

Racial Disparities in Readmissions for Patients with Inflammatory Bowel Disease (IBD) After Colorectal Surgery

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Abstract

Background The incidence of inflammatory bowel disease (IBD) in minorities is increasing, and health outcome disparities are becoming more apparent. Our aim was to investigate the contribution of race to readmissions in IBD patients undergoing colorectal surgery.

Design The National Surgical Quality Improvement Program database from 2012 to 2013 was queried for all patients with IBD undergoing elective colorectal surgery. After stratifying by race, unadjusted univariate and bivariate comparisons were made. Primary outcome was all-cause 30-day readmission. Predictors of readmission were identified using multivariable logistic regression.

Results Of the 2523 patients with IBD who underwent elective colon surgery, 15.0 % were readmitted within 30 days of index operation. Black patients constituted 7.7 % of the entire cohort. Black patients were significantly different in smoking status (27 vs. 22 %) and Crohn's diagnosis (84 vs. 73 %) ($p < 0.05$). Black patients had significantly higher readmission rates (20 vs. 15 %) and longer length-of-stays (8 vs. 6 days) after surgery ($p < 0.05$). On multivariable analysis, black race remained a significant predictor for 30-day readmissions in patients with IBD (odds ratio 1.6, 95 % confidence interval 1.1–2.5).

Conclusions Black patients with IBD have an increased risk for readmission after colorectal surgery. Efforts to reduce readmissions need to target not only well-studied risk factors such as postoperative complications, but also investigate non-SQIP-measured elements such as social and behavioral determinants of health.

Keywords Inflammatory bowel disease · Racial disparities · Surgery · Readmission

Introduction

In the USA at least 1.3 million people suffer from inflammatory bowel disease (IBD), which includes Crohn's disease (CD) and ulcerative colitis (UC).^{1,2} Over \$6.3 and \$5.5 billion dollars in direct and indirect treatment costs, respectively, were spent in 2008 for IBD care.^{3,4} The incidence of IBD in minority populations has significantly increased over the last 20 years⁵ and over 75 % of CD⁶ and 25 % of UC patients⁷ will undergo at least one major abdominal operation during their lifetime. Surgical procedures, while potentially effective treatment and frequently indicated in IBD, are inextricably linked to postoperative complications such as hospital readmissions and these metrics have substantial clinical and financial repercussions.⁸

The Centers for Medicare and Medicaid Services (CMS) Hospital Readmissions Reduction Program has provided significant impetus to identify and target high-risk patients and procedures for readmissions.^{9,10} Readmissions are among the

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highest for patients after colorectal surgery¹¹ and are even higher in vulnerable populations such as black patients.¹² Compared to non-IBD patients, IBD patients are at greater risk for readmissions and hospitalizations^{13,14} with 30 % greater in-hospital costs.¹⁵

As the incidence of IBD increases in minority patients, it remains unknown whether black patients with IBD, which represent two at-risk populations for complications, are at even higher risk for readmissions after surgery. Identification of high-risk populations and specific risk factors would better inform the development of interventions to reduce readmissions and health outcome disparities. To address this knowledge gap, we selected a nationally represented IBD population to test the hypothesis that black patients are at increased risk for readmission following colorectal surgery for IBD.

Materials and Methods

This is a retrospective cohort study of all IBD patients undergoing elective colectomies from the 2012–2013 American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) Colectomy Targeted Participant Use Data File. For all patients, the preoperative indication for surgery was either CD or UC as collected and reported by ACS-NSQIP. Patients that were neither white nor black were also excluded as the number present in the cohort was prohibitively small ($n=40$) for modeling purposes. The cohort was represented by white and black patients with the exposure of interest identified as black.

The primary outcome was all-cause readmission within 30 days of index surgery. Secondary outcomes included length-of-stay and postoperative complications. Covariates recorded by ACS-NSQIP included patient and procedure-specific characteristics. Stoma construction was identified via CPT codes under primary procedures (44141, 44143, 44144, 44146, 44150–44158, 44206, 44208, 44210–44212, 44310, 45110, 45111, 45113, 45121, 45126, 45395, 45397) or secondary procedures (in addition to previous CPT codes: 44186–44188, 44316, 44320, 44605, 45119, 45563, 45805, 45825). Postoperative complications were categorized into the following groups: wound infection (superficial and deep infection), organ space infection, sepsis, venous thromboembolism (VTE), urinary tract infection, respiratory, neurologic, and cardiac and renal complications (Appendix A).

Univariate and bivariate comparisons were used to study differences between readmitted vs. non-readmitted IBD patients and white versus black IBD patients (main exposure comparison). Chi-square test or Wilcoxon rank-sum test were used to examine differences in bivariate frequencies and continuous variable distributions, respectively. A final parsimonious model was constructed using two different statistical

methods that yielded the same final model. The first method utilized a saturated logistic model for readmission, which included all covariates that were significantly different by readmission or race and then applied backwards-selection ($p>0.05$ as exit criterion). The second method used forward-selection ($p<0.05$ as entry criterion). Both of these approaches offered insight into the clinical relevance of the variables in predicting readmissions. All analyses were completed using SAS v9.2.

Results

Of the 2987 patients identified by an index diagnosis of IBD (CD or UC) in the 2012–2013 ACS-NSQIP Colectomy Targeted Participant Use Data File, 464 (15.5 %) patients were excluded due to emergency surgery ($n=210$), missing race data ($n=194$), other race ($n=40$ with 27 Asians, 10 American Indian/Alaskan, and 3 Pacific Islander) or died within 30 days ($n=20$). Of the final 2523 IBD patients included in the analysis, 379 patients were readmitted (15.0 %) within 30 days of index operation (Table 1). Black patients constituted 7.7 % of the entire IBD cohort. Most patients were diagnosed with CD (74 %) rather than UC (26 %). The median age of an IBD patient was 39, and the majority of patients were of normal BMI (43 %) with 21 % of the population being obese. Of the comorbidities evaluated, 58 % were on steroids, 21 % were active smokers, 18 % had hypertension, and 5 % were diabetic. Operations performed included ileocecectomy (47 %), total abdominal colectomy with or without ileostomy (26.0 %), partial colectomy (19 %), low anterior resection (4 %), and Hartmann-type procedures (4 %). For these operations, 56 % were minimally invasive and 44 % were open approach. A stoma was constructed in 38 % of cases ($n=955$). Of these patients with stomas, 9 % had an ileocecectomy, 67 % had a total colectomy, 10 % had a partial colectomy, 5 % had a low anterior resection, and 9 % had a Hartmann-type procedure.

In unadjusted comparisons, black and white patients with IBD were similar in certain comorbidities (diabetic status, body mass index, weight loss, COPD, hypertension, steroid use, and ASA class), rate of stoma construction, type of bowel prep, surgical approach, and wound classification ($p>0.05$) (Table 2). Black patients were significantly different in age (35 vs. 40), smoking status (27 vs. 22 %), and Crohn's diagnosis (84 vs. 73 %) ($p<0.05$) compared to white patients. Black patients had significantly higher readmission rates (20 vs. 15 %) and longer hospital and post-op length-of-stays (8 vs. 6 days and 6 vs. 5 days) compared to white patients after surgery ($p<0.05$).

The primary diagnoses on readmission were documented in 343 (90.5 %) out of 379 total readmissions and were categorized by infection, gastrointestinal complications, pain, bleeding, and other complications such as VTE. Overall,

Table 1 IBD population characteristics and outcomes stratified by readmission

Overall		Overall <i>N</i> (%)	Readmitted <i>N</i> (%)	Not readmitted <i>N</i> (%)	<i>p</i> value
		2523 (100)	379 (15)	2144 (85)	
Demographics					
Gender	Female	1321 (52)	192 (51)	1129 (53)	0.48
	Male	1202 (48)	187 (49)	1015 (47)	
Race	White	2328 (92)	340 (90)	1988 (93)	0.04
	Black	195 (8)	39 (10)	156 (7)	
Age	Years, median (IQR)	39 (29–55)	40 (29–56)	39 (29–54)	0.34
Comorbidities					
Diabetes	None	2401 (95)	350 (92)	2051 (96)	0.01
	NIDDM	60 (2)	12 (3)	48 (2)	
	IDDM	62 (3)	17 (5)	45 (2)	
Smoking	Yes	524 (21)	86 (23)	438 (20)	0.32
BMI category	Underweight	279 (11)	50 (13)	229 (11)	0.47
	Normal weight	1088 (43)	155 (41)	933 (44)	
	Over weight	610 (24)	97 (26)	513 (24)	
	Obese; Class I	357 (14)	55 (15)	302 (14)	
	Obese; Class II	128 (5)	14 (4)	114 (5)	
	Obese; Class III	61 (2)	8 (2)	53 (3)	
Functional health ^a	Independent	2498 (99)	373 (98)	2125 (99)	0.09
Weight loss	Yes	262 (10)	48 (13)	214 (10)	0.11
COPD	Yes	40 (2)	5 (1)	35 (2)	0.65
Hypertension	Yes	461 (18)	93 (25)	368 (17)	<0.001
Steroid use	Yes	1463 (58)	250 (66)	1213 (57)	<0.001
IBD type	Crohn’s disease	1855 (74)	264 (70)	1591 (74)	0.06
	Ulcerative colitis	668 (26)	115 (30)	553 (26)	
Preoperative labs					
Pre-op albumin	>3	1501 (59)	212 (56)	1289 (60)	0.002
	<3	453 (18)	92 (24)	361 (17)	
	Missing	569 (23)	75 (20)	494 (23)	
Surgical characteristics					
Procedure	Hartmann	89 (4)	11 (3)	78 (4)	<0.001
	Low anterior	107 (4)	16 (4)	91 (4)	
	Ileocectomy	1186 (47)	152 (40)	1034 (48)	
	Partial colectomy	485 (19)	65 (17)	420 (20)	
	Total colectomy	656 (26)	135 (35)	521 (24)	
Ileostomy/colostomy	Yes	965 (38)	202 (53)	763 (36)	<0.001
Type of bowel prep	None	933 (37)	147 (39)	786 (37)	0.41
	Mech only	574 (23)	87 (23)	487 (23)	
	OABP only	226 (9)	31 (8)	195 (9)	
	Both	502 (20)	64 (17)	438 (20)	
	Missing	288 (11)	50 (13)	238 (11)	
Approach ^a	MIS	1406 (56)	194 (51)	1212 (57)	0.15
	Open	1110 (44)	184 (49)	926 (43)	
Hospital LOS	Days, median (IQR)	6 (4–10)	7 (4–12)	6 (4–10)	0.001
Post-Op LOS	Days, median (IQR)	5 (4–7)	6 (4–8)	5 (4–7)	0.33
Work RVU	Units, median (IQR)	23 (23–30)	26 (23–30)	23 (23–30)	0.001
ASA class	1–2	1540 (61)	206 (54)	1334 (62)	0.03
	3	949 (38)	166 (44)	783 (37)	
	4–5	34 (1)	7 (2)	27 (1)	

Table 1 (continued)

Overall		Overall N (%)	Readmitted N (%)	Not readmitted N (%)	p value
		2523 (100)	379 (15)	2144 (85)	
Wound classification	Clean	17 (1)	4 (1)	13 (1)	
	Clean/contaminated	1637 (65)	225 (59)	1412 (66)	0.07
	Contaminated	589 (23)	98 (26)	491 (23)	
	Dirty/infected	280 (11)	52 (14)	228 (11)	
Complications					
Wound complication	Yes	221 (9)	64 (17)	157 (7)	<0.001
Organ space infection	Yes	173 (7)	89 (23)	84 (4)	<0.001
Sepsis	Yes	166 (7)	64 (17)	102 (5)	<0.001
Bleeding	Yes	245 (10)	55 (15)	190 (9)	<0.001
VTE	Yes	65 (3)	33 (9)	32 (1)	<0.001
Respiratory	Yes	63 (2)	19 (5)	44 (2)	<0.001
Neurological	Yes	2 (0)	1 (0)	1 (0)	0.16
Cardiac	Yes	4 (0)	2 (1)	2 (0)	0.21
UTI	Yes	64 (3)	20 (5)	44 (2)	<0.001
Renal	Yes	173 (7)	89 (23)	84 (4)	<0.001

^a n = 6 missing

among both white and black patients, the top three reasons for readmission were deep infection, obstruction, and dehydration (21, 13, and 12 %, respectively) (Table 3).

On multivariable analysis, black race remained a significant predictor for 30-day readmissions in patients with IBD (odds ratio (OR) 1.6, 95 % confidence-interval (CI) (1.1–2.5) (Table 4). Additional clinically important predictors for readmissions included stoma construction (OR 2.6, 95 % CI 1.9–3.5), comorbidities such as HTN (OR 1.6, 95 % CI 1.2–2.1) and postoperative complications including organ space infections (OR 12.6, 95 % CI 8.5–18.7), renal complications (OR 9.1, 95 % CI 3.3–25.2), and VTE (OR 6.2, 95 % CI 3.5–10.9).

Discussion

Using the 2012–2013 ACS-NSQIP colectomy data, our study shows that race is independently associated with an increased risk of readmission for IBD patients after elective surgery. Specifically, black patients with IBD have a 60 % increased risk of readmission after surgery compared to white patients. This risk persists even after adjustment for well-known drivers of readmissions such as patient comorbidities and postoperative complications. To our knowledge, this study is the first to demonstrate racial disparities in surgical IBD patients using a national outcomes-based registry. While readmission reduction efforts should target well-studied etiologies such as postoperative complications, efforts must also be made to better understand and address the factors that drive racial disparities in readmissions.

IBD patients are a unique and high-risk population for complications even among colorectal patients. In the pediatric IBD population, recent studies have shown that black children have a 16 % higher risk for readmission compared with white children.¹⁶ Studies on disparities in adult IBD patients using claims-based databases have shown that black patients with IBD seem to undergo fewer surgeries than white patients.^{17,18} In a comprehensive Medicare study, which included non-IBD patients, black patients had significantly higher readmission rates than white patients (14.8 vs. 12.8 %) and an increased 19 % risk-adjusted odds of being readmitted after surgery.¹⁹ Our study raises important concerns because we have demonstrated that when black patients with IBD undergo surgery, there is a 60 % higher risk of readmission. Our finding adds to the growing body of evidence that significant racial disparities exist in surgical populations and these variations warrant further investigation.

In our study, readmitted patients with IBD had more comorbidities (diabetic status, steroid use, ASA class) and a longer index length of stay compared to non-readmitted patients. These differences have been observed in previous studies.²⁰ Independent risk factors for readmission after surgery have also been well-documented and focused on postoperative complications such as blood transfusions, pulmonary complications, wound complications, sepsis/shock, urinary tract infections, and vascular complications.^{11,21} For IBD patients, our study reaffirms that postoperative complications including wound complications, VTEs, renal complications, and organ space infections are associated with higher readmission risk. Furthermore, our study shows that the most common diagnoses on readmission were deep infection (21 %),

Table 2 IBD population characteristics and outcomes stratified by race

Overall		Overall	White	Black	<i>p</i> value
		<i>N</i> (%)	<i>N</i> (%)	<i>N</i> (%)	
		2523 (100)	2328 (92)	195 (8)	
Demographics					
Gender	Female	1321 (52)	1206 (52)	115 (59)	0.05
	Male	1202 (48)	1122 (48)	80 (41)	
Age	Years, median (IQR)	39 (29–55)	40 (29–55)	35 (27–50)	0.002
Comorbidities					
Diabetes	None	2401 (95)	2220 (96)	181 (93)	0.24
	NIDDM	60 (2)	54 (2)	6 (3)	
	IDDM	62 (2)	54 (2)	8 (4)	
BMI category	Underweight	279 (11)	247 (11)	32 (16)	0.14
	Normal weight	1088 (43)	1003 (43)	85 (44)	
	Over weight	610 (24)	573 (25)	37 (19)	
	Obese; Class I	357 (14)	331 (14)	26 (13)	
	Obese; Class II	128 (5)	119 (5)	9 (5)	
	Obese; Class III	61 (2)	55 (2)	6 (3)	
Functional health ^a	Independent	2498 (99)	2306 (99)	192 (98)	0.01
Smoking	Yes	524 (21)	472 (20)	52 (27)	0.04
Weight loss	Yes	262 (10)	237 (10)	25 (13)	0.25
COPD	Yes	40 (2)	39 (2)	1 (1)	0.21
Hypertension	Yes	461 (18)	419 (18)	42 (22)	0.22
Steroid use	Yes	1463 (58)	1351 (58)	112 (57)	0.87
IBD type	Crohn’s disease	1855 (74)	1692 (73)	163 (84)	0.001
	Ulcerative colitis	668 (26)	636 (27)	32 (16)	
Preoperative labs					
Pre-op albumin	>3	1501 (59)	1394 (60)	107 (55)	0.004
	<3	453 (18)	401 (17)	52 (27)	
	Missing	569 (23)	533 (23)	36 (18)	
Surgical characteristics					
Procedure	Hartmann	89 (4)	81 (3)	8 (4)	<0.001
	Low anterior	107 (4)	105 (5)	2 (1)	
	Ileocectomy	1186 (47)	1097 (47)	89 (46)	
	Partial colectomy	485 (19)	427 (18)	58 (30)	
	Total colectomy	656 (26)	618 (26)	38 (19)	
Ileostomy/colostomy	Yes	965 (38)	897 (39)	68 (35)	0.31
Type of bowel prep	None	933 (37)	859 (37)	74 (38)	0.08
	Mech. only	574 (23)	539 (23)	35 (18)	
	OABP only	226 (9)	211 (9)	15 (8)	
	Both	502 (20)	464 (20)	38 (19)	
	Missing	288 (11)	255 (11)	33 (17)	
Approach ^a	MIS	1406 (56)	1307 (56)	99 (51)	0.29
	Open	1110 (44)	1015 (44)	95 (49)	
Hospital LOS	Days, median (IQR)	6 (4–10)	6 (4–10)	8 (5–14)	<0.0001
Post Op LOS	Days, median (IQR)	5 (4–7)	5 (4–7)	6 (5–9)	<0.0001
Work RVU	Units, median (IQR)	23 (23–30)	23 (23–30)	23 (23–30)	0.190
ASA class	1–2	1540 (61)	1430 (61)	112 (57)	0.47
	3	949 (38)	866 (37)	81 (42)	
	4–5	34 (1)	32 (1)	2 (1)	

Table 2 (continued)

Overall		Overall N (%)	White N (%)	Black N (%)	<i>p</i> value
		2523 (100)	2328 (92)	195 (8)	
Wound classification	Clean	17 (1)	17 (1)	0 (0)	
	Clean/contaminated	1637 (1)	1516 (65)	121 (62)	0.47
	Contaminated	589 (23)	540 (23)	49 (25)	
	Dirty/infected	280 (11)	255 (11)	25 (13)	
Outcomes					
Readmission	Yes	379 (15)	340 (15)	39 (20)	0.04
Wound complication	Yes	221 (9)	211 (9)	10 (5)	0.06
Organ space infection	Yes	173 (7)	152 (7)	21 (11)	0.02
Sepsis	Yes	166 (7)	147 (6)	19 (10)	0.06
Bleeding	Yes	245 (10)	213 (9)	32 (16)	0.001
VTE	Yes	65 (3)	60 (3)	5 (3)	0.99
Respiratory	Yes	63 (2)	57 (2)	6 (3)	0.59
Neurological	Yes	2 (0)	2 (0)	0 (0)	0.68
Cardiac	Yes	4 (0)	3 (0)	1 (1)	0.20
UTI	Yes	64 (3)	60 (3)	4 (2)	0.65
Renal	Yes	22 (1)	21 (1)	1 (1)	0.57

^a *n* = 6 missing**Table 3** Causes of readmission related to index surgery

	Overall N (%)	White N (%)	Black N (%)
Overall readmissions	343 (100)	307 (90)	36 (10)
Infection (<i>n</i> = 121)			
Deep infection	73 (21)	68 (22)	5 (14)
Surface infection	16 (5)	15 (5)	1 (3)
General infection	17 (5)	16 (5)	1 (3)
Severe infection	12 (4)	11 (4)	1 (3)
UTI	3 (1)	2 (1)	1 (3)
GI complication (<i>n</i> = 138)			
Obstruction	46 (13)	43 (14)	3 (8)
Dehydration	40 (12)	37 (12)	3 (8)
GI distress	23 (7)	22 (7)	1 (3)
Nutrition	9 (3)	6 (2)	3 (8)
IBD relapse	13 (4)	11 (4)	2 (6)
Stoma complication	7 (2)	6 (2)	1 (3)
Pain (<i>n</i> = 23)			
Pain	23 (7)	18 (6)	5 (14)
Bleeding (<i>n</i> = 14)			
Bleeding	14 (4)	12 (4)	2 (6)
Other (<i>n</i> = 36)			
Other	11 (3)	10 (3)	1 (3)
Renal	5 (2)	5 (2)	0 (0)
Respiratory	3 (1)	3 (1)	0 (0)
VTE	17 (5)	16 (5)	1 (3)
Missing (<i>n</i> = 11)			
Missing	11 (3)	6 (2)	5 (14)

obstruction (13 %), and dehydration (12 %) (Table 3). Merkow et al. demonstrated similar findings in the 2012 ACS-NSQIP database with surgical site infections (26 %), ileus (18 %), and obstruction (7 %) as the leading readmission diagnoses after any colectomy or proctectomy.²² These factors, however, do not explain all of readmissions as race remained an independent predictor for 30-day readmission on multivariate analysis.

Non-NSQIP measured factors such as social and behavioral determinants of health likely play an equally if not more important role in racial disparities. Studies on racial and socioeconomic disparities in IBD have demonstrated significantly lower utilization of surgical interventions, lower rates of medication adherence, and decreased access to healthcare for black patients.^{17,23} Black patients with IBD also have higher hospitalization rates and reduced quality of life measures when compared to white patients.^{17,23–27} Disparities are a confluence of patient, provider, and systemic factors.²³ Socioeconomic factors, geographic location, and even type of hospital can affect surgical outcomes.^{19,28} At the patient-level, studies have shown that black patients with IBD have reduced medication adherence rates.^{29,30} Pre- and postoperative medication adherence is of substantial importance in long-term IBD management and these health behaviors, which are poorly understood, could contribute to worse outcomes such as 30-day readmissions. At the disease-level, black patients with IBD may present on index encounter with more advanced disease which leads to worse postoperative outcomes. National datasets like ACS-NSQIP, however, cannot control for index disease severity. At the provider level, studies have shown

Table 4 Independent predictors for readmissions in IBD patients undergoing colorectal surgery

		Unadjusted			Adjusted		
		OR	(95 % CI)	<i>p</i> value	OR	(95 % CI)	<i>p</i> value
Demographics							
Race	Black vs. white	1.5	(1.0–2.1)	0.04	1.6	(1.1–2.5)	0.02
Comorbidities							
Hypertension	Yes vs. no	1.6	(1.2–2.0)	<0.001	1.6	(1.2–2.1)	0.002
Weight loss	Yes vs. no	1.3	(0.9–1.8)	0.12	1.5	(1.0–2.1)	0.04
IBD indication	Crohn’s vs. UC	0.8	(0.6–1.0)	0.06	1.4	(1.0–1.9)	0.03
Surgical characteristics							
Ileostomy/colostomy	Yes vs. no	2.1	(1.7–2.6)	<0.001	2.6	(1.9–3.5)	<0.001
Post OP LOS	Days	1.0	(0.9–1.0)	0.79	0.9	(0.9–0.9)	<0.001
Post-surgical complications							
Wound complication	Yes vs. no	2.6	(1.9–3.5)	<0.001	2.8	(2.0–4.1)	<0.001
Respiratory complication	Yes vs. no	2.5	(1.5–4.4)	0.001	2.2	(1.1–4.4)	0.03
VTE	Yes vs. no	6.3	(3.8–10.4)	<0.001	6.2	(3.5–10.9)	<0.001
UTI	Yes vs. no	2.7	(1.5–4.6)	<0.001	2.0	(1.1–3.9)	0.03
Renal	Yes vs. no	8.4	(3.6–19.9)	<0.001	9.1	(3.3–25.2)	<0.001
Organ space infection	Yes vs. no	7.5	(5.5–10.4)	<0.001	12.6	(8.5–18.7)	<0.001

that physicians exhibit unconscious bias and communicate more poorly with black patients as compared to white patients.³¹ Black patients, for example, are far less likely to receive recommendations for colorectal cancer screening.³² If we extrapolate to perioperative counseling and education, there may be similarly poor communication towards black patients that contribute to outcomes such as early readmissions. Future work will therefore need to couple institutional or IBD-specific registries with qualitative studies at the patient and provider-level to better understand drivers of racial disparities.

Our analysis of procedure-specific characteristics show that IBD patients with a stoma had a twofold increased risk of readmission after surgery. This finding supports results from recent studies on readmissions after stoma construction.^{8,13} Post-stoma complications primarily result from dehydration which leads to readmission.^{33,34} Educational programs can substantially decrease readmissions for dehydration after stoma formation. In a single institution study,³⁵ post-ileostomy readmission rates were 35 % with 15 % due to dehydration. After the implementation of preoperative teaching, standardized teaching materials, in-hospital engagement, observed management, and post-discharge tracking of intake and output, readmission rates decreased from 35 to 21 % with none due to dehydration.³⁵ These results demonstrate how modifying social and behavioral determinants of health, namely through education and

patient engagement, can profoundly impact a major clinical outcome. Efforts to reduce racial disparities in readmissions will likely require similar innovative strategies.

Smoking was more common in black vs. white IBD patients (27 vs. 20 %) and may be an additional opportunity for quality improvement (Table 1). Smoking has been associated with serious postoperative complications. Recent studies have demonstrated a twofold increased risk for surgical site infections after stoma reversals, a fourfold higher risk for anastomotic leak after left colectomy, and 50 % higher risk for hospital readmission after surgery for CD.^{36–38} While our multivariate analysis did not show smoking to be a statistically significant predictor for readmissions, when included in the final model, smokers had a 30 % increased risk for 30-day readmission after surgery (OR 1.3, 95 % CI 0.9–1.6). This data supports the association between smoking and poor surgical outcomes, and we would posit that smoking cessation should be considered a part of any quality improvement efforts in surgery.

To our knowledge, our study is the first to report on racial disparities in surgical IBD patients using a national, risk-adjusted, outcomes-based surgery registry. The large and diverse sample size, which represents adult surgical patients across various healthcare settings, promotes the generalizability of our findings. However, our study is not without limitations. Databases such as ACS-NSQIP may

have misclassified data elements, and not all patients are prospectively enrolled which introduces informational and selection bias, respectively. Uncontrolled confounders may also exist that were not captured by ACS-NSQIP. These confounders include biological/genetic factors and social/behavior determinants of health that may contribute to racial disparities in readmissions. Certain IBD populations, such as those who underwent ileal pouch-anal anastomosis (IPAA), were not accounted for in this procedure-targeted cohort and missing data on index IBD diagnosis. Additionally, ACS-NSQIP measures readmission at 30 days post-procedure and not 30 days post-discharge. We likely underestimated racial disparities as black race was associated with longer index LOS, thus decreasing the exposure time for 30-day readmission.

Conclusions

Black patients with IBD have an increased risk for re-admission after colorectal surgery. Efforts to reduce readmissions need to target not only well-cited risk factors such as postoperative complications, but also investigate non-NSQIP measured elements such as social and behavioral determinants of health that may drive disparities in readmissions for high-risk patients.

Compliance with Ethical Standards

Disclaimers None.

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Appendix A

Table 5 Definition of complication categories

Category	Included NSQIP-defined data elements
Wound complications	Superficial infection, deep-incisional infection, and dehiscence
Sepsis	Septic shock and other septic shock
VTE	DVT and pulmonary embolism
Respiratory complications	Pneumonia, reintubation, and failure to wean
Neuro complications	Stroke and coma
Cardiac complications	Cardiac arrest or MI
Renal complications	Renal insufficiency and renal failure

All categories not otherwise specified are based on the 2013 ACS-NSQIP Participant Use Data File (PUF). Variables found in Table 4 were defined based on the ICD-9 codes used in the operative or pathology report

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