ORIGINAL CONTRIBUTION

Factors Associated With Performing IPAA After Total Colectomy for Ulcerative Colitis

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BACKGROUND: IPAA is considered the procedure of choice for restorative surgery after total colectomy for ulcerative colitis. Previous studies have examined the rate of IPAA within individual states but not at the national level in the United States.

OBJECTIVE: This study aimed to assess the rate of IPAA after total colectomy for ulcerative colitis in a national population and identify factors associated with IPAA.

DESIGN: This was a retrospective cohort study.

SETTINGS: This study was performed in the United States.

PATIENTS: Patients who were aged 18 years or older and who underwent total colectomy between 2009 and 2019 for a diagnosis of ulcerative colitis were identified within a commercial database. This database excluded patients with public insurance, including all patients older than 65 years with Medicare.

MAIN OUTCOME MEASURES: The primary outcome was IPAA. Multivariable logistic regression was used to assess the association between covariates and the likelihood of undergoing IPAA.

RESULTS: In total, 2816 patients were included, of whom 1414 (50.2%) underwent IPAA, 928 (33.0%) underwent no further surgery, and 474 (16.8%) underwent proctectomy with end ileostomy. Younger age, lower comorbidities, elective case, and laparoscopic approach in the initial colectomy were significantly associated with IPAA but socioeconomic status was not.

LIMITATIONS: This retrospective study included only patients with commercial insurance.

CONCLUSIONS: A total of 50.2% of patients who had total colectomy for ulcerative colitis underwent IPAA, and younger age, lower comorbidities, and elective cases are associated with a higher rate of IPAA placement. This study emphasizes the importance of ensuring follow-up with colorectal surgeons to provide the option of restorative surgery, especially for patients undergoing urgent or emergent colectomies. See **Video Abstract**.

FACTORES ASOCIADOS CON LA REALIZACIÓN DE ANASTOMOSIS ANAL-BOLSA ILEAL DESPUÉS DE UNA COLECTOMÍA TOTAL POR COLITIS ULCEROSA

ANTECEDENTES: La anastomosis ileo-anal se considera el procedimiento de elección para la cirugía reparadora tras la colectomía total por colitis ulcerosa. Estudios previos han examinado la tasa de anastomosis ileo-anal dentro de los estados individuales, pero no a nivel nacional en los Estados Unidos.

OBJETIVO: Evaluar la tasa de anastomosis bolsa ileal-anal después de la colectomía total para la colitis ulcerosa en una población nacional e identificar los factores asociados con la anastomosis bolsa ileal-anal.

DISEÑO: Se trata de un estudio de cohortes retrospectivo.

LUGAR: Este estudio se realizó en los Estados Unidos.

PACIENTES: Los pacientes que tenían ≥18 años de edad que se sometieron a colectomía total entre 2009

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y 2019 para un diagnóstico de colitis ulcerosa fueron identificados dentro de una base de datos comercial. Esta base de datos excluyó a los pacientes con seguro público, incluidos todos los pacientes >65 años con Medicare.

MEDIDAS DE RESULTADO PRINCIPALES: El resultado primario fue la anastomosis ileal bolsa-anal. Se utilizó una regresión logística multivariable para evaluar la asociación entre las covariables y la probabilidad de someterse a una anastomosis ileal.

RESULTADOS: En total, se incluyeron 2.816 pacientes, de los cuales 1.414 (50,2%) se sometieron a anastomosis ileo-anal, 928 (33,0%) no se sometieron a ninguna otra intervención quirúrgica y 474 (16,8%) se sometieron a proctectomía con ileostomía terminal. La edad más joven, las comorbilidades más bajas, el caso electivo, y el abordaje laparoscópico en la colectomía inicial se asociaron significativamente con la anastomosis ileal bolsa-anal, pero no el estatus socioeconómico.

LIMITACIONES: Este estudio retrospectivo incluyó sólo pacientes con seguro comercial.

CONCLUSIONES: Un 50,2% de los pacientes se someten a anastomosis ileo-anal y la edad más joven, las comorbilidades más bajas y los casos electivos se asocian con una mayor tasa de colocación de anastomosis ileo-anal. Esto subraya la importancia de asegurar el seguimiento con cirujanos colorrectales para ofrecer la opción de cirugía reparadora, especialmente en pacientes sometidos a colectomías urgentes o emergentes. *(Traducción—Dr. Yolanda Colorado)*

KEY WORDS: Ileal pouch; Socioeconomic status; Ulcerative colitis.

IPAA is often considered the procedure of choice after total colectomy for ulcerative colitis (UC) because it avoids the need for a long-term stoma. Although overall quality of life is similar in patients who receive an IPAA versus those who retain a permanent end ileostomy (EI), previous studies have shown improved body image and work/social function among those who undergo IPAA.[1,2] Given these factors, IPAA should be offered as an option for all patients who undergo total colectomy for UC unless otherwise contraindicated.[3]

Previous population-based studies in England have reported an IPAA rate of 33% and those in Sweden have reported a rate of 46% among patients who underwent total colectomy for ulcerative colitis.[4–6] Studies have also examined state-level populations in the United States, including Vermont (65.7%) and New York (34%).[7–9] However, so far, no previous studies have analyzed the rate of IPAA in the United States at the national level.

We sought to use a nationwide longitudinal database based on insurance claims from the United States to study IPAA after total colectomy for UC. Our goal was to determine the proportion of patients undergoing IPAA and to identify patient and provider factors associated with IPAA. We hypothesized that patients with low socioeconomic status who underwent total colectomy in urgent/emergent settings would have lower rates of IPAA.

MATERIALS AND METHODS

Study Population

Patients who were aged 18 years or older and who underwent total colectomy between 2009 and 2019 for a diagnosis of UC were identified within the IBM MarketScan Commercial Database. This longitudinal database includes data on more than 273 million patients covered by employer-sponsored commercial health insurance plans across the United States. Of note, this database excludes patients with public insurance, including all patients older than 65 years with Medicare. The MarketScan database offers a distinct advantage for addressing this clinical question because it tracks individual patients across multiple hospitalizations and procedures. Analysis of this database was determined to be exempt from review by the University of North Carolina Institutional Review Board (IRB # 19-2857).

We excluded patients who lacked continuous enrollment in the database for at least 6 months after the initial colectomy. This was based on a median time between colectomy and IPAA of 5 months. We included patients who underwent a total colectomy or proctocolectomy as an initial operation using the current procedural terminology (CPT) codes 44150, 44210, 44151, 44212, 44155, 44156, 44211, and 44158. UC was identified using the International Classification of Diseases, Ninth Revision, codes 556, 556.0, 556.1, 556.2, 556.3, 556.5, 556.6, 556.8, and 556.9 or International Classification of Diseases, Tenth Revision, codes K51 to 51.919 from the initial colectomy. Patients with a subsequent diagnosis of Crohn's disease were also excluded.

Outcomes and Variables

Our primary outcome was IPAA creation, which was identified using the CPT codes 44157, 45113, 44158, or 44211. This included IPAA placement regardless of approach, including 2-stage, modified 2-stage, and 3-stage procedure. Alternate outcomes included total colectomy with subsequent proctectomy and EI or initial proctocolectomy with EI (CPT codes 44212, 44155, 44156, 45395, 44150, 45111). Finally, total colectomy with no proctectomy (NP) was identified as total colectomy alone with no further procedures (44150, 44210, and 44151).

Patient demographic factors included in the analyses included age (by decade) and sex. Socioeconomic factors included region, employment status, employment class, employment industry, and area deprivation index. The area deprivation index is a metric initially created by the Health

Resources and Services Administration and is based on 17 education, employment, housing quality, and poverty measures drawn from American Community Survey data at the metropolitan statistical area level.[10] Clinical factors included the Charlson Comorbidity Index (CCI).[11] Surgeon factors included whether the initial total colectomy involved a colorectal surgeon (self-reported specialty code 510). Case factors included year of surgery, categorized on the basis of the median year (2012), surgical approach (laparoscopic vs open), and case acuity, identified on the basis of whether patients were admitted for >1 day preoperatively.

Statistical Analysis

Differences in demographic and clinical characteristics between outcome groups were assessed using χ^2 tests for categorical variables and *t* tests for continuous variables. To quantify associations between variables and IPAA, multivariable logistic regression was used to estimate ORs and 95% CIs, where the reference outcome category was no IPAA (EI and NP). Associations between surgery received and patient characteristics were assessed in models adjusted for age, sex, region, employment status, employment class, industry status, CCI, area deprivation index, provider type, year of surgery, operative approach, and case acuity based on patients having complete covariate information. We also performed multivariable logistic regression to assess the association between each covariate and IPAA vs EI, with EI as the reference outcome. Analysis items with a 2-sided *p* value of <0.05 were considered statistically significant. All analyses were performed using SAS version 9.4 (SAS Inc, Cary, NC).[12]

RESULTS

The study population included 2816 patients with UC who initially underwent total colectomy or proctocolectomy. Of these, 1414 (50.2%) ultimately underwent IPAA, 928 (33.0%) were not observed to undergo further surgery, and 474 (16.8%) underwent proctectomy with EI (Fig. 1). Patients who did not undergo IPAA (EI and NP) totaled 1402 (49.8%). One thousand two hundred sixty-seven patients (45.0%) were women, 2247 (79.8%) had no major comorbidities (CCI score 0), and 1014 (36.0%) underwent initial colectomy by a colorectal surgeon. The median follow-up was 26.3 months (interquartile range, 13.8–47.1 months), with no significant difference in duration of follow-up between groups.

On univariate analysis, patient characteristics, including younger age and lower CCI, were found to be associated with IPAA. In addition, characteristics of the case, including involvement of a colorectal surgeon, use of laparoscopy, elective acuity, and initial operation during the first half of the study period, were also associated with a higher incidence of IPAA (Table 1). On multivariable analysis, a

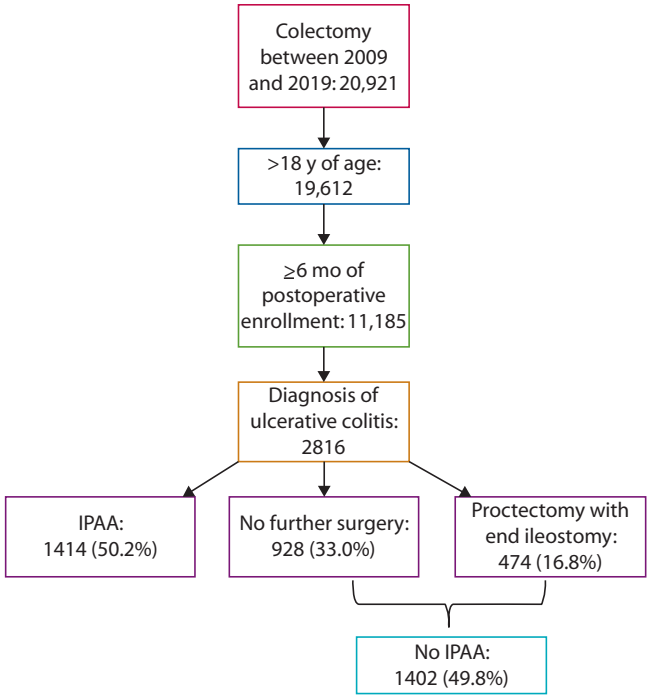

FIGURE 1. Flow chart of study cohort and outcomes.

subset of these variables remained significant: age, year of surgery, CCI, and case acuity (Table 2). Younger patients were more likely to undergo IPAA compared with older patients. 57.4% of patients aged 18 to 29 years and 61.3% of patients aged 30 to 39 years underwent IPAA, whereas 32.9% of patients aged 60 to 65 years underwent IPAA ($p < 0.0001$). This relationship remained significant with multivariate analysis, with an adjusted OR of 2.3 ($p = 0.0008$) for patients aged 18 to 29 versus 60 to 64 years, and an adjusted OR of 2.7 ($p < 0.0001$) for patients aged 30 to 39 versus 60 to 64 years. For CCI, 54.1% of patients with a CCI score of 0 underwent IPAA, compared with 32.3% of patients with a CCI score of 2+ (OR 0.57, $p = 0.01$). A total of 56.9% of patients who underwent colectomy with the involvement of a colorectal surgeon underwent IPAA. In comparison, 46.5% of patients who underwent colectomy with a general surgeon underwent IPAA. On multivariate analysis, this trended toward significance with an OR of 1.2 ($p = 0.19$). Patients undergoing urgent vs elective colectomies were significantly less likely to undergo IPAA (26.6% vs 53.9%), and this finding remained significant on multivariate analysis (OR 0.34, $p < 0.0001$). Patients undergoing laparoscopic vs open colectomies were more likely to undergo IPAA (53.3% vs 45.6%), and this trended toward significance on multivariate analysis (OR 1.3, $p = 0.08$). Patients who underwent surgery between 2013 and 2019 had a higher rate of IPAA than those who underwent surgery between 2009 and 2012 (OR 0.57, $p < 0.0001$). The area deprivation index did not show a significant association with IPAA ($p = 0.66$).

We also examined factors associated with IPAA vs proctectomy with EI with multivariable analysis. Age

TABLE 1. Characteristics of the study cohort at the time of initial colectomy

Variable	*IPAA*	*No IPAA (EI + NP)*	*EI*	*NP*	*p*
Overall, n (%)	1414 (50.2)	1402 (49.8)	474 (16.8)	928 (33.0)	
Age category, y, n (%)					
18–29	361 (57.39)	268 (42.61)	43 (6.84)	225 (35.77)	<0.0001
30–39	355 (61.31)	224 (38.69)	53 (9.15)	171 (29.53)	
40–49	292 (50.34)	288 (49.66)	94 (16.21)	194 (33.45)	
50–59	300 (42.49)	406 (57.51)	186 (26.35)	220 (31.16)	
60–65	106 (32.92)	216 (67.08)	98 (30.43)	118 (36.65)	
Female, n (%)	619 (48.86)	648 (51.14)	218 (17.21)	430 (33.94)	0.4247
Year of surgery					<0.0001
2009–2012	765 (55.47)	614 (44.53)	238 (17.26)	376 (27.27)	
2013–2019	649 (45.16)	788 (54.84)	236 (16.42)	552 (38.41)	
Region of surgery, n (%)					
Northeast	289 (54.32)	243 (45.68)	88 (16.54)	155 (29.14)	0.051
North Central	383 (47.76)	419 (52.24)	126 (15.71)	293 (36.53)	
South	513 (49.52)	523 (50.48)	192 (18.53)	331 (31.95)	
West	211 (50.24)	209 (49.76)	66 (15.71)	143 (34.05)	
Unknown	18	8	2	6	
CCI, n (%)					
0	1216 (54.12)	1031 (45.88)	339 (15.09)	692 (30.8)	<0.0001
1	100 (37.59)	166 (62.41)	50 (18.8)	116 (43.61)	
2+	98 (32.34)	205 (67.66)	85 (28.05)	120 (39.6)	
Employment class, n (%)					
Salary	364 (53.29)	319 (46.71)	110 (16.11)	209 (30.6)	0.2027
Hourly	291 (46.63)	333 (53.37)	110 (17.63)	223 (35.74)	
Other	759 (50.3)	750 (49.7)	254 (16.83)	496 (32.87)	
Employment status, n (%)					
Active	771 (51.68)	721 (48.32)	241 (16.15)	480 (32.17)	0.245
Nonactive	643 (48.56)	681 (51.44)	233 (17.6)	448 (33.84)	
Industry status, n (%)					
Manufacturing, resource extraction, construction	324 (48.29)	347 (51.71)	124 (18.48)	223 (33.23)	0.0579
Services	449 (54.23)	379 (45.77)	122 (14.73)	257 (31.04)	
Transportation, communications, utilities	138 (46.31)	160 (53.69)	52 (17.45)	108 (36.24)	
Missing	503	516	176	340	
ADI quartile, n (%)					
<25	36 (52.17)	33 (47.83)	15 (21.74)	18 (26.09)	0.0898
25–49	276 (55.76)	219 (44.24)	76 (15.35)	143 (28.89)	
50–74	498 (48.07)	538 (51.93)	171 (16.51)	367 (35.42)	
75+	34 (49.28)	35 (50.72)	11 (15.94)	24 (34.78)	
Missing	570	577	201	376	
Provider type, n (%)					
Colorectal surgeon	577 (56.9)	437 (43.1)	158 (15.58)	279 (27.51)	<0.0001
General surgeon	837 (46.45)	965 (53.55)	316 (17.54)	649 (36.02)	
Operative approach, n (%)					
Laparoscopic	902 (53.31)	790 (46.69)	249 (14.72)	541 (31.97)	<0.0001
Open	504 (45.57)	602 (54.43)	215 (19.44)	387 (34.99)	
Hospitalized preoperative, n (%)					
Yes	101 (26.58)	279 (73.42)	59 (15.53)	220 (57.89)	<0.0001
No	1313 (53.9)	1123 (46.1)	415 (17.04)	708 (29.06)	

P value compares IPAA vs no IPAA.
ADI = area deprivation index; CCI = Charlson Comorbidity Index; EI = proctectomy with end ileostomy; NP = no proctectomy.

(OR 5.3, $p < 0.0001$) and CCI (OR 0.82, $p = 0.0007$) continued to show a strong association with IPAA. Laparoscopic vs open cases were also significantly associated with IPAA, with OR 1.6 ($p = 0.02$). Area deprivation index and involvement of a colorectal surgeon did not show a significant association with IPAA vs EI (Table 3).

DISCUSSION

In the current study population of continuously insured patients in the United States, 50.2% of patients underwent IPAA after total colectomy for UC. Younger age, lower comorbidities, earlier year of surgery, and elective cases were significantly associated with IPAA vs EI or no further

TABLE 2. Multivariate analysis of the association between covariates and IPAA placement vs no IPAA placement

Variable	*Adjusted OR*	*95% CI*	*p*
Age category, y			
18–29 vs 60–64	2.297	1.41–3.74	0.0008
30–39 vs 60–64	2.746	1.68–4.48	<0.0001
40–49 vs 60–64	1.844	1.13–3.01	0.0142
50–59 vs 60–64	1.349	0.84–2.17	0.2163
Sex			
Female vs male	0.865	0.67–1.12	0.2663
Year of surgery			
2013–2019 vs 2009–2012	0.573	0.44–0.75	<0.0001
Region			
Northeast vs South	0.968	0.65–1.45	0.8732
North Central vs South	1.007	0.74–-1.37	0.9642
West vs South	0.669	0.42–1.06	0.0898
Employment status			
Employed vs unemployed	1.139	0.86–1.52	0.3738
Employment class			
Hourly vs salary	1.008	0.75–1.36	0.9609
Other vs salary	1.05	0.75–1.47	0.7741
Industry status			
Services vs manufacturing	0.961	0.72–1.28	0.7877
Transportation vs manufacturing	0.809	0.56–1.18	0.2681
CCI			
1 vs 0	0.711	0.45–1.12	0.1444
2 vs 0	0.573	0.37–0.88	0.0119
ADI			
2 (25–49) vs 1 (<25)	0.976	0.49–1.93	0.9443
3 (50–74) vs 1 (<25)	0.679	0.33–1.41	0.2976
4 (≥75) vs 1 (<25)	0.804	0.31–2.1	0.6558
Provider type			
Colorectal surgeon vs general surgeon	1.194	0.92–1.55	0.1868
Prehospitalized			
Urgent vs elective	0.341	0.23–0.51	<0.0001
Laparoscopic			
Laparoscopic vs open	1.274	0.98–1.66	0.0754

ADI = area deprivation index; CCI = Charlson Comorbidity Index.

surgery. Notably, the area deprivation index (a measure of socioeconomic status) was not associated with IPAA in this data set.

Previous studies have examined the rate of IPAA after total colectomy for UC at the state level in Vermont and New York and at the national level in England and Sweden. In the United States, a study from 2013 in Vermont that included 118 patients reported an IPAA rate of 65.7%, and a study from 2017 in New York that included 2203 patients reported an IPAA rate of 34%.[7,8] In New York, patient factors including younger age, fewer comorbidities, and elective surgery were associated with IPAA. Hospital factors, including colorectal surgeon involvement and IPAA volume, were also associated with IPAA.[8] In England, a 2018 study including 76,129 patients found a rate of restorative surgery of 33%. Finally, in Sweden, a 2021 study including 5969 patients found a rate of restorative surgery of 46.8%; patients with high income and who were non-Nordic immigrants had a higher rate of restorative surgery.[5]

The results of the current study largely confirm the risk factors identified by previous studies in a nationwide US population.[13,14] However, unlike the Swedish study, we did not find that socioeconomic status was significantly associated with IPAA. This is likely because our study population included only patients with continuous commercial insurance, suggesting that this coverage may provide a protective effect against differences in income and education. The rate of IPAA in the current study is lower than it was in a small state with highly centralized colorectal surgical care (Vermont) but higher than in a larger and more populated state (New York). Like previous studies, we found a higher rate of IPAA in patients who underwent colectomy by a colorectal surgeon (although this did not remain significant when controlling for covariates). In addition, we also found that higher comorbidities and higher case acuity had a strong negative association with IPAA. This is potentially related to the lower rates of IPAA seen in later years of our study because patients on new biologics may have higher frailty after failing therapy.[15,16] As a whole, these results emphasize the importance of ensuring follow-up for patients undergoing urgent/emergent procedures with colorectal providers to provide the option of restorative surgery.

TABLE 3. Multivariate analysis of the association between covariates and IPAA vs proctectomy with end ileostomy

Variable	*Adjusted OR*	*95% CI*	*p*
Age category, y			
18–29 vs 60–64	5.256	2.63–10.52	<0.0001
30–39 vs 60–64	4.967	2.53–9.75	<0.0001
40–49 vs 60–64	2.674	1.41–5.06	0.0025
50–59 vs 60–64	1.454	0.81–2.61	0.2113
Sex			
Female vs male	0.78	0.54–1.13	0.189
Year of surgery			
2013–2019 vs 2009–2012	0.764	0.52–1.12	0.1622
Region			
Northeast vs South			0.8055
North Central vs South	0.933	0.54–1.62	0.0335
West vs South	1.662	1.04–2.66	0.8383
Employment status			
Employed vs unemployed	1.229	0.81–1.86	0.3269
Employment class			
Hourly vs salary	0.981	0.63–1.53	0.9308
Other vs salary	0.956	0.59–1.56	0.8572
Industry status			
Services vs manufacturing	0.891	0.58–1.37	0.5998
Transportation vs manufacturing	0.728	0.44–1.22	0.2272
CCI			
1 vs 0	0.815	0.42–1.6	0.55
2 vs 0	0.397	0.23–0.68	0.0007
ADI			
2 (25–49) vs 1 (<25)	1.322	0.52–3.39	0.5622
3 (50–74) vs 1 (<25)	0.927	0.34–2.53	0.8829
4 (≥75) vs 1 (<25)	1.651	0.41–6.69	0.4823
Provider type			
Colorectal surgeon vs general surgeon	1.112	0.76–1.64	0.5902
Prehospitalized			
Elective vs not elective	0.631	0.34–1.19	0.1545
Laparoscopic			
Laparoscopic vs open	1.578	1.08–2.31	0.0187

ADI = area deprivation index; CCI = Charlson Comorbidity Index.

However, our results also raise interesting questions for further study regarding the rate of no IPAA (49.8%). Although the findings of the present study are aligned with those of previous studies, there is limited literature on patients' decision-making surrounding restorative surgery.[17] Even among patients receiving care from colorectal surgeons, 43% of patients do not undergo IPAA, and nearly one-third do not undergo proctectomy, raising the risk for future rectal cancers.[18] Further studies, including qualitative analyses, are needed to evaluate patients' reasons for not pursuing further surgery and to develop targeted interventions to improve follow-up.

This study has important limitations. First, the study population included only patients in the United States with commercial insurance, which is not representative of the entire US population and may not be geographically uniform. In addition, the database excludes patients aged 65 years or older. Second, we minimized bias due to loss to follow-up through the use of a long minimum follow-up duration (6 mo), but some patients may have been misclassified if they underwent surgery after a change in insurance. Also, this approach did exclude patients who may have lost insurance coverage after undergoing a total colectomy and who may undergo IPAA at even lower rates. Third, as mentioned above, because this analysis relied on an administrative database, many relevant variables related to the preoperative clinical scenario, postoperative outcomes, and patient race/ethnicity are not included, and the study is dependent on the accuracy of the database and procedure/specialty coding.[19] Fourth, the lack of association between socioeconomic status and IPAA in our study could also be directly influenced by loss of insurance coverage, which would result in their exclusion and bias our results. In addition, estimates used for the area deprivation index are based on averages for metropolitan statistical areas and are not specific to individual patients.

CONCLUSION

We found that the rate of IPAA after total colectomy for UC among patients with commercial insurance in the United States was 50.2% and that younger age, lower

comorbidities, elective cases, and earlier year of surgery were significantly associated with IPAA. There was no significant difference based on geographic areas of the country or socioeconomic status. These data emphasize the importance of follow-up with colorectal surgeons when operating in the urgent/emergent setting to provide the option of restorative surgery.

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