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Factors associated with colorectal cancer screening adherence and the impact of COVID-19 on screening patterns in Connecticut, USA

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Abstract

Colorectal cancer (CRC) is one of the leading causes of cancer death worldwide. Many communities remain under the 80% CRC screening goal. We aimed to identify factors associated with non-adherence to CRC screening and to describe the effect of the COVID-19 pandemic in CRC screening patterns. A retrospective review of patients aged 50–75 years seen at the Griffin Faculty Physicians primary care offices between January 2019 and December 2020 was performed. Logistic regression models were used to identify factors associated with CRC screening non-adherence. Of 12,189 patients, 66.2% had an updated CRC screen. On univariable logistic regression, factors associated with CRC screening non-adherence included age ≤ 55 years [odds ratio (OR) 2.267, $p < 0.001$], White/Caucasian race (OR 0.858, $p = 0.030$), Medicaid insurance (OR 2.097, $p < 0.001$), morbid obesity (OR 1.436, $p < 0.001$), current cigarette smoking (OR 1.849, $p < 0.001$), and elevated HbA1c (OR 1.178, $p = 0.004$). Age, Medicaid insurance, morbid obesity, current smoking, and HbA1c ≥ 6.5% remained significant in the final multivariable model. Compared to 2019, there was an 18.2% decrease in the total number of CRC screening tests in 2020. The proportion of colonoscopy procedures was lower in 2020 compared to the proportion of colonoscopy procedures conducted in 2019 (65.9% vs 81.7%, $p < 0.001$), with a concurrent increase in stool-based tests. CRC screening rates in our population are comparable to national statistics but below the 80% goal. COVID-19 affected CRC screening. Our results underscore the need to identify patient groups most vulnerable to missing CRC screening and highlight the importance of stool-based testing to bridge screening gaps.

Keywords Colonoscopy · Cancer screening · FIT-DNA · Cologuard · COVID-19

Introduction

Colorectal cancer (CRC) is one of the leading causes of cancer death worldwide. In 2020, it was estimated that there were 1.93 million new CRC cases and 0.94 million CRC-related deaths globally [1, 2]. In the United States, there are more than 1.5 million men and women living with a previous CRC diagnosis [3]. The American Cancer Society estimates 106,180 new cases of colon cancer and 44,850 new cases of rectal cancer in the United States in 2022 [4].

The lifetime risk of developing colorectal cancer is about 1 in 23 (4.3%) for men and 1 in 25 (4%) for women [4]. The United States Preventive Services Task Force (USPSTF) recommends screening for CRC in all adults aged 50–75 years and, in 2021, revised the recommendations for screening to start at age 45 [5, 6]. Various CRC screening modalities are available, including guaiac-based fecal occult blood test (gFOBT), fecal immunochemical test (FIT), and the FIT-DNA test. Direct visualization techniques include flexible sigmoidoscopy, colonoscopy, or CT colonography [7]. The U.S. Multi-Society Task Force on Colorectal Cancer recommends high-quality colonoscopy every 10 years or an annual FIT as first-tier options for screening [8].

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The Centers for Disease Control and Prevention (CDC) Division of Cancer Prevention and Control initially funded the Colorectal Cancer Control Program (CRCCP) in 2009. The overall goal of the CRCCP was to increase colorectal cancer screening rates to 80% in funded states and tribal areas [9]. The National Colorectal Cancer Roundtable has set a similar goal of achieving 80% CRC screening rates in every community across the United States [10]. In most communities, CRC screening is largely coordinated by primary care providers (PCPs) and their clinic systems [11]. Given the usually limited resources of the primary care team, it is important to identify and focus outreach efforts on the patients who have barriers to CRC screening [12]. Moreover, efforts to achieve the 80% screening target have been hampered by the COVID-19 pandemic. These delays in CRC diagnoses can lead to progression of cancer stages among those with undiagnosed cancer, and subsequent increase in CRC mortality [13].

To help us understand our patient population and guide our outreach efforts, we aimed to identify the rates of CRC screening adherence at our primary care offices in the Naugatuck Valley in Connecticut. Additionally, we explored clinical and demographic characteristics of patients who do not have an updated CRC screening. Finally, we described the changes in CRC screening patterns in our primary care offices during the COVID-19 pandemic.

Methods

Subjects and setting

We included patients aged 50–75 years seen at least once at the six Griffin Faculty Physicians (GFP) primary care offices between January 1, 2019 and December 31, 2020. This age group was selected based on the USPSTF recommendation at the time our study received IRB approval to perform CRC screening in all adults aged 50–75 years [5]. GFP is a multispecialty group affiliated with Griffin Hospital, a 160-bed community hospital in the Naugatuck Valley. The Naugatuck Valley is a community of Connecticut towns located in New Haven and Fairfield Counties. According to the 2019 Valley Community Index, there are a total of 140,243 residents in The Valley in 2017 with an overall median age of 42.5 years [14]. There are currently six offices where GFP provides primary care: Ansonia, Shelton Family Health Care Center, Primary Care at Quarry Walk, Naugatuck, Southbury, and White Hills. This retrospective study was approved by the Griffin Hospital Institutional Review Board (IRB# 2020–14). Due to the retrospective nature of this research and the study involved no more than minimal risk to the patients, a Waiver of Informed Consent was granted by the Griffin Hospital IRB. Patient data was handled confidentially and the final analysis was performed on a de-identified data set.

Variables and data sources

Patients at GFP are identified using a unique medical record number (MRN). Each patient when registering to GFP provide their identification card, date of birth, and a unique Social Security number provided by the United States government. This helps prevent the same patient from receiving multiple medical record numbers. We further checked the database of patients aged 50–75 years using IBM SPSS Statistics (version 27) to perform duplicate search of MRN and dates of birth (executed from the Data tab by selecting 'identify duplicate cases' command). Patients with similar dates of birth were manually checked. No duplicates were found.

An electronic search of patients' medical records was performed using the AthenaHealth Electronic Medical Record (EMR) of GFP. Emerge ChartPop, an AthenaHealth EMR extension, was also utilized which allows free-text search of scanned medical records. The search for CRC screening was comprehensive and included gastroenterology procedure records, laboratory orders for FOBT or FIT-DNA, medical history, insurance claims, and scanned colonoscopy procedures from outside facilities. The primary outcome is having an updated CRC screen. Patients were categorized as having updated CRC screen if they had any of the following: FOBT within 12 months, FIT-DNA within 3 years, flexible sigmoidoscopy within the past 5 years, or screening colonoscopy within 10 years. The cut-off date for these tests were set at December 31, 2020.

Statistical analysis

Demographic characteristics were compared between patients with and without CRC screening using χ^2 test for proportions and independent-samples t test for continuous variables. Univariable logistic regression models were used to analyze associations of demographic and clinical characteristics with not having an updated CRC screen. Variables that were significant on univariable logistic regression were included in the final multivariable logistic regression model. Patients with a history of colorectal cancer ($n = 24$) were excluded in the analysis. The proportion of colonoscopy tests and stool-based tests performed in 2020 were compared with those in 2019 using χ^2 test for proportions.

Results

A total of 12,189 patients were included in the analysis. Mean age was 61.1 (SD 6.7) years. Majority (54.5%) were females, White/Caucasian (91.3%), and had English as their first language (98.7%). Only 3.6% identified as Black/African–American and 6.0% identified as Hispanic.

The proportion of patients with updated CRC screen was 66.2% ($n=8073$). The types of screening conducted were colonoscopy ($n=7222$; 89.5%); FIT-DNA ($n=790$; 9.8%), FOBT ($n=60$; 0.7%), sigmoidoscopy ($n=2$; 0.02%), and CT colonography from an outside facility ($n=1$; 0.01%). A comparison of the characteristics of the patients with and without CRC screen is summarized in Table 1.

On univariable logistic regression (Table 2), factors associated with not having an updated CRC screen included

Table 1 Clinical and demographic characteristics of patients with and without colorectal cancer screening

	With updated CRC screen ($n=8073$)	No CRC screen[a] ($n=4116$)	p value[b]
Age (mean, SD)	61.9 ± 6.5	59.5 ± 6.9	< 0.001
Sex			
Male	3638 (65.6%)	1904 (34.4%)	0.210
Female	4435 (66.7%)	2212 (33.3%)	
Race			
Caucasian/white	6873 (68.0%)	3228 (32.0%)	0.030
Non-Caucasian	625 (64.6%)	342 (35.4%)	
Ethnicity			
Hispanic or Latino	391 (65.6%)	205 (34.4%)	0.483
Non-Hispanic or Latino	6247 (67.0%)	3077 (33.0%)	
Primary language			
English	7677 (67.5%)	3700 (32.5%)	0.701
Non-English	99 (66.0%)	51 (34.0%)	
Primary insurance			
Medicaid	767 (50.8%)	743 (49.2%)	< 0.001
Non-Medicaid	7306 (68.4%)	3373 (31.6%)	
Smoking status			
Current smoker	1029 (54.9%)	845 (45.1%)	0.002
Past smoker	2901 (70.4%)	1219 (29.6%)	
Never smoker	4034 (68.3%)	1874 (31.7%)	
Body mass index (mean, SD)	30.3 ± 6.5	30.8 ± 7.3	< 0.001
Hemoglobin A1c (mean, SD)	6.0 ± 1.0	6.2 ± 1.3	< 0.001

[a]Number of patients per category may not always equal to column total (N) due to missing data

[b]χ^2 test for proportions and independent-samples t test for continuous variables

Table 2 Univariable logistic regression analysis of factors associated with non-adherence to colorectal cancer screening

	Odds ratio	p value	95% Confidence interval	
			Lower limit	Upper limit
Age ≤ 55 years old	2.267	< 0.001*	2.083	2.467
Male	1.049	0.210	0.973	1.131
Caucasian/White	0.858	0.030*	0.747	0.986
Hispanic ethnicity	1.064	0.483	0.894	1.267
English as first language	0.936	0.701	0.666	1.315
Medicaid insurance	2.097	< 0.001*	1.880	2.340
Morbid obesity (BMI ≥ 40 kg/m^2)	1.436	< 0.001*	1.262	1.634
Current cigarette smoker	1.849	< 0.001*	1.672	2.045
HbA1c ≥ 6.5%	1.178	0.004*	1.054	1.316

*statistically significant

Table 3 Multivariable logistic regression analysis of factors associated with non-adherence to colorectal cancer screening

	Adjusted odds ratio	*p* value	95% Confidence interval	
			Lower limit	Upper limit
Age ≤ 55 years old	1.961	< 0.001*	1.745	2.204
Caucasian/white	1.033	0.708	0.870	1.228
Medicaid insurance	1.599	< 0.001*	1.388	1.842
Morbid obesity (BMI ≥ 40 kg/m^2)	1.372	< 0.001*	1.166	1.615
Current cigarette smoker	1.628	< 0.001*	1.424	1.860
HbA1c ≥ 6.5%	1.187	0.008*	1.045	1.349

*statistically significant

age ≤ 55 years old [odds ratio (OR) 2.267, $p < 0.001$], White/Caucasian race (OR 0.858, $p = 0.030$), having Medicaid insurance (OR 2.097, $p < 0.001$), morbid obesity (OR 1.436, $p < 0.001$), current cigarette smoker (OR 1.849, $p < 0.001$), and elevated HbA1c ≥ 6.5% (OR 1.178, $p = 0.004$). In the final multivariable model (Table 3), age ≤ 55 years [adjusted OR (aOR) 1.961, $p < 0.001$], Medicaid insurance (aOR 1.599, $p < 0.001$), morbid obesity (aOR 1.372, $p < 0.001$), current smoking (aOR 1.628, $p < 0.001$), and HbA1c ≥ 6.5% (aOR 1.187, $p = 0.008$) remained significantly associated with non-adherence to CRC screening. Similar results were found when data were analyzed with age as a continuous variable.

There was an overall decrease in the total number of CRC screening tests conducted in 2020 compared with 2019 (1,213 vs 1,482 tests, an 18.2% decrease). Investigating the type of CRC screening tests conducted, the proportion of colonoscopy procedures was significantly lower in 2020 compared to the proportion of colonoscopy procedures conducted in 2019 (65.9% vs 81.7%, $p < 0.001$), with a concurrent increase in stool-based tests. This trend was seen during the first few months of the COVID-19 pandemic (March to June 2020) as illustrated in Fig. 1. The differences in the proportion of CRC screening tests by month are presented in Table 4.

Discussion

In this cross-sectional study of patients in the Naugatuck Valley Region of Connecticut, we found that 66.2% of patients aged 50 to 75 years old had an updated CRC screen. This rate is comparable to the estimated national CRC screening uptake of 71.6% for all test types [15], but falls behind the 80% goal set by the National Colorectal Cancer Roundtable and the CDC [9, 10].

In the current study, factors associated with not having an updated CRC screen on univariable analysis included younger age, Medicaid insurance, non-Caucasian race, current cigarette smoking, obesity, and elevated HbA1c. Our findings are consistent with previous reports of sociodemographic and risk factors associated with disparities in CRC screening. According to the American Cancer Society, one-third of eligible US adults are not updated with CRC screening, including half of those ages 50–54 years [16]. From the same report, only 54% of Medicaid enrollees had updated

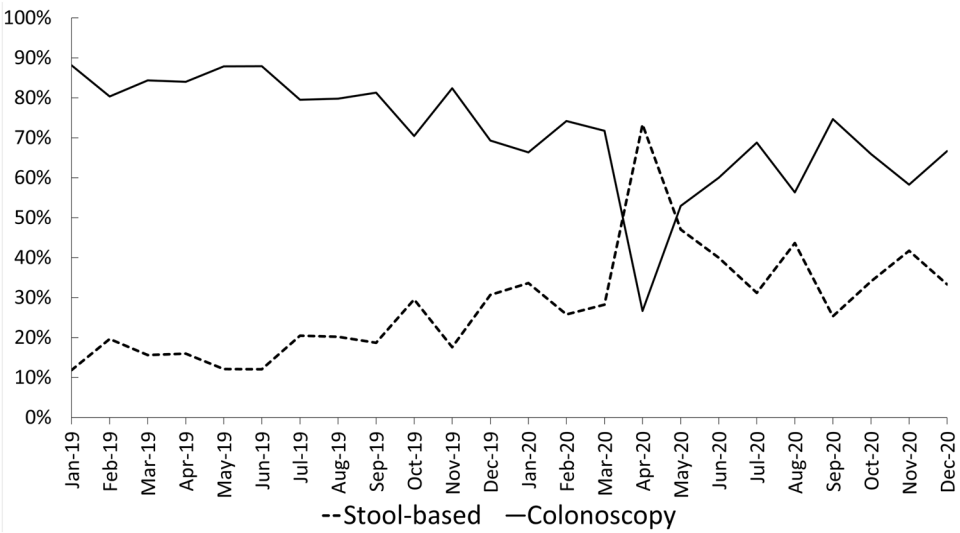

Fig. 1 Proportion of stool-based colon cancer screening tests versus colonoscopy conducted from January 1, 2019 to December 31, 2020. Note: elective procedures, including colonoscopies, were suspended at Griffin Hospital in mid-March 2020

Table 4 Proportion of colorectal cancer screening tests conducted in 2019 and 2020

	2019		2020		*p* value[b]
	Stool-based[a]	Colonoscopy	Stool-based[a]	Colonoscopy	
January	16 (11.9%)	119 (88.1%)	36 (33.6%)	71 (66.4%)	< 0.001
February	22 (19.6%)	90 (80.4%)	32 (25.8%)	92 (74.2%)	0.260
March[c]	25 (15.6%)	135 (84.4%)	26 (28.3%)	66 (71.7%)	0.016
April	24 (16.0%)	126 (84.0%)	11 (73.3%)	4 (26.7%)	< 0.001
May	16 (12.1%)	116 (87.9%)	8 (47.1%)	9 (52.9%)	< 0.001
June	15 (12.1%)	109 (87.9%)	22 (40.0%)	33 (60.0%)	< 0.001
July	26 (20.5%)	101 (79.5%)	34 (31.2%)	75 (68.8%)	0.059
August	19 (20.2%)	75 (79.8%)	48 (43.6%)	62 (56.4%)	< 0.001
September	20 (18.7%)	87 (81.3%)	39 (25.3%)	115 (74.7%)	0.208
October	39 (29.5%)	93 (70.5%)	46 (34.1%)	89 (65.9%)	0.427
November	19 (17.6%)	89 (82.4%)	68 (41.7%)	95 (58.3%)	< 0.001
December	31 (30.7%)	70 (69.3%)	44 (33.3%)	88 (66.7%)	0.669
Total	272 (18.3%)	1210 (81.7%)	414 (34.1%)	799 (65.9%)	< 0.001

[a]Stool-based tests: guaiac-based fecal occult blood test or fecal immunochemical-DNA test

[b]χ^2 test or Fisher's exact test

[c]Connecticut Governor Ned Lamont signed Executive Order No. 7H, which ordered that effective at 8PM on March 23, 2020, all non-essential businesses statewide should close and provided guidance on social distancing

CRC screening compared to 65% of commercially insured adults and 80% of Medicare- and privately insured adults [16].

Similarly, we found that non-White patients had lower rates of CRC screening on univariable analysis. Despite advances in CRC screening and management, Black men and women in the United States have the highest incidence of CRC compared with other racial/ethnic subgroups and have disproportionately high mortality rates [2]. Compared to their non-Hispanic White counterparts, African Americans have lower CRC screening uptake due to various factors, including socioeconomic challenges (e.g. insurance status), provider/patient communication barriers, and medical mistrust [17]. The association of race lost its statistical significance in the final multivariable model, likely due to the low sample size of non-White patients in our study.

Current smokers were found in our study to be 1.6 times more likely not to have an updated CRC screen. This association remained significant in the final multivariable model. A meta-analysis has shown that current smokers have higher risk of CRC than never smokers [18]. Cigarette smoke has been shown to promote inflammation-associated colonic adenoma, angiogenesis, cellular proliferation, and tumorigenesis [19]. Multidisciplinary approach to aid smoking cessation, as well as health education campaigns among current smokers, may increase CRC screening uptake in our population.

We found that obesity was associated with lower CRC screening. A previous study among uninsured adults in Connecticut also found that patients with obesity were two times more likely than non-obese patients to be non-adherent with colonoscopy despite being offered the procedure at no cost [20]. A systematic review has previously reported that women with diabetes have suboptimal breast, cervical, and colorectal cancer screening rates compared with women without diabetes [21]. In our study, history of diabetes mellitus was not associated with CRC screening adherence (OR 0.97, $p = 0.574$; data not shown). However, elevated HbA1c was found to be associated with decreased adherence (aOR 1.187, $p = 0.008$). Similar results were found by investigators from Massachusetts, USA where patients with poor glycemic control were more likely to not have CRC screening compared to patients with good glycemic control, even after adjusting for the number of primary care visits [22]. It is likely that uncontrolled HbA1c is a surrogate of poor adherence and decreased health-seeking behavior. Future interventions should target patients with uncontrolled HbA1c to increase CRC screening in this group.

Majority of our patients who have an updated CRC screen had colonoscopy (~90%). A study in Virginia showed that 74% identified fear and bowel preparation as the most important barriers to colorectal cancer screening [23]. Other barriers identified from focused group discussions included lack of information and time, the role of physicians, and limited access to care. Participants also cited low self-worth, fatalism, "para-sexual" sensitivities, negative past experiences with testing, and skepticism about the financial motivation behind screening recommendations [23].

Our primary care offices serve the Naugatuck Valley, a community of Connecticut towns located in New Haven and

Fairfield Counties. Between 2015 and 2035, the Valley's senior population is projected to increase by 39% [14]. The USPSTF recently issued a revised recommendation to start screening for CRC at age 45 years [5, 6]. With the aging population of Naugatuck Valley, our primary care offices need to identify our vulnerable patients and design targeted interventions that address barriers to increase CRC screening. Combination or multilevel interventions appear to be more effective than single-component strategies [24]. It has been shown that the most important intervention component is outreach, which includes active dissemination of screening tests outside the primary care office (e.g., distributing stool-based testing via mail). Other interventions include patient or provider reminders and patient navigation [24].

The USPSTF found no head-to-head studies demonstrating that one CRC screening strategy is more effective than others [6]. A recent systematic review among African Americans showed that stool-based screening is an effective intervention, because it is low cost and does not have as many logistical barriers compared to colonoscopy (e.g. taking time off work and finding transportation) [25]. Additionally, mailing free stool-based screening kits can bridge the financial constraint that patients may experience [26]. Apart from patient education and engagement, discussing the availability of stool-based tests may help increase CRC screening among those who are adamant on undergoing colonoscopy.

The importance of stool-based tests was further highlighted by our experience during the COVID-19 pandemic. Connecticut had its first reported COVID-19 case during the first week of March 2020. An overall decrease in the number of CRC screening was seen, with a statistically significant decrease in the proportion of colonoscopies performed. Elective procedures, including colonoscopies, were suspended in Griffin Hospital in mid-March 2020. Stool-based tests, particularly FIT-DNA testing, was utilized to bridge this screening gap among our patients.

The impact of the COVID-19 pandemic in cancer screening has been reported widely by various groups. A systematic review of 25 studies showed that CRC screening has decreased, ranging from 28% to 100%, in various countries and at different time points during the pandemic [27]. In the Northeastern United States, one site reported decreases in various cancer screening tests during the start of the COVID-19 pandemic (March to June 2020) but recovered to pre-pandemic levels in June to September 2020 [28]. This was similar to the trend in CRC screening seen at our facility.

Our study has several limitations. First, our data analysis was limited by the availability of information within the AthenaHealth EMR. Although care was taken to perform a comprehensive search of patients' medical records, including free-text search of scanned files from outside facilities, some CRC screening performed elsewhere may not have been recorded. Second, the USPSTF screening recommendations apply to asymptomatic adults who are at average risk for colorectal cancer. Our electronic search was able to exclude patients with a history of CRC. However, we were not able to obtain data on other diseases that may predispose patients to higher CRC risk, such as familial adenomatous polyposis, Lynch syndrome, or inflammatory bowel disease. We were also not able to distinguish between routine screening colonoscopy and colonoscopy performed for other medical indication, such as clinical suspicion of colon cancer. Lastly, we categorized patients as having updated CRC screening if they had colonoscopy within the past 10 years. However, the current study does not take into account the gross or pathological findings from the colonoscopy. Hence, patients who may have been recommended to have more frequent colonoscopies were categorized as having 'updated' CRC screen.

Despite these limitations, we present data from a relatively large primary care population consisting of over 12,000 patients. Our results underscore the need for organized outreach efforts from primary care offices to their most vulnerable patients [29]. Offering stool-based tests may help alleviate the staffing and logistical challenges associated with colonoscopy procedures during the COVID-19 pandemic and under non-pandemic conditions. As reported by other groups, stool-based tests appear to be an acceptable alternative to colonoscopy [25] and its utilization should be maximized especially among those who decline to undergo colonoscopy.

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Declarations

Conflict of interest This research project was supported by the Health Resources and Services Administration (HRSA) Preventive Medicine Grant (D33HP31664-05-00) and the American Cancer Society (ACS) Physician Training Award in Cancer Prevention (134129-PTAPM-19-186-18-PTAPM). The authors declare that they have no conflicts of interest.

Human and animal rights and informed consent Due to the retrospective nature of this research and the conduct of the study involved no more than minimal risk to the patients, a Waiver of Informed Consent was granted by the Griffin Hospital IRB. Patient data was handled confidentially and the final analysis was performed on a de-identified data set.

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