001
18–39	10,798 (45)	4040 (49)	
40–59	7968 (33)	2634 (32)	
≥60	5002 (21)	1516 (18)	
Female sex	13,370 (56)	4441 (54)	0.005
Anxiety	2678 (11)	1268 (15)	<0.001
Depression	592 (2)	285 (3)	<0.001
Tobacco abuse	4246 (17)	1805 (22)	<0.001
Chronic pain	1434 (6)	811 (10)	<0.001
Charlson comorbidity score			<0.001
≤1	22,050 (92)	7397 (89)	
2	1180 (5)	492 (6)	
>2	846 (4)	378 (5)	
Location and teaching status of hospital			<0.001
Metropolitan nonteaching	9439 (39)	3075 (37)	
Metropolitan teaching	12,830 (51)	4673 (57)	
Rural	1807 (8)	519 (6)	
Payer/insurance			<0.001
Medicare	5818 (24)	2392 (29)	
Medicaid	3383 (14)	1807 (22)	
Private insurance	11,657 (48)	2993 (36)	
Self-pay	1833 (8)	618 (5)	
No charge	292 (1)	95 (1)	
Other	1072 (4)	346 (4)	
CDI	479 (2)	249 (3)	<0.001
Need for IBD-related surgery	3834 (16)	941 (11)	<0.001
LOS for index hospitalization, d			<0.001
≤3	12,370 (51)	3599 (44)	
4–7	8050 (33)	2970 (36)	
>7	3656 (15)	1698 (21)	
Presence of a fistula (CD only)	1464 (6)	643 (8)	<0.001
Small bowel obstruction (CD only)	10,608 (18)	3572 (17)	0.534

TABLE 2. Baseline Clinical and Demographic Characteristics of Patients with UC in the 2013 NRD

	No Readmission, n = 16,015 (%)	Readmission, n = 4140 (%)	*P*
Age			0.002
18–39	5787 (36)	1584 (38)	
40–59	5044 (31)	1199 (29)	
≥60	4990 (31)	1297 (31)	
Female sex	8441 (53)	2069 (50)	0.004
Anxiety	1508 (9)	501 (12)	<0.001
Depression	368 (2)	110 (3)	0.023
Tobacco abuse	1388 (9)	330 (8)	0.178
Chronic pain	606 (4)	229 (6)	<0.001
Charlson comorbidity score			<0.001
≤1	13,847 (86)	3489 (84)	
2	1116 (7)	347 (7)	
>2	1052 (7)	344 (8)	
Location and teaching status of hospital			<0.001
Metropolitan nonteaching	6409 (40)	1499 (36)	
Metropolitan teaching	8583 (54)	2432 (59)	
Rural	1023 (6)	209 (5)	
Payer/insurance			<0.001
Medicare	4402 (27)	1224 (30)	
Medicaid	1899 (12)	678 (16)	
Private insurance	7614 (48)	1771 (43)	
Self-pay	1081 (7)	203 (5)	
No charge	168 (1)	41 (1)	
Other	827 (5)	223 (5)	
CDI	772 (5)	227 (5)	0.056
LOS for index hospitalization, d			<0.001
≤3	7108 (44)	1425 (34)	
4–7	5830 (36)	1665 (40)	
>7	3077 (19)	1050 (25)	

$P = 0.019$). When aggregated among all IBD patients in the NRD, the total charges attributed to the first readmission within 90 days were $576,702,174.

Factors Associated with Readmission in CD

Several factors were associated with readmission within 90 days among patients with CD, in both unadjusted and adjusted analysis. In multivariable analysis, anxiety (OR 1.18, 95% CI, 1.11–1.26), depression (OR 1.27, 95% CI, 1.07–1.50), chronic pain (OR 1.31, 95% CI, 1.18–1.46), and tobacco abuse (OR 1.13, 95% CI, 1.06–1.22) were associated with a significant increase in odds of readmission within 90 days of index hospitalization (Table 3). In addition, younger age, diagnosis of a fistula, higher Charlson comorbidity scores, CDI, Medicare and Medicaid insurance status or self-pay status, and an LOS greater than 3 days on the index admission all were associated with increased odds of readmission within 90 days (Table 3). An IBD-related surgery during the index admission was associated with decreased odds of readmission within 90 days (OR 0.56, 95% CI, 0.51–0.61). When evaluating hospital-related factors, patients admitted to a rural (OR 0.75, 95% CI, 0.67–0.84) or a metropolitan nonteaching hospital (0.88, 95% CI, 0.83–0.93) were less likely to be readmitted when compared with patients admitted to metropolitan teaching hospitals.

Factors Associated with Readmission in UC

When patients with UC were evaluated in multivariable analysis, anxiety (OR 1.28, 95% CI, 1.14–1.45), depression (1.35, 95% CI, 1.07–1.70), and chronic pain (OR 1.44, 95% CI, 1.21–1.73) were also associated with a significant increase in odds of readmission within 90 days of index hospitalization (Table 4). Younger age and LOS of greater than 3 days were associated with increased odds of readmission, as were Medicare and Medicaid insurance status, and higher Charlson comorbidity scores (Table 4). In addition, patients admitted to a rural or metropolitan nonteaching hospital were less likely to be readmitted when compared with patients admitted to metropolitan teaching hospitals (Table 4).

TABLE 3. Unadjusted and Adjusted Analyses, Odds of Readmission Among Patients with CD in the 2013 NRD

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age		
18–39	1.14 (1.07–1.22)	1.18 (1.11–1.26)
40–59	Reference	Reference
>59	0.94 (0.86–1.01)	0.78 (0.71–0.86)
Female sex	0.93 (0.88–0.98)	0.87 (0.82–0.92)
Anxiety	1.51 (1.39–1.63)	1.31 (1.21–1.43)
Depression	1.53 (1.30–1.79)	1.27 (1.07–1.50)
Tobacco abuse	1.30 (1.21–1.39)	1.13 (1.06–1.22)
Chronic pain	1.69 (1.53–1.87)	1.31 (1.18–1.46)
Charlson comorbidity score		
≤1	Reference	Reference
2	1.25 (1.11–1.41)	1.17 (1.03–1.33)
>2	1.38 (1.21–1.58)	1.30 (1.12–1.51)
Location and teaching status of hospital		
Metropolitan nonteaching	0.87 (0.83–0.92)	0.88 (0.83–0.93)
Metropolitan teaching	Reference	Reference
Rural	0.77 (0.69–0.85)	0.75 (0.67–0.84)
Payer/insurance		
Medicare	1.57 (1.47–1.68)	1.64 (1.50–1.78)
Medicaid	2.05 (1.90–2.21)	1.79 (1.66–1.94)
Private insurance	Reference	Reference
Self-pay	1.25 (1.12–1.39)	1.13 (1.02–1.27)
No charge	1.36 (1.03–1.78)	1.17 (0.89–1.55)
Other	1.12 (0.98–1.29)	1.07 (0.93–1.23)
CDI	1.70 (1.44–2.02)	1.47 (1.23–1.75)
Need for IBD-related surgery	0.67 (0.61–0.73)	0.56 (0.51–0.61)
LOS for index hospitalization, d		
≤3	Reference	Reference
4–7	1.27 (1.19–1.35)	1.31 (1.23–1.40)
>7	1.56 (1.44–1.68)	1.62 (1.49–1.77)
Presence of a fistula	1.32 (1.18–1.46)	1.42 (1.26–1.59)

All variables included in the final multivariable analysis are listed above.

DISCUSSION

In a nationally representative database, we identified several potentially modifiable risk factors for readmission among patients with UC and CD, including concomitant diagnoses of anxiety, depression, or chronic pain conditions. Almost one-fourth of patients admitted with a diagnosis of IBD in the 2013 NRD were readmitted within 90 days of their index hospitalization. Additional risk factors for readmission include markers of more complex disease such as fistulizing disease among patients with CD and an increased LOS on the index admission. Insurance or payer status was also significantly associated with increased odds of readmission, with Medicare or Medicaid insurance being significantly associated with readmission among patients with both UC and CD.

Previous single-center studies have associated an increased risk of hospital readmission with factors such as chronic pain and depression.[9] Abdominal pain is a common symptom among patients with IBD[15] and may be associated with IBD-irritable bowel syndrome.[16,17] Although there were no available data on medication use within the NRD, a previous study evaluating narcotic pain use among inpatients with IBD demonstrated that use of narcotic pain medications was not associated with disease severity.[18] Among patients with IBD, chronic pain has been associated with significant effects on quality of life, as well as functional and social outcomes.[19]

TABLE 4. Unadjusted and Adjusted Analyses, Odds of Readmission Among Patients with UC in the 2013 NRD

	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age		
18–39	1.18 (1.08–1.30)	1.24 (1.12–1.36)
39–59	Reference	Reference
>59	1.10 (1.00–1.22)	0.98 (0.87–1.11)
Female sex	0.89 (0.82–0.96)	0.86 (0.79–0.93)
Anxiety	1.33 (1.18–1.50)	1.28 (1.14–1.45)
Depression	1.46 (1.17–1.84)	1.35 (1.07–1.70)
Tobacco abuse	0.82 (0.80–1.05)	0.92 (0.80–1.06)
Chronic pain	1.54 (1.0–1.83)	1.44 (1.21–1.73)
Charlson comorbidity score		
≤1	Reference	Reference
2	1.18 (1.02–1.36)	1.12 (0.96–1.31)
>2	1.39 (1.21–1.60)	1.28 (1.10–1.48)
Location and teaching status of hospital		
Metropolitan nonteaching	0.79 (0.73–0.86)	0.82 (0.76–0.89)
Metropolitan teaching	Reference	Reference
Rural	0.66 (0.56–0.77)	0.69 (0.59–0.81)
Payer/insurance		
Medicare	1.14 (1.04–1.25)	1.19 (1.09–1.35)
Medicaid	1.42 (1.27–1.59)	1.40 (1.25–1.57)
Private insurance	Reference	Reference
Self-pay	0.72 (0.61–0.85)	0.75 (0.63–0.90)
No charge	0.83 (0.58–1.20)	0.83 (0.57–1.20)
Other	1.07 (0.90–1.27)	1.04 (0.88–1.24)
CDI	1.17 (0.99–1.38)	1.03 (0.87–1.22)
LOS for index hospitalization, d		
≤3	Reference	Reference
4–7	1.41 (1.29–1.54)	1.39 (1.27–1.52)
>7	1.68 (1.52–1.86)	1.57 (1.42–1.74)

All variables included in the final multivariable analysis are listed above.

Chronic abdominal pain involves dysregulation of the brain–gut axis, which may lead to increased rates of anxiety and depression.[20] Both anxiety and depression are increased among patients with IBD as compared to other disease states and the general population.[21–23] In addition, anxiety and depression have been associated with an increased risk of clinical recurrence of disease in patients with IBD,[24] and higher anxiety has been associated with increased resource utilization among patients with IBD.[25,26] Although the impact of these psychological comorbidities has been identified in multiple studies of patients with CD and UC, a majority of patients may not be receiving adequate psychosocial support and services as part of their overall care.[27]

There seems to be a significant opportunity for interventions aimed at decreasing readmissions among patients with psychosocial and chronic pain risk factors. In particular, early recognition of patients with coexisting psychiatric disease and/or chronic pain syndromes during the index admission is critical. After recognition of these comorbidities, multidisciplinary approaches including the use of inpatient case management teams, behavioral health consultations, and the integration of pain management specialists into inpatient care models may lead to better discharge planning. In addition, early identification of responsible stakeholders after discharge including the patient's outpatient gastroenterologist, outpatient pain management specialists, and primary care provider may ultimately decrease readmission rates as well.

With 24% of patients requiring readmission within 90 days of the index hospitalization, readmission represents a significant burden to patients with IBD and the health care system overall. Previous single-center experiences have reported 90-day readmission rates between 21% and 31% for patients with IBD.[9,28] Although the demonstrated rate of readmission in this study was similar, our use of a nationally representative sample is perhaps a more accurate representation of the proportion of patients with UC and CD requiring readmission within 90 days. In addition, our findings are similar to the rate of readmission within 1 year reported from an analysis using a Canadian national health database.[29]

The significant cost burden of hospital readmission has previously been demonstrated by Hazratjee et al[4] who found that hospital readmissions within 30 days of index hospitalization increased cost of care by 111%. We also demonstrated the substantial economic impacts of readmission. When aggregated among all patients with IBD in the NRD, the total charges associated with readmissions within 90 days were over $576 million. In addition, those patients requiring readmission represented over 74,000 excess hospital days as compared to those patients who did not require readmission.

When the reason for readmission has been evaluated in earlier studies, recurrent UC or CD has been identified as the driver of readmission in 27.8% to 31.4% of cases.[4,9] Small bowel obstruction has been commonly associated with readmission among patients with CD in multiple studies[4,9,30] and represented 1.7% of readmissions among patients with CD in our population. The association between infectious complications and the need for readmission among patients with IBD is significant, particularly the association between septicemia and both UC and CD readmissions. In a previous study, patients with UC and sepsis demonstrated a significantly higher mortality rate during hospitalization when compared with a control population.[31] In a separate study using NIS, patients with IBD admitted to centers with a high annual volume demonstrated lower in-hospital mortality.[14] In a sensitivity analysis in which hospital volume was included in our multivariable models, our final ORs were similar to those demonstrated in the original models.

In our analysis, younger patients demonstrated increased odds of readmission, whereas patients over 59 years of age

demonstrated the lowest odds of readmission. An increased rate of hospitalizations and readmissions among younger patients with IBD has been demonstrated in other administrative databases as well.[29,32] The increase in odds of readmission among younger patients is likely multifactorial, as patients may have a more severe disease course potentially associated with an earlier onset of IBD.[32] In addition, older patients are likely to have other comorbidities, which might lead to increased follow-up with primary care or other providers after discharge from and index admission. These factors would not be captured in the NRD, however, and thus, we were not able to explore further.

Our study is the one of the first nationally representative study of hospital readmissions among patients with IBD. However, our study has inherent limitations that should be noted. The NRD does not include information regarding an individual patient's medication profile before admission or during the hospitalization. Although infections such as CDI and pneumonia represented significant etiologies of readmission, we were unable to evaluate the potential relationship between steroid use or other immunosuppressive therapy and risk of subsequent infection requiring hospitalization. In addition, the NRD does not contain laboratory data or clinical data regarding the phenotype or severity of an individual patient's IBD at the time of admission. Although we demonstrated increased odds of readmission among patients with CD and a fistula, and increased odds of readmission with longer LOS on index hospitalization, our ability to evaluate the relationship between the severity of disease and odds of readmission is limited.

With a large database such as NRD, there is potential for misclassification of those factors associated with readmission, particularly tobacco use which was associated with increased odds of readmission among patients with CD.[33] There is also potential for misclassification of UC and CDI, given the nature of *ICD-9-CM* coding and the common term colitis. This misclassification is a potential explanation for the significant relationship between CDI and readmission among patients with CD but not UC. The potential exists that comorbid conditions such as anxiety, depression, and chronic pain may be less likely to be coded, because of the high likelihood that active CD or UC or related complications are driving the index admission. If this were the case, we would expect to underestimate the burden of these comorbid diseases, even when using validated algorithms for case finding. As such, despite demonstrating a significant increase in odds of readmission associated with these diagnoses, we may still be underestimating their effect on readmission. In large databases, the potential also exists for statistically significant differences because of large sample sizes that may not be clinically meaningful. Multivariable analysis with logistic regression is particularly helpful in the assessment of such findings, as both the clinical significance and the magnitude of the associations demonstrated after adjusting for potential confounders must be considered. In our study, modifiable risk factors such as anxiety, depression, and chronic pain demonstrated increases in odds of readmission that are larger and likely more clinically meaningful than smaller, statistically significant associations such as the decreased odds of readmission among female patients.

The NRD also does not include information on race, which is a significant limitation, as black race has been associated with shorter time to readmission among pediatric patients[34] and an increased risk for readmission after colorectal surgery.[35] Given the structure of the NRD, we were also unable to evaluate provider factors that may have contributed to readmission, including early discharge from the index hospitalization or treatment plans that may have led to worse outcomes including readmission. Although future approaches to decreasing readmission will likely require multidisciplinary approaches, a continued focus on provider decision making during the hospitalization and discharge planning will remain a key point in improving outcomes among hospitalized patients with IBD.

In conclusion, within a nationally representative database, we identified multiple risk factors for readmission among patients with UC and CD that are associated with a significant increase in charges. These include several potentially modifiable risk factors including psychiatric disease and chronic pain conditions. Earlier recognition of comorbid diagnoses of chronic pain, anxiety, and depression, along with increased use of multidisciplinary teams and care transition models, may lead to decreased hospital readmissions and improved outcomes among patients with UC and CD.

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