

Type of GI Provider Does Not Affect Rates of Vaccination Amongst Inflammatory Bowel Disease Patients

Mehul Trivedi (✉ mtrivedi248@gmail.com)

UCSD: University of California San Diego <https://orcid.org/0000-0003-0715-3686>

Neena Malik

Montefiore Hospital and Medical Center: Montefiore Medical Center

Joann Kwah

NYU Langone Medical Center: NYU Langone Health

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Abstract

Background:

Patients with Inflammatory Bowel Disease (IBD) are at heightened risk of infection, and are often under vaccinated. At our institution, IBD patients may follow up with one of three gastroenterology (GI) providers: IBD specialists, GI Fellows and General GI providers.

Aims:

Our primary objective was to identify whether the type of GI provider had an effect on rates of vaccinations for IBD patients. The seven vaccines studied were listed in the American College of Gastroenterology's 2017 Guidelines on Preventative Care in IBD, and include Influenza, Tetanus/Diphtheria/Pertussis, Hepatitis A (HAV), Hepatitis B (HBV), Pneumococcus (PCV13 and PPSV23), Meningococcus, and Human Papillomavirus (HPV).

Methods:

Retrospective case control study of IBD patients, looking at vaccination rates for each of the seven vaccinations listed above, and type of GI provider followed. Other data collected included patient demographics, IBD type, treatment regimen and insurance.

Results:

Of 338 IBD patients, 65 (19.2%) followed up with a GI fellow, 110 (32.5%) with a general GI provider, and 163 (48.2%) with an IBD specialist. HBV was the only vaccine with a significant difference in vaccination rate by type of provider. Bivariate analysis showed that patients who followed with IBD specialists and GI fellows were more likely to be vaccinated for HBV than patients who followed up with general GI provider (OR = 2.55, $p = .003$ and OR = 2.73, $p = .007$ respectively).

Conclusion

Type of GI provider only impacted rates of vaccination for HBV among IBD patients in this study, with IBD specialists and GI fellows outperforming general GI providers.

Introduction

Inflammatory Bowel Disease (IBD) is an inflammatory condition with an increasing incidence and prevalence throughout the world [1]. The pathogenesis of IBD, while not completely understood, is thought to involve a dysregulated immune response to gut flora, as well as environmental factors that promote intestinal inflammation [2]. Due to this inflammation, IBD patients often face the prospect of long-term immunosuppressive therapy in order to control their symptoms. As a result, serious or opportunistic infections can pose a problem for this patient population [3]. Many of these infections can be preventable through regular vaccination, however the literature shows that IBD patients have suboptimal rates of vaccination, in most cases, lower than non-IBD patients [4].

The reason behind the lower vaccination rate is likely multifactorial, but one possibility may be due to whom the patient identifies as their primary provider. Patients with IBD are likely to follow up with both a gastroenterology (GI) provider and a primary care physician (PCP), but most, if not all will see their GI provider more often [5]. This close relationship may lead to patients treating their GI provider as their PCP, leading to confusion over whose responsibility it is to vaccinate IBD patients [6]. There is data that shows that many GI providers are less likely to vaccinate patients than PCPs and are less aware of the appropriate immunizations for IBD patients [7–9]. As a result, IBD patients often miss opportunities to receive necessary vaccines [10]. To address the under vaccination of IBD patients, the American College of Gastroenterology (ACG) published clinical guidelines in 2017 with the goal of increasing awareness of this issue among GI providers [11]. These guidelines

represent the first official set of recommendations for the vaccination of IBD patients, an important step towards educating GI providers about the importance of vaccinating this distinct patient population.

Many factors have been shown to contribute to differences in vaccine rates, including insurance status, income, education level and the presence of preexisting conditions such as IBD [12]. Studies have also examined vaccine-specific differences among IBD patients, but no study has sought to examine the effect that the specific type of GI provider has on vaccination rates of IBD patients.

The objective of this study is to identify whether there are differences in vaccination rates among IBD patients who follow up with these three different types of GI providers: IBD specialist, GI fellow, and general GI provider. We also aim to examine other factors that may influence the vaccination rates of IBD patients, including age, race, sex, type of IBD diagnosis, immunosuppression status, and socioeconomic factors such as insurance status.

Methods

We performed a retrospective case-control study of vaccination rates in IBD patients who followed at the Montefiore Medical Center (Bronx, NY) with either an IBD specialist, a GI fellow, or a general GI provider.

Patient Selection

Our study utilized Clinical Looking Glass (CLG), a proprietary software used at Montefiore that assists in searching through patient records, to create a database of patients with a confirmed diagnosis of IBD who followed up with a GI provider at the institution. Patients were identified by searching for those with an ICD 9 diagnosis code of regional enteritis, idiopathic colitis or ulcerative colitis (555.1, 555.2, 555.9, 556.0-556.9). Inclusion criteria included (a) patients 18 years or older, (b) patients with an ICD 9 diagnosis listed above and (c) patients with a documented follow up visit with a GI provider at the institution between 1/1/18 and 12/31/19. Exclusion criteria included (a) patients younger than 18 years and (b) patients who have not followed up with a GI provider at the institution since 1/1/18.

Study Outcomes

The primary outcome assessed was whether patients were current on the following vaccines: Influenza, Tetanus/Diphtheria/Pertussis (Tdap), Hepatitis A (HAV), Hepatitis B (HBV), Pneumococcus (PCV13 and PPSV23), Meningococcus, and Human Papillomavirus (HPV). These vaccines represent the seven recommended inactivated vaccines in the ACG clinical guidelines for health maintenance in IBD patients. We also utilized guidelines published by the Advisory Committee on Immunization Practices (ACIP) to determine which patients were current on vaccinations [13]. Two vaccinations, Meningococcus and HPV, were recommended primarily for younger people, so for analysis, patients considered eligible for these vaccines had to be age 27 or younger. The remainder of the criteria that determined if a patient was current on a vaccine are listed in Table 1.

Table 1
ACIP guidelines for determining status of vaccinations

Vaccine	Guidelines
Influenza	Patients were considered current on Influenza if they were vaccinated for the 2019–2020 flu season (vaccines given as early as June 2019)
TDaP	Patients were considered current on TDaP if they had received a vaccination or booster shot within the last 10 years.
Hepatitis A	Patients were considered current for Hepatitis A if they had recent documented positive Hepatitis A IgG antibody titers.
Hepatitis B	Patients were considered current of Hepatitis B if they had recent documented positive Hepatitis B Surface antibody titers.
Pneumococcus	Patients were considered current for Pneumococcus if they received a dose of PCV13, followed by PPSV23 eight weeks to one year later. Patients were also considered current if they received a PPSV23 dose, followed by a PCV13 dose one year later. Patients who had received their first vaccination less than one year ago and who were currently awaiting a second were also considered to be current.
Meningococcus	Patients 27 years old and younger were considered current for Meningococcus if they had received a conjugate vaccine followed by a booster shot, or the serogroup B shot.
HPV	Patients 27 years old and younger were considered current for HPV if they had received three doses of the HPV vaccine within six months.

Demographic and Clinical Data

Chart review was conducted using the electronic medical record to gather demographic information about each patient who met criteria for the study (age, sex, race and type of insurance) as well as information about the disease and its management (type of IBD diagnosis, treatment regimen and type of GI provider followed). Finally, information regarding vaccination status was obtained (date and type of vaccination).

Statistics

Our initial database was exported from CLG to Excel, where data from chart review was added. Once collated, our spreadsheet was imported into IBM SPSS for Mac (Version 25.0. Armonk, NY). Categorical variables were coded numerically to streamline statistical analysis. The Shapiro-Wilk test was used to assess normal distribution in continuous descriptive variables (age). As age was not normally distributed, it was converted to a categorical variable using 60 as a cutoff in order to separate the cohort into a “young” and “elderly” age group.

Univariate chi-squared and regression analysis was first done to assess for independent predictors that affected vaccination status for each of the seven vaccines that were studied.

Bivariate logistic regression analysis was then done to identify significant variables that affected vaccination rates. Each model was adjusted for age, sex, race, type of GI provider, IBD diagnosis, immunosuppression status, and insurance. Statistically significant values were determined by a two-sided p value < 0.05.

Results

A total of 338 patients were diagnosed with IBD and followed up with a Montefiore GI provider between the dates of 1/1/2018 and 12/31/2019 (Table 2). The average age was 50.7 years. There were 180 (53.30%) male and 158 (46.70%) female patients. The most predominant race was Hispanic (36.10%), followed by Black (31.70%), White (29.0%), Asian (2.40%), and Other (0.80%). There were 165 (48.80%) patients who had a diagnosis of Crohn disease, 169 (50%) who had Ulcerative Colitis (UC), and 4 (1.20%) who had indeterminate colitis. There were 163 (48.30%) patients in this cohort who followed up with an IBD specialist, 110 (32.50%) who followed up with a general GI provider, and 65 (19.20%) who followed up with a GI fellow. The most predominant type of insurance in this cohort was private (51.48%), followed by Medicaid (24.85%) and Medicare

(23.67%). There were 155 (45.86%) patients who were on immunosuppressive therapy (either biologic, immunosuppressant or a combination of both with or without steroids), 131 (38.76%) patients who were on non-biologic therapy (aminosalicylates or anti-diarrheals), and 52 (15.39%) patients who were not on any therapy. Of note, no patient in this cohort was on steroid monotherapy and any patient on steroids was also on either a biologic or immunomodulator.

Table 2
Patient Characteristics

Demographic	# of Patients	Percent
Total Patients	338	
Avg. Age (SD)	50.7 (18.0)	
Sex		
Male	180	53.3%
Female	158	46.7%
Race		
White	98	29.0%
Black	107	31.7%
Hispanic	122	36.1%
Asian	8	2.4%
Other	3	0.8%
Type IBD		
Crohn's	165	48.8%
UC	169	50.0%
Indeterminate	4	1.2%
Type of GI Providers		
GI fellow	65	19.2%
GI provider	110	32.5%
IBD specialist	163	48.3%
Insurance		
Private	174	51.5%
Medicare	80	23.7%
Medicaid	84	24.9%
Immunosuppressive Regimen		
Biologic	118	34.9%
Immunomodulator Therapy	28	8.3%
Combination therapy (Biologic + Immunomodulator)	9	2.7%
Non-Biologic Therapy	131	38.8%
None	52	15.4%

Overall, 115 (34.0%) patients in this cohort were up to date with the Influenza vaccine (Table 3). There were 163 (48.2%) who were up to date with the Tdap vaccination, 74 (21.9%) who were up to date with the HAV vaccination, and 144 (42.6%) who were up to date with the HBV vaccination. There were 86 patients (25.4%) who received both Pneumococcus vaccines (both PCV13 and PPSV23), or were scheduled to receive a second Pneumococcus vaccination within the year of their first Pneumococcus vaccine. Current guidelines recommend that the Meningococcus and HPV vaccines be given to young patients, so for these vaccinations, only patients age 27 and under were considered. Out of a total of 50 patients in this age range, 22 (44.0%) were current on Neisseria and 13 (26.0%) on HPV (Table 4).

Table 3
Demographic characteristics of patients current on vaccines

	Influenza		TDaP		Hep A		Hep B		Pneumococcus	
Demographics	Current (%)	<i>P</i> ^a	Current (%)	<i>P</i>	Current (%)	<i>P</i>	Current (%)	<i>P</i>	Current (%)	<i>P</i>
Overall: 338 patients	155 (34.0%)		163 (48.2%)		74 (21.9%)		144 (42.6%)		86 (25.4%)	
Age										
< 60	66 (30.4%)	0.061	97 (44.7%)	0.082	54 (24.9%)	0.075	116 (53.5%)	0.0001	25 (11.5%)	0.0001
≥ 60	49 (40.5%)		66 (54.5%)		20 (16.5%)		28 (23.1%)		61 (50.4%)	
Sex										
Male	49 (31.0%)	0.274	62 (39.2%)	0.002	33 (20.9%)	0.675	75 (47.5%)	0.09	33 (20.9%)	0.071
Female	66 (36.7%)		101 (56.1%)		41 (22.8%)		69 (38.2%)		53 (29.4%)	
Race										
White	29 (29.6%)	0.495	36 (36.7%)	0.009	10 (10.2%)	0.011	24 (24.5%)	0.0001	16 (16.3%)	0.003
Black	42 (39.3%)		62 (57.9%)		29 (27.1%)		56 (52.3%)		40 (37.4%)	
Hispanic	41 (33.6%)		62 (50.8%)		32 (26.2%)		56 (45.9%)		29 (23.8%)	
Other	3 (37.5%)		3 (27.3%)		3 (27.3%)		8 (72.7%)		1 (9.1%)	
GI Provider										
IBD Specialist	64 (39.3%)	0.119	78 (47.9%)	0.976	34 (20.9%)	0.137	85 (52.1%)	0.0001	38 (23.3%)	0.553
GI Fellow	17 (26.2%)		31 (47.7%)		20 (30.8%)		32 (49.2%)		16 (24.6%)	
General GI	34 (30.9%)		54 (49.1%)		20 (18.2%)		27 (24.5%)		32 (29.1%)	
IBD Diagnosis										
Crohn's	67 (39.6%)	0.029	81 (47.9%)	0.913	39 (23.1%)	0.599	80 (47.2%)	0.078	48 (28.4%)	0.212
UC	48 (28.4%)		82 (48.5%)		35 (20.7%)		64 (37.9%)		38 (22.5%)	
Immunosuppression										
Yes	59 (38.1%)	0.149	64 (41.3%)	0.019	42 (27.1%)	0.033	82 (52.9%)	0.0001	44 (28.4%)	0.253
No	56 (30.6%)		99 (54.1%)		32 (17.5%)		62 (33.9%)		42 (23.0%)	

^a P-values represent univariate chi-squared analysis

	Influenza		TDaP		Hep A		Hep B		Pneumococcus	
Insurance										
Private	56 (32.2%)	0.462	79 (45.2%)	0.285	40 (23.0%)	0.616	83 (47.7%)	0.051	32 (18.4%)	0.002
Public	59 (36.0%)		84 (51.2%)		34 (20.7%)		61 (37.2%)		54 (32.9%)	

^a P-values represent univariate chi-squared analysis

Table 4
Characteristics of patients current on age-dependent vaccines

	Neisseria		HPV	
Demographic	Current (%)	<i>P</i> ^b	Current (%)	<i>P</i>
Overall: 50 patients ^a	22 (44.0%)		13 (26.0%)	
Sex				
Male	16 (51.6%)	0.166	9 (47.4%)	0.007
Female	6 (31.6%)		4 (12.9%)	
Race				
White	6 (50.0%)	0.563	3 (25.0%)	0.801
Black	5 (38.5%)		3 (23.1%)	
Hispanic	11 (47.8%)		7 (30.4%)	
Other	0		0	
GI Provider				
IBD Specialist	18 (48.6%)	0.340	9 (24.3%)	0.504
GI Fellow	4 (36.4%)		4 (36.4%)	
GI Provider	0		0	
IBD Diagnosis				
Crohn's	16 (42.1%)	0.631	7 (18.4%)	0.030
UC	6 (50.0%)		6 (50.0%)	
Immunosuppression				
Yes	20 (47.6%)	0.238	10 (23.8%)	0.418
No	2 (25.0%)		3 (37.5%)	
Insurance				
Private	13 (43.3%)	0.907	7 (23.3%)	0.418
Public	9 (45.0%)		6 (30.0%)	

^a Patients between ages 18 and 27 were included in this cohort as these vaccines were age-dependent

^b P-values represent univariate chi-squared analysis

Vaccination Status

Univariate chi-squared analysis (Table 3) showed that patients with Crohn disease were more likely to be vaccinated for influenza than those with UC ($p = .029$). For the Tdap vaccination, patients who were female, Black, Hispanic and immunocompetent were more likely to be vaccinated than male, White and immunosuppressed patients ($p = .002$, $.009$ and $.019$ respectively). For the HAV vaccination, patients who were Black, Hispanic and immunosuppressed were more likely to be vaccinated rather than White and immunocompetent patients ($p = .011$ and $.033$ respectively). For the HBV vaccination, patients were more likely to be vaccinated if they were younger than 60, Black, Hispanic, followed by IBD Specialists or GI Fellows, and if they were immunosuppressed when compared to patients older than 60, White, followed by a general GI and if they were immunocompetent ($p = .0001$ for all). For the pneumococcus vaccinations, patients older than 60, Black, Hispanic, and those with public insurance were more likely to be vaccinated than patients younger than 60, White and with private insurance ($p = .0001$, $.003$, $.002$ respectively). For the HPV vaccination, patients who were male and those with UC were more likely to be vaccinated than females and those with Crohn disease ($p = .007$ and $.030$ respectively)

In bivariate logistical regression analysis (Table 5), some of the initial trends seen in univariate analysis did not persist. With influenza, age was the only significant factor with patients under the age of 60 being less likely to be up to date on their influenza vaccine than patients age 60 and above (OR = 0.55, $p = 0.025$). With the Tdap vaccination, sex, race and immunosuppression status persisted in their significance. Females were more likely to be up to date than males (OR = 1.65, $p = 0.005$), while Black (OR = 2.34, $p = 0.004$) and Hispanic (OR = 1.88, $p = 0.033$) patients were more likely to be up to date with Tdap than White patients. Patients on immunosuppressive therapy were less likely to be up to date than patients not on immunosuppression (OR = 0.53, $p = 0.017$).

Table 5
Significant results of multivariate analysis

	OR	95% Confidence Interval	P
Influenza			
Age < 60 vs Age ≥60	0.55	0.33–0.93	0.025
TDaP			
Female vs Male	1.65	1.05–2.60	0.031
Black vs White	2.34	1.30–4.20	0.004
Hispanic vs White	1.88	1.05–3.36	0.033
Immunosuppression: Yes vs No	0.53	0.32–0.89	0.017
Hepatitis A			
Black vs White	3.15	1.42–6.99	0.005
Hispanic vs White	2.67	1.20–5.93	0.016
Hepatitis B			
Age < 60 vs Age ≥60	3.04	1.74–5.31	0.0001
Black vs White	4.39	2.26–8.51	0.0001
Hispanic vs White	2.68	1.40–5.11	0.003
Asian/Other vs White	8.03	1.83–35.2	0.006
IBD Provider vs General GI	2.55	1.38–4.72	0.003
GI Fellows vs General GI	2.73	1.32–5.68	0.007
Pneumococcus (PCV13 and PPSV23)			
Black vs White	3.85	1.77–8.39	0.001
Hispanic vs White	2.29	1.03–5.11	0.043
Ulcerative Colitis vs Crohn's	0.52	0.28–0.99	0.045
Immunosuppression: Yes vs No	2.06	1.05–4.03	0.035

With the HAV vaccination, race was the only significant factor that persisted. Black (OR = 3.15, p = 0.005) and Hispanic (OR = 2.67, p = 0.016) patients were more likely to be up to date with the HAV vaccination than White patients. For the HBV vaccination, age, race and type of GI provider persisted in their significance. Patients under the age of 60 were more likely to be up to date with the HBV vaccination than patients 60 and older (OR = 3.04 p = 0.0001). Black (OR = 4.39, p = 0.0001), Hispanic (OR = 2.68, p = 0.003), and Asian/Other (OR = 8.03, p = 0.006) patients were all more likely to be up to date with the HBV vaccination than White patients. Patients who followed with an IBD provider (OR = 2.55, p = 0.003) or GI Fellow (OR = 2.73, p = 0.007) were more likely to be up to date with the HBV vaccination than patients who followed up with a general GI provider.

For the pneumococcus vaccinations, race was the only factor that persisted in significance but type of IBD and immunosuppression status were significant in multivariate analysis. Black (OR = 3.85, p = 0.001) and Hispanic (OR = 2.29, p = 0.043) patients were more likely to be up to date, as compared to White patients. Patients with UC were less likely than patients with Crohn disease to be up to date on their pneumococcus vaccinations (OR = 0.52, p = 0.045). Patients on immunosuppression were more likely to be up to date than patients not on immunosuppression (OR = 2.06, p = 0.035).

For Meningococcal and HPV vaccinations, no factors were found to be significant.

Discussion

Patients with IBD are at higher risk for certain serious infections which may be partly due to the use of immunosuppressive medication but also due to their underlying disease. Therefore, vaccinations in these patients are a critical part of their treatment plan, however rates of vaccinations in this patient population are lagging. This study is the first that examines the effect that type of GI provider plays on vaccination status in IBD patients. Focusing on seven inactivated vaccines recommended in the ACG clinical guidelines for preventive care in IBD patients, we performed an analysis of 338 IBD patients followed by GI providers at a single institution to see if type of GI provider affected vaccination status in IBD patients. The results showed that type of GI provider did not influence an IBD patient's vaccination status for all but one of the seven inactivated vaccines. The HBV vaccination was the only vaccination where type of GI provider was significant for likelihood to be up to date with vaccination where IBD specialists and GI Fellows outperformed general GI providers. The significance of HBV specifically may be explained by the fact that IBD specialists may be more likely to prescribe immunosuppressive therapies such as a biologic or immunomodulator where immunization to HBV is considered standard of care prior to giving the medication. Also, insurers tend to request vaccination history including HBV status prior to approving the use of biologic, possibly contributing to the significant number of patients up to date with the HBV vaccination. GI Fellows also outperformed general GI providers as well, likely due to GI fellow supervision by IBD specialists when seeing IBD patients at this institution.

Looking beyond type of provider, there were several other interesting observations in regards to vaccinations in this IBD patient population. Race played a significant role in vaccination rates in multivariate analysis for four of the vaccines studied (Tdap, HAV, HBV, and Pneumococcus). For each of these vaccines, Black and Hispanic patients were better vaccinated than White patients. These results were surprising, given that other studies on racial differences in vaccine administration typically found that Black and Hispanic patients had lower rates of vaccine coverage [14, 15]. When comparing this cohort's vaccination rates to the US national averages for these four vaccines, Black patients with IBD in this cohort were better vaccinated than Black Americans nationally (Tdap, HAV, HBV, and Pneumococcus rates of 57.9%, 27.1%, 52.3% and 37.4% in our cohort versus 51.1%, 10.2%, 27.0% and 34.2%) while White patients with IBD in this cohort were less likely to be vaccinated than White Americans nationally (Tdap, HAV, HBV, and Pneumococcus rates of 36.7%, 10.2%, 24.5% and 16.3% in our cohort versus 63.4%, 14.0%, 36.2% and 47.5%) [16]. These differences could be attributed to the work of the institution itself since it is located in the Bronx, New York, one of the most racially diverse counties in the United States. The institution is sensitive to health inequities and disparities in their patients and as a result, has expertise in handling health issues in these minority patients. Also, since IBD patients utilize the health care system more than the general population, this may have allowed for higher vaccination rates at an institution that is focused on minority health issues as a whole [17].

Age was another factor that played a role in rates of vaccination for Influenza and the HBV vaccination. IBD patients 60 and older were better vaccinated against Influenza, while IBD patients under 60 were better vaccinated for HBV. This data is consistent with national trends in vaccination seen in both the general population and IBD patients specifically, showing that that younger patients were more likely to be current with HBV vaccination status and less likely to be current on influenza when compared to older patients [16, 18]. One reason for this trend could be due to enhanced influenza counselling by providers to older patients [19]. For the HBV vaccination, as it is typically indicated for high risk patients such as those with IBD, one reason to explain why younger patients are better vaccinated is that the incidence of IBD is greater in younger people, leading to rates of vaccination that skew towards the younger population [20, 21].

Immunosuppressive therapy also played a role in vaccination status for Tdap and Pneumococcus vaccines. Immunosuppressed IBD patients had a lower rate of being vaccinated for Tdap and a higher rate of being vaccinated for pneumococcus. A reason for why this effect was seen may be because Tdap is more likely to be given to patients by their PCP, rather than their GI provider [7]. PCP's are also less likely to immunize patients on immunosuppression, possibly explaining the negative effect immunosuppressive therapy had on Tdap [22]. Pneumococcus is primarily indicated for high risk patients (when under 65) such as those on immunosuppressive therapy. Given that this therapy is as an indication for the vaccine, it is likely that high-risk patients were better vaccinated due to the indication [23].

Finally, sex was seen to play a role in Tdap vaccination status, with women being more likely than men to be vaccinated. While there is no consistent data that supports this trend on a national level, a possible explanation for this is that ACIP guidelines since 2013 have recommended a Tdap shot for women during every pregnancy [24]. Pregnant women therefore may have led to better Tdap vaccination rates because of this additional opportunity to be vaccinated.

This study had several limitations that are important to note. The first is related to the reliance on accuracy of data from one institution's medical records. While efforts are made to update patient records to reflect care that was provided at outside institutions, it is possible that there were missed vaccinations if they were given elsewhere and not documented in the institution's medical records. Another limitation is a lack of information as to what provider specifically ordered and administered vaccines. A GI provider may have requested a certain vaccination for their patient, however, if they were unable to administer it in their own practice it is out of their control whether or not a patient actually gets the requested vaccination. Finally, this study was unable to gather information on any reasons for why patients were not vaccinated. Previous studies have shown that patient anxiety plays a role in low vaccination rates among IBD patients, and it is possible that it played a role among this cohort as well [9].

Despite limitations, there were several strengths of this study including a large cohort of racially and socioeconomically diverse IBD patients following up at a single institution. Also, this study was the first to examine if differences in type of GI provider follow up affected vaccination rates. While type of GI provider may not influence the likelihood of vaccination, this study did show other factors that influenced vaccination rates specifically the effect of race. Black and Hispanic IBD patients were more likely to be vaccinated compared to White IBD patients for Tdap, the HAV vaccination, the HBV vaccination, and Pneumococcus vaccination, a finding which is not consistent with national vaccination rates amongst races. This may reflect more the work of the single institution that is located in a racially diverse county of New York and is focused on minority health issues. Future research should include efforts to better understand the effects of the institution itself on this finding or if there are other factors that shaped these results. Vaccination rates for the institution should be analyzed to compare with the IBD patients' vaccination rates to see if this finding is consistent with the institution as a whole or just to the IBD patients at the institution. Despite the interesting findings regarding race, this study shows IBD patients at this institution still lag in receiving appropriate vaccinations. Future studies should be done to better understand IBD patients and all GI providers attitudes and knowledge of vaccinations, as well as assessing for any barriers to vaccinations. With this information, areas to explain gaps in vaccination can be identified and prospective studies can be designed to address these issues specifically in hopes of improving vaccination rates for these patients.

Declarations

Ethics Approval

This study was approved by the Institutional Review Board at Albert Einstein College of Medicine and was deemed to be ethically conducted and carried out.

Consent for Publication

This study does not contain individual personal data, therefore consent for publication is not applicable.

Availability of Data and Materials

The datasets generated during and/or analyzed during the current study are not publicly available as they contain identifiable patient information and are stored on a secure hard drive. However, data can be de-identified and made available from the corresponding author on reasonable request.

Competing Interests

The authors declare they have no competing interests.

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Author's contribution

MT collected, analyzed and interpreted patient data, as well as was a major contributor to writing the manuscript. Both NM and JK helped devise the study and played major roles in writing and refining the manuscript.

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