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Reduced Unplanned Care and Disease Activity and Increased Quality of Life After Patient Enrollment in an Inflammatory Bowel Disease Medical Home

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Abstract

Background & Aims—Specialty medical homes (SMHs) are a new healthcare model in which a multidisciplinary team and specialists manage patients with chronic diseases. As part of a large integrated payer–provider network, we formed an inflammatory bowel diseases (IBD) SMH and investigated its effects on healthcare use, disease activity, and quality of life (QoL).

Methods—We performed a retrospective analysis of 322 patients (58% female, mean age 34.6 years, 62% with Crohn’s disease, 32% with prior IBD surgery) enrolled in an IBD SMH, in conjunction with the UPMC Health Plan, from June 2015 through July 2016. Patients had at least 1 year of follow up. We evaluated changes in numbers of emergency department visits and

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hospitalizations from the year before vs after SMH enrollment. Secondary measures included IBD activity assessments and QoL.

Results—Compared to the year before IBD SMH enrollment, patients had a 47.3% reduction in emergency department visits ($P<.0001$) and 35.9% reduction in hospitalizations ($P=.008$). In the year following IBD SMH enrollment, patients had significant reductions in the median Harvey Bradshaw Index score (reduced from 4 to 3.5; $P=.002$) and median ulcerative colitis activity index score (from 4 to 3; $P=.0003$) and increases in QoL (median short inflammatory bowel disease questionnaire score increased from 50 to 51.8; $P<.0001$). Patients in the most extreme (highest and lowest) quartiles had the most improvement when we compared scores at baseline vs after enrollment. Based on multivariable regression analysis, use of corticosteroids (odds ratio [OR], 2.72; 95% CI, 1.32–5.66; $P=.007$) or opioids (OR, 3.20; 95% CI, 1.32–7.78; $P=.01$), and low QoL (OR, 4.44; 95% CI, 1.08–18.250; $P=.04$) at enrollment were significantly associated with persistent emergency department visits and hospitalizations.

Conclusion—We found development of an IBD SMH to be feasible and significantly reduce unplanned care and disease activity and increase patient QoL 1 year after enrollment.

Keywords

ulcerative colitis; patient-centered medical home; value-based care; gastroenterologist; psychiatric care

INTRODUCTION

Inflammatory bowel diseases (IBD) including Crohn's disease (CD) and ulcerative colitis (UC) are life-long chronic diseases that afflict 1.6 million Americans and require integrated medical and surgical management.¹ IBD patients have higher rates of comorbid behavior conditions that impact medical response, regimen adherence, unplanned care, and disease-related quality of life.^{2–4} Due to the complexity of care, segmentation and fragmentation of IBD management amongst multiple providers is common. Such siloed care falls short of seamless, integrated healthcare.

Over the past decade of healthcare reform and value-based care, new models have emerged including accountable care organizations and patient-centered medical homes (PCMH). Designed to improve patient experience, enhance health care quality, and decrease costs, these models have been deployed in primary care, but have yet to be tested in specialty care. Inflammatory bowel diseases are chronic diseases that often develop in the first three decades of life and the primary medical care is provided by the gastroenterologist. Due to the unique healthcare needs of this population, an IBD specialty medical home (SMH) would provide a novel model in which the gastroenterologist serves as the principle care provider.

In conjunction with the University of Pittsburgh Medical Center (UPMC) Health Plan (HP), we designed and established an IBD SMH, designated UPMC Total Care-IBD.⁵ Initiated in July 2015 with ongoing active enrollment, UPMC Total Care-IBD has assumed care for over 650 patients to date. We aimed to investigate the feasibility, durability, and impact of Total

Care-IBD after one year of enrollment and treatment. The primary outcome of interest was unplanned care, and secondary outcomes of quality of life (QoL) and disease activity.

MATERIALS AND METHODS

UPMC Total Care-IBD Design

UPMC is an integrated delivery and finance system, operating both a large academic health system and a health insurance plan that covers over 3 million members, predominantly in Western Pennsylvania. Details of the design, implementation, and flow of UPMC Total Care-IBD program have been previously published.^{5, 6} The multidisciplinary care team included a social worker, dietitian, schedulers, nurse coordinators, and advanced practice providers, and was led by a gastroenterologist (M.R.) and psychiatrist (E.S.). The gastroenterologist became the principle care provider for this population and coordinated the total care of the patient. Some of the UPMC Total Care-IBD staff, e.g. the nurse coordinator, advanced practice provider, dietitian, and social worker, were paid for by the Health Plan. The Total Care-IBD team routinely coordinated care with chronic pain specialists, colorectal surgeons, and peer volunteer specialists (IBD Connect), and relied on nurse and social worker home visits to the highest utilizer patients, open-access scheduling, remote monitoring, and telemedicine. Weekly meetings between the payer and providers reviewed patient care plans, outcomes, and utilization data.

UPMC Total Care-IBD Enrollment

Enrollment criteria included: member of UPMC HP insurance product (i.e., commercial, Medicare, Medicaid, Medicaid/Medicare dually eligible); confirmed diagnosis of CD or UC; and age 18 through 60 years.

Study Population

To assess the impact of UPMC Total Care-IBD in a “proof of concept” manner, we conducted a quasi-experimental, time-interrupted study of patients enrolled in Total Care-IBD. Patients underwent informed consent; all data were prospectively collected and the study was approved by the Institutional Review Board at the University of Pittsburgh (Protocol #15100396). Patients who enrolled in Total Care-IBD in the first calendar year (June 2015 to July 2016) with at least 365 days follow-up were eligible for study inclusion. Patients were excluded if they were not enrolled in Total Care-IBD, if they changed to a non-UPMC HP product prior to 365 days of follow-up, or if they had less than 365 days follow-up.

Patient and Disease Characteristics

Patient demographics and disease characteristics were collected at the first UPMC Total Care-IBD encounter and included age, gender, body mass index, ethnicity, smoking status, insurance status (commercial or governmental product). IBD characteristics included disease type (CD or UC), disease duration, prior IBD-related surgery, and prior or present ostomy or ileal pouch anal anastomosis.

Disease Activity, Quality of Life, and Mental Health Metrics

Patient-reported disease activity scores (Harvey-Bradshaw Index [HBI] for CD and ulcerative colitis activity index [UCAI] for UC), disease-related quality of life (QoL) metric (short inflammatory bowel disease questionnaire [SIBDQ]), depression and anxiety screening metrics (patient health questionnaire [PHQ]-9 and generalized anxiety disorder [GAD]-7 respectively) were prospectively collected at each visit.⁷⁻¹¹ All patients entering Total Care-IBD were initially evaluated by the gastroenterologist, dietitian, social worker, advanced practitioner, and registered nurse. If scores on mental health metrics indicated significant mental health impairment (PHQ-9 or GAD-7 ≥ 10), the Total Care-IBD social worker or psychiatrist (E.S.) performed a full psychiatric evaluation for and potential diagnosis of comorbid behavioral health disorders. Other determinants to meet with the social worker, psychiatrist and/or an integrated pain anesthesiologist were the presence of other comorbid psychiatric conditions, chronic pain, as well as the discretion of the team (e.g., patients requiring social assistance or stress management). Active IBD was defined by an HBI or UCAI score > 4 , poor QoL considered at SIBDQ < 50 , and depression or anxiety a PHQ9 or GAD7 > 10 respectively.¹²⁻¹⁴

Medications

IBD medications were prospectively collected at each Total Care-IBD visit and included, 5-aminosalicylates, systemic corticosteroids, thiopurines (azathioprine and 6-mercaptopurine), methotrexate, anti-tumor necrosis factor (TNF) (infliximab, adalimumab, certolizumab pegol, golimumab), anti-integrin (natalizumab, vedolizumab), and anti-interleukin 12/23 (ustekimumab) agents. Other medications including opioids and antidepressants (tricyclic antidepressants, selective-serotonin reuptake inhibitors, and serotonin-norepinephrine reuptake inhibitors) were similarly recorded. Dosing, intervals, and medications for other indications were not prospectively documented.

Healthcare Utilization

At each Total Care-IBD encounter, patient-reported interim healthcare utilization including endoscopy, radiography (computed tomography or magnetic resonance imaging for IBD purposes), IBD-related surgery, emergency department visits and hospitalizations for IBD indications were recorded. For comparison, emergency department visits and hospitalizations in the three months and year prior to enrollment were recorded via manual chart review.

Primary Outcomes

The primary outcome of interest was unplanned healthcare utilization (inpatient hospitalization and/or emergency department [ED] visits) in the one year following Total Care-IBD enrollment. We compared rates of utilization in the one year before enrollment to the one year following an individual's Total Care-IBD engagement. For purposes of evaluating the rapidity of impact of Total Care-IBD, we also subdivided and compared three-month utilization prior to and after an individual's enrollment.

Secondary Outcomes

Secondary outcomes included changes in patient-reported disease activity, disease-specific QOL, depression scores, and stress/anxiety metrics. We also aimed to determine baseline predictors of post-enrollment utilization using demographic, clinical, and disease related factors. To examine for heterogeneity of treatment effect the SIBDQ, PHQ-9, and GAD-7 baseline scores were divided into quartiles and change in each metric by quartile was examined.

Statistical Analysis

Categorical variables were compared using Chi square and Fisher's exact test where appropriate. Continuous variables were compared using Student's T test or one-way analysis of variance for normally distributed variables and Wilcoxon rank sum or sign rank test for nonparametric variables.

Logistic regression modeling to determine baseline predictors of post-enrollment healthcare utilization was performed. Regression imputation was performed for predictor variables with >5% missing data. Variables with $p < 0.1$ on univariate testing were included in a multivariate model. Significance was considered at $p = 0.05$ unless otherwise stated.

All authors had access to the study data and reviewed and approved the final manuscript.

RESULTS

Patient Cohort

There were 346 patients enrolled in the first year of Total Care-IBD and 322 met inclusion criteria. The majority (57.6%) were female, Caucasian (81.1%), non-smokers (82.1%), with mean age 34.6 years (Table 1). Most patients (77.3%) had a commercial product of UPMC HP insurance. The majority (62%) of patients had CD and nearly half (44.4%) had prior IBD-related surgery, with 12.1% undergoing three or more surgeries. Nearly one-fifth (21.2%) of CD patients were actively smoking.

The majority (59%) of CD patients had previously received anti-TNF therapy. At enrollment, 14.1% CD patients were receiving corticosteroids, 43.9% (n=87) were on a biologic agent, of whom 40% (n=35) were on concomitant immunomodulator.

Of UC patients, 12.1% had undergone prior colectomy. At enrollment, 19.4% UC patients were receiving corticosteroids, 25% (n=31) a biologic agent, of whom 38.7% (n=12) were on combination therapy with an immunomodulator.

Compared to UC, CD patients had significantly longer disease duration ($p=0.02$), more patients with prior IBD surgery ($p<0.0001$), an ostomy ($p=0.03$), more historical and current anti-TNF use (both $p<0.0001$), and more combination therapy ($p=0.05$).

At enrollment, nearly half (49.1%) of patients had a "poor" QoL (SIBDQ<50), 45.6% of CD patients qualified as active disease (HBI>4), and 31.5% of UC patients had clinically active disease (UCAI >4). Nearly a third of total patients (28.3%) met criteria for depression on

PHQ-9 screening at enrollment (PHQ-9 = 10) and 18.6% met criteria for significant stress or anxiety (GAD-7 = 10). Of patients with inactive disease 9% met criteria for depression.

Healthcare Utilization

In the year prior to Total Care-IBD, there were 510 ED visits by 112 patients and 209 hospitalizations by 83 patients (Figure 1). In the year following enrollment, there was a significant reduction in the number of both ED visits (269 events by 98 patients, $p < 0.0001$) and hospitalizations (134 events by 67 patients, $p = 0.008$).

The impact of Total Care-IBD on unplanned care was evident shortly after patient enrollment. Within three months there was a significant drop in the ED utilization and hospitalizations compared to the same time period immediately preceding enrollment into Total Care-IBD: 226 ED visits by 79 patients and 92 hospitalizations by 46 patients in the 3 months prior; and 32 ED visits by 23 patients and 19 hospitalizations by 17 patients after entry (both $p < 0.0001$).

Only 18 of the patients enrolled in Total Care-IBD in the first year discontinued. Fourteen changed to non-UPMC HP insurance, and 4 patients moved to another state. Excluded patients demonstrated relatively low resource utilization. Three patients had a single ED visit each in the year prior to Total Care-IBD and one had a single hospitalization after enrollment.

In the year prior to enrollment, 7.5% patients had an intestinal resection, 42.7% had at least one radiographic study, and 51.8% underwent at least one endoscopic procedure. In the year following enrollment more patients underwent an intestinal resection (10.6%, $p = 0.22$), but fewer had radiographic studies (34.1%, $p = 0.06$) and endoscopic procedures (43.5%, $p = 0.08$).

Interventions

In the first year of Total-Care IBD, 255 patients had more than one clinic visit and were available for patient-reported intervention assessment. Of these, 32.9% were prescribed at least one new steroid prescription. Maintenance medication changes included starting an immunomodulator in 38.4% (thiopurine $n = 79$, methotrexate $n = 19$) and 27.5% newly initiated or changed a biologic agent (anti-TNF $n = 54$, anti-integrin $n = 12$, ustekinumab $n = 4$). Anti-TNFs were stopped in 54 patients and 3 were transitioned to anti-integrin therapy. Thiopurines were stopped in 39 patients of whom 4 switched to methotrexate while 11 patients on methotrexate at enrollment stopped with 4 changing to thiopurines. The reason for stopping or switching IBD medications was not always readily recorded, but most indications were due to patient intolerance, lack of efficacy, or a desire to de-escalate therapy. Of the patients who entered IBD-Total Care, 9 were successfully weaned off of opioids and have remained free of narcotics.

The mean number of clinic visits was 3.4 ± 4.6 (max 51). Nearly one-third (34.8%) of patients met with a psychiatrist at least once and 73.3% with the social worker. Of patients who met with the psychiatrist, the mean number of visits was 4.4 ± 5.8 (max 37) and 7.8% patients engaged in tele-psychiatry sessions. The mean number of social work visits was 5.2

± 8.2 (max 54). The integrated pain specialist was utilized by 7.8% patients with 7.0 ± 5.3 mean number of visits.

Disease Activity, Quality of Life and Mental Health Metrics

Over the first year of Total Care-IBD, there was a significant reduction in disease activity scores for both CD (median HBI 4 to 3.5; $p=0.002$) and UC (median UCAI 4 to 3; $p=0.0003$) (Table 2). The highest quartiles at enrollment experienced the largest reduction for HBI (median HBI 9 to 6; $p<0.001$) and UCAI (median UCAI 9 to 5; $p<0.001$) (Figure 2).

Similarly, depression (median PHQ-9 6 to 5; $p<0.0001$) and anxiety (median GAD-7 4 to 4; $p=0.02$) metrics were significantly reduced over the first year. The most extreme quartiles for both mental health metrics demonstrated the most improvement (median PHQ-9 16 to 12; $p<0.001$ and median GAD-7 14 to 11; $p<0.001$).

Finally, quality of life scores significantly improved over the first year (median SIBDQ 50 to 51.8; $p<0.0001$) and the lowest quartile exhibited the largest improvement (median SIBDQ 31 to 39; $p<0.001$).

In sum, there was moderate, but significant improvement in IBD activity, depression, anxiety, and quality of life scores after enrollment in the medical home. The most pronounced impact on patient reported outcomes was realized in the highest quartile of disease severity, mental health impairment, and poorest quality of life.

Predictors of Healthcare Utilization

Multivariable logistic regression of healthcare utilization (ED or hospitalization) in the year following enrollment demonstrated that baseline steroid requirement (adjusted odds ratio [AOR] 2.72; 95% CI 1.32–5.66; $p=0.007$), opioids at enrollment (AOR 3.20; 95% CI 1.32–7.78; $p=0.01$), and low QoL (AOR 4.44; 95% CI 1.08–18.25; $p=0.04$) remained independently predictive of post-enrollment healthcare utilization (Table 3). On univariate analysis, high PHQ-9 score (OR 2.60; $p=0.004$) was associated with future utilization, but in the multivariate model, the two median quartiles (AOR 0.42; 95% CI 0.18–0.99; $p=0.05$ and AOR 0.22; 95% CI 0.07–0.68; $p=0.008$) were at significantly decreased risk of utilization compared to the lowest quartile and the highest PHQ-9 was no longer statistically associated (AOR 0.51; 95% CI 0.13–2.01; $p=0.33$).

Notable non-significant independent predictors of post-enrollment healthcare utilization included active smoking, insurance (Medicaid compared to commercial), number of prior anti- TNFs and baseline anxiety metrics.

DISCUSSION

Implementing a patient-centered specialty medical home for the care of IBD patients is feasible and results in significant reduction in unplanned care, improvement in disease activity, and better quality of life. To date, this is the first-of-its-kind specialty medical home and could serve as a template for new models of healthcare. The results highlight the

opportunity for deeper collaboration between payers and providers where aligned incentives could be sufficient to encourage investment in such alternative models.

Patients enrolled in Total Care-IBD had high rates of healthcare utilization that significantly decreased in the year after enrollment. The reduction in unplanned care and quality of life improvement was due to three core elements, 1) stratification of the determinants that drove health utilization, 2) care plans that utilized the multidisciplinary team, and 3) the partnership between the provider group and health plan around the collective care of a population of patients. Stratifying patients by biological, social, and behavioral risk factors for high healthcare resource utilization and poor quality of life allowed individualized care plans and resource allotment.

Risk factors independently predictive of healthcare utilization post-enrollment included corticosteroid requirement, opioid use, and poor quality of life scores. Corticosteroids may be a surrogate marker for more severe IBD while chronic opioid use may indicate pain issues, addiction, or narcotic bowel syndrome. We successfully weaned a small cohort of patients off opioids. Despite the aggressive multidisciplinary approach of the IBD SMH, those patients continuing to use opioids had high rates of unplanned care and poor quality of life. These findings corroborate previous results from our group as well as others.¹⁵⁻¹⁸ Anxiety and depression rates were comparable to published rates.^{19, 20} Psychosocial complexity influenced the IBD course.²¹ Less than one half of our cohort had active IBD at baseline with psychosocial factors adversely impacting quality of life and medical utilization. The Total Care IBD program integrated behavioral care into management plans which improved anxiety, depression, quality of life, and reduced unplanned care.

Several other programs have designed novel approaches to improving care and reducing cost for IBD populations. The Division of Digestive Disease at UCLA has introduced a comprehensive, integrated, and holistic approach to value-based care in the chronic disease management of Inflammatory Bowel Diseases (IBD), with the development of the “Value-Quotient” (or vQ) for value-based and cost-effective IBD management.²²⁻²⁵ The Illinois Gastroenterology Group developed Project Sonar, a care management solution for patients with IBD. Project Sonar utilizes nurse care managers and physician medical directors in a team approach to coordinate care for patients with IBD, along with clinical decision support and patient engagement, and has recently partnered with a national payer to create a specialist intensive medical home.²⁶⁻²⁸ Although these programs have different design elements from the UPMC IBD SMH, the reliance on multidisciplinary care of a chronic disease population and partnership with an insurance plan is similar.

Our study has several limitations. The greatest limitation is the lack of a control group to compare SMH intervention to routine clinical IBD care. We initially planned to compare Total Care-IBD patients to those not enrolled, however, the most complex and highest utilizer UPMC Health Plan IBD patients were disproportionately enrolled into Total Care-IBD. While this was the intent of the program, the non-Total Care-IBD patients were of lower complexity and utilizers and could not serve as an accurate comparator group. This initial patient complexity was similar to most tertiary referral practices, but may nonetheless limit the generalizability of the study findings. Another significant limitation was that we

lacked important data on the number of clinic visits, telephone calls, electronic messages and total cost of care from the full cohort for the one year prior to medical home enrollment. A significant proportion of our patients did not have UPMC HP insurance for a full year prior to enrollment in the medical home which did not allow pre- and post-enrollment analyses on these parameters. Data on medical comorbidities was not routinely collected and may have influenced unplanned care outcomes. Scalability and reproducibility to other providers and healthcare systems may also be limited. We acknowledge that the integrated delivery and finance system of UPMC is unique and other healthcare systems may face additional challenges in payer-provider collaboration and securing payer fiscal support. We assessed outcomes at one year, which may be too short of a duration to see a lasting impact and our results may represent early regression to the mean. Ultimately, longer follow-up, comparison to a propensity matched cohort, data on total cost of care, and return on investment will be evaluated in the future. Despite these limitations, the enrollment of a population of IBD patients from a single payer with prospective collection of data, a high retention rate, and assessment of outcomes is unique and allowed meaningful analyses.

In conclusion, a patient-centered specialty medical home for IBD patients is a feasible alternative healthcare delivery model that reduced healthcare utilization, improved disease activity, and led to a better quality of life.

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Abbreviations

AOR	adjusted odds ratio
BMI	body mass index
CD	Crohn's disease
CI	confidence interval
ED	emergency department
GAD	generalized anxiety disorder
HBI	Harvey-Bradshaw Index
HP	health plan
IBD	inflammatory bowel disease
OR	odds ratio
PHQ	patient health questionnaire
QoL	quality of life

SD	standard deviation
SIBDQ	short inflammatory bowel disease questionnaire
SMH	specialty medical home
TNF	tumor necrosis factor
UC	ulcerative colitis
UCAI	ulcerative colitis activity index
UPMC	University of Pittsburgh Medical Center

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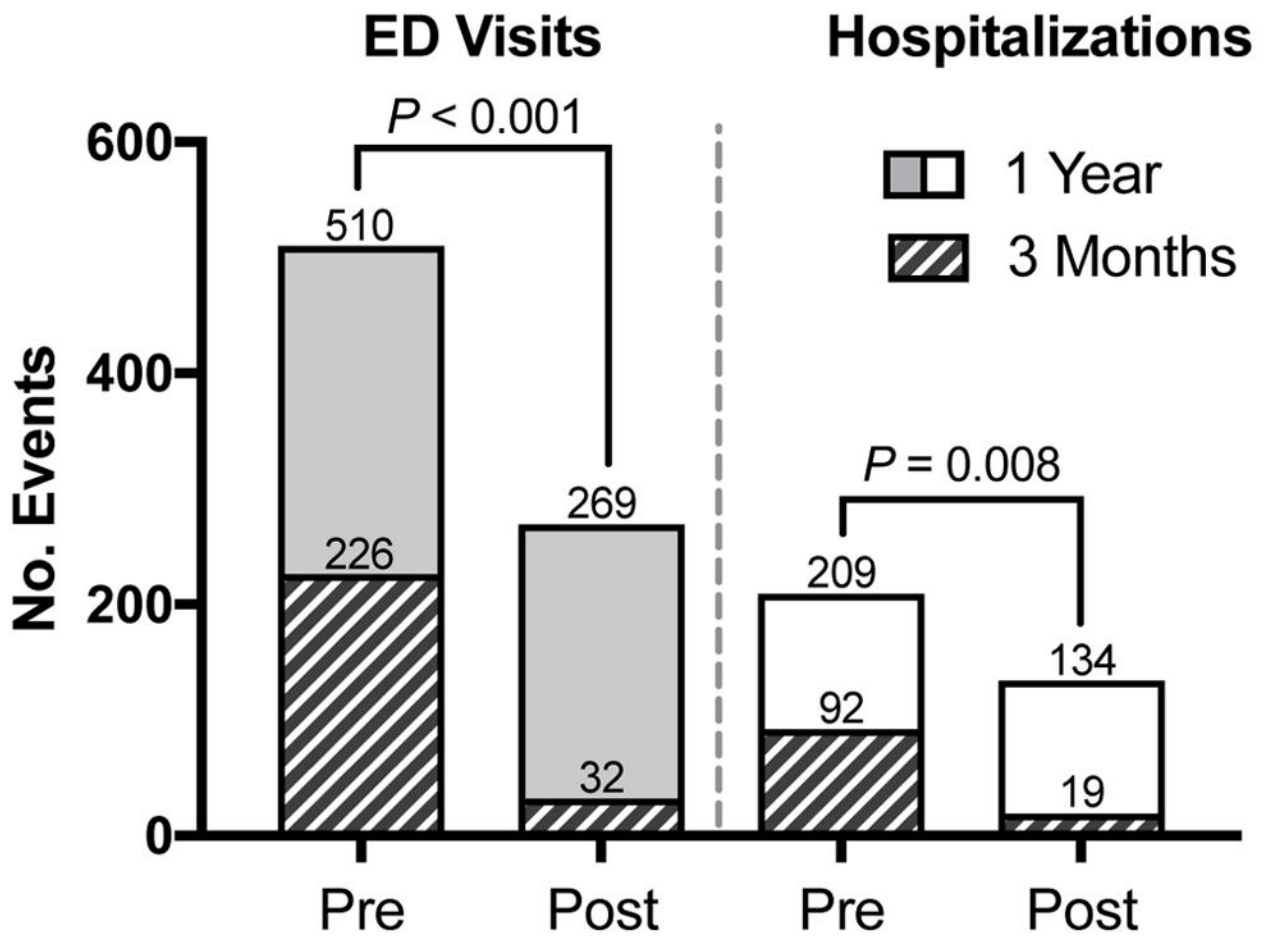


Figure 1. IBD-related healthcare utilization in the three-month and one-year period before and after SMH enrollment.

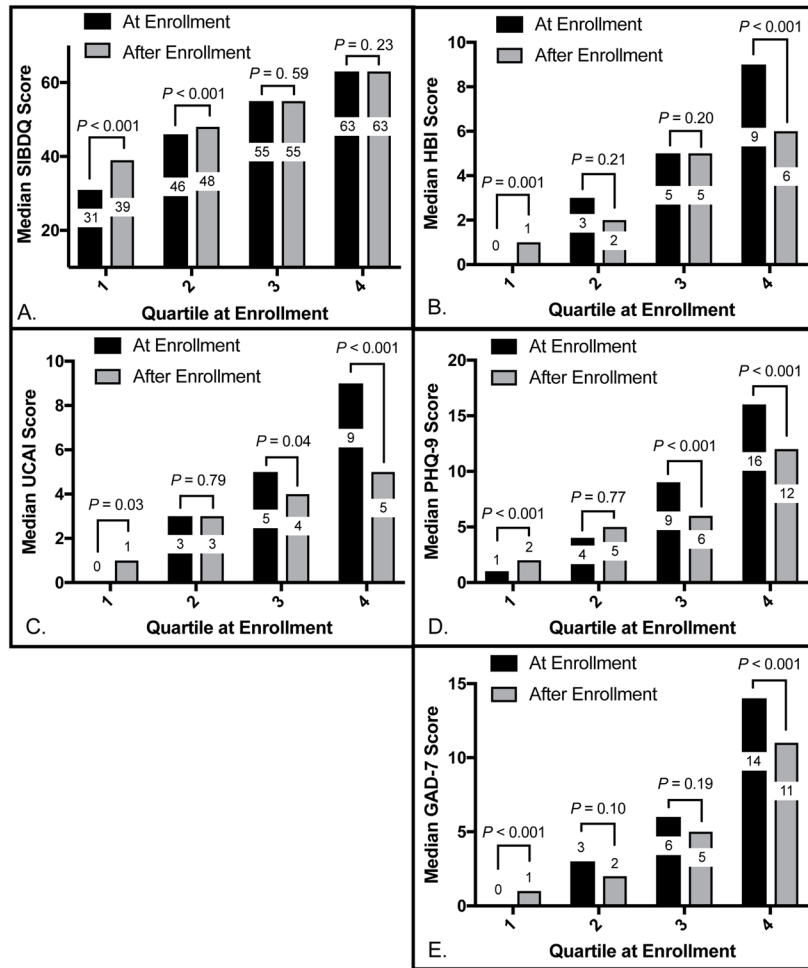


Figure 2. Change from baseline for (A) short inflammatory bowel disease questionnaire (SIBDQ), (B) Harvey-Bradshaw Index (HBI), (C) Ulcerative Colitis Activity Index (UCAI), (D) Patient Health Questionnaire-9 (PHQ-9), and (E) Generalized Anxiety Disorder-7 (GAD-7) by baseline quartile.

Table 1

Population demographics, disease characteristics, and medication requirement at initial visit of patients enrolled in the first year of the specialty medical home.

	All (N=322)	CD (N=198)	UC (N=124)	p-value
Male (%)	136 (42.4)	79 (39.9)	57 (46.0)	0.36
Mean Age, years (SD)	34.6 (9.7)	34.1 (9.6)	35.3 (9.9)	0.29
Mean BMI (SD)	27.0 (6.7)	26.8 (6.2)	27.3 (7.4)	0.87
Ethnicity, No. (%)				0.02
Caucasian	261 (81.1)	170 (85.9)	91 (73.4)	
Black	8 (2.5)	5 (2.5)	3 (2.4)	
Asian	2 (0.6)	0	2 (1.6)	
Hispanic	0	0	0	
Middle Eastern	2 (0.6)	1 (0.5)	1 (0.8)	
Indian	1 (0.3)	0	1 (0.8)	
Unknown/Declined	48 (14.9)	22 (11.1)	26 (21.0)	
Smoking on Enrollment, No. (%)				0.17
Never	206 (64.0)	121 (61.1)	85 (68.5)	
Active	58 (18.0)	42 (21.2)	16 (12.9)	
Past	58 (18.0)	35 (17.7)	23 (18.5)	
Insurance				0.21
Commercial	249 (77.3)	147 (74.2)	102 (82.3)	
Medicaid	70 (21.7)	49 (24.7)	21 (16.9)	
Medicare	3 (0.9)	2 (1.0)	1 (0.8)	
Psychiatric Diagnoses, (%)				0.64
Depression	68 (21.1)	44 (22.2)	24 (19.4)	0.58
Stress/Anxiety	154 (47.8)	94 (47.5)	60 (48.4)	0.91
Substance Abuse	13 (4.0)	8 (4.0)	5 (4.0)	0.99
Other	67 (20.8)	43 (21.7)	24 (19.4)	0.67
Mean Disease Duration (SD)	10.0 (8.5)	10.9 (8.9)	8.6 (7.6)	0.02
Prior Resection (%)	103 (32.0)	88 (44.4)	15 (12.1)	<0.0001
No. of Prior Surgeries				0.21
1	49 (15.2)	45 (22.7)	4 (3.2)	
2	25 (7.7)	19 (9.6)	6 (4.8)	
3-5	19 (5.9)	15 (7.6)	4 (3.2)	
>5	10 (3.1)	9 (4.5)	1 (0.8)	
Ostomy (%)	24 (7.4)	20 (10.1)	4 (3.2) ^b	0.03

	All (N=322)	CD (N=198)	UC (N=124)	p-value
J Pouch (%)	20 (6.2)	7 (3.5) ^a	13 (10.5) ^b	0.02
Medications Prior to Enrollment				
Steroids (%)	212 (65.8)	142 (71.7)	70 (56.5)	0.01
Immunomodulator				
Thiopurines	115 (35.7)	86 (43.4)	29 (23.4)	<0.0001
Methotrexate	50 (15.5)	37 (18.7)	13 (10.5)	0.06
Anti-Tumor Necrosis Factor ^c				
Infliximab	87 (27.0)	64 (32.3)	23 (18.5)	0.01
Adalimumab	72 (22.3)	51 (25.7)	21 (16.9)	0.08
Certolizumab pegol	13 (4.0)	13 (6.6)	--	--
Golimumab	0	--	0	--
Anti-Integrin				
Natalizumab	2 (0.6)	2 (1.0)	0	NA
Vedolizumab	0	0	0	NA
Anti-Interleukin 12/23				
Ustekinumab	0	0	--	--
Opioids ^d	109 (33.9)	80 (40.4)	29 (23.4)	0.002
No. of Prior Anti-TNFs ^e (%)				
1	108 (33.5)	79 (39.9)	29 (23.4)	<0.0001
2	67 (20.8)	46 (23.2)	21 (16.9)	
3	12 (3.3)	12 (6.1)	0	
Medications at Enrollment				
Steroids (%)	52 (16.1)	28 (14.1)	24 (19.4)	0.22
Immunomodulator				
Thiopurines	75 (23.3)	51 (25.8)	24 (19.4)	0.22
Methotrexate	17 (5.3)	14 (7.1)	3 (2.4)	0.08
Anti-Tumor Necrosis Factor				
Infliximab	57 (17.7)	39 (19.7)	18 (14.5)	0.29
Adalimumab	43 (13.4)	36 (18.2)	7 (5.6)	0.001
Certolizumab pegol	4 (1.2)	4 (2.0)	--	--
Golimumab	2 (0.6)	--	2 (1.6)	--
Anti-Integrin				
Natalizumab	0	0	0	NA
Vedolizumab	11 (3.4)	7 (3.5)	4 (3.2)	0.99
Anti-Interleukin 12/23				
Ustekinumab	1 (0.3)	1 (0.5)	--	--
Combination Therapy ^f	47 (14.6)	35 (17.7)	12 (9.7)	0.05
Antidepressant ^g	71 (22.0)	44 (22.2)	27 (21.8)	0.99
Benzodiazepine	57 (17.7)	36 (18.2)	21 (16.9)	0.88

	All (N=322)	CD (N=198)	UC (N=124)	p-value
Opioids ^d	39 (12.1)	26 (13.1)	13 (10.5)	0.60

CD: Crohn's disease; UC: ulcerative colitis; SD: standard deviation; BMI: body mass index

^aPatients initially diagnosed with ulcerative colitis, underwent a colectomy with J-pouch, later found to have Crohn's disease.

^bTwo patients at enrollment had both diverting ileostomy after J-pouch creation.

^cPatients on anti-TNF previously, but not at enrollment. Could have been on more than one anti-TNF previously.

^dIncludes tramadol

^eIncluding active anti-TNF at time of enrollment.

^fImmunomodulator (thiopurine or methotrexate) with concurrent biologic agent (anti-TNF, anti-integrin, or ustekinumab)

^gIncludes selective serotonin reuptake inhibitors, serotonin-norepinephrine reuptake inhibitors, and tricyclic antidepressants.

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Table 2

Questionnaire scores from initial SMH visit and scores during SMH treatment.

	All (N=322)			CD (N=198)			UC (N=124)		
	At Enrollment	During SMH ^a	P-value	At Enrollment	During SMH ^a	P-value	At Enrollment	During SMH ^a	P-value
SIBDQ Median (IQR)	50 (19)	51.8 (17)	<0.0001	49.5 (19)	50 (18)	0.0001	50 (21)	53.7 (13.8)	<0.0001
HBI Median (IQR)	--	--	--	4 (6)	3.5 (4)	0.002	--	--	--
UCAI Median (IQR)	--	--	--	--	--	--	4 (7)	3 (4)	0.0003
PHQ-9 Median (IQR)	6 (9)	5 (8)	<0.0001	6 (9)	5 (8)	0.003	5 (9)	4.5 (5)	0.003
GAD-7 ^b Median (IQR)	4 (8)	4 (8)	0.02	4 (8)	4 (9)	0.19	4 (9)	3 (6)	0.02

SMH: specialty medical home; CD: Crohn's disease; UC: ulcerative colitis; SIBDQ: short inflammatory bowel disease questionnaire; HBI: Harvey-Bradshaw Index; UCAI: ulcerative colitis activity index; PHQ-9: Patient Health Questionnaire-9; GAD-7: Generalized Anxiety Disorder-7 Significance testing between time periods performed using Wilcoxon sign rank test.

^a Average of scores in all visits after the first visit.

^b Total of 61 patients had incomplete GAD-7 at enrollment.

Table 3

Logistic regression of post-enrollment utilization (emergency department or hospitalization) in one year (N=322) using demographics, metrics, and medications at the time of enrollment.

	Univariate		Multivariate		
	OR	p-value	AOR	95% CI	p-value
Male Gender	0.79	0.33			
Age	0.99	0.70			
BMI	1.00	0.89			
Caucasian Ethnicity	1.27	0.44			
Smoking					
Never	Ref	Ref	Ref	Ref	Ref
Active	2.02	0.02	1.41	0.66–3.01	0.37
Past	1.23	0.51	1.06	0.50–2.23	0.88
Insurance					
Commercial	Ref	Ref	Ref	Ref	Ref
Medicaid	2.19	0.004	1.78	0.88–3.59	0.11
Medicare	1.10	0.94	0.34	0.02–7.41	0.49
Psychiatric Comorbidity	1.29	0.29			
Disease Type					
CD	Ref	Ref	Ref	Ref	Ref
UC	0.67	0.10	0.66	0.35–1.23	0.19
Disease Duration	1.00	0.83			
Prior Surgery	2.02	0.004			
No. Prior Anti-TNFs					
0	Ref	Ref	Ref	Ref	Ref
1	1.51	0.14	1.14	0.58–2.24	0.70

	Univariate		Multivariate	
	OR	p-value	AOR	95% CI
2	1.56	0.16	1.21	0.56-2.62
3	4.92	0.01	2.37	0.41-13.80
Ostomy	3.35	0.006	2.33	0.73-7.43
J-Pouch	1.54	0.36		
SIBDQ score Quartile				
1	5.18	<0.0001	4.44	1.08-18.25
2	1.56	0.23	1.66	0.53-5.24
3	1.88	0.09	2.33	0.89-6.11
4	Ref	Ref	Ref	Ref
HBI/UCAI Quartile				
1	Ref	Ref	Ref	Ref
2	2.23	0.02	1.72	0.70-4.25
3	2.37	0.03	1.66	0.60-4.57
4	5.23	<0.0001	2.06	0.70-6.10
PHQ-9 Quartile				
1	Ref	Ref	Ref	Ref
2	0.76	0.42	0.42	0.18-0.99
3	0.97	0.94	0.22	0.07-0.68
4	2.60	0.004	0.51	0.13-2.01
GAD-7 Quartile^d				
1	Ref	Ref	Ref	Ref
2	1.07	0.84	0.85	0.39-1.83
3	1.75	0.12	1.35	0.52-3.51
4	1.98	0.04	0.63	0.20-2.02
Steroids	3.33	<0.0001	2.72	1.32-5.66
				0.007

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	Univariate		Multivariate		
	OR	p-value	AOR	95% CI	p-value
Thiopurines	0.76	0.33			
Methotrexate	2.14	0.13			
anti-TNF	1.39	0.18			
anti-Integrin	2.26	0.19			
Combination Therapy	1.16	0.65			
Opioids	4.43	<0.0001	3.20	1.32–7.78	0.01

OR: odds ratio; AOR: adjusted odds ratio; CI: confidence interval; BMI: body mass index; CD: Crohn's disease; UC: ulcerative colitis; TNF: tumor necrosis factor; SIBDQ: short inflammatory bowel disease questionnaire; HBI: Harvey-Bradshaw Index; UCAI: ulcerative colitis activity index; PHQ-9: Patient Health Questionnaire-9

⁴ Underwent regression imputation due to significant number of missing data (n=61) at enrollment.