

## Retrospective Study

## Facilitators and barriers to colorectal cancer screening in an outpatient setting

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## Abstract

### BACKGROUND

Colorectal cancer (CRC) is the third most common cancer and the second leading cause of cancer-related deaths in the United States. Still, 1 in 3 adults aged 50 years to 75 years have not been screened for CRC. Early detection and management of precancerous or malignant lesions has been shown to improve overall mortality.

### AIM

To determine the most significant facilitators and barriers to CRC screening in an outpatient clinic in rural North Carolina. The results of this study can then be used for quality improvement to increase the rate of patients ages 50 to 75 who are up to date on CRC screening.

### METHODS

This retrospective study examined 2428 patients aged 50 years to 75 years in an outpatient clinic. Patients were up to date on CRC screening if they had fecal occult blood test or fecal immunochemical test in the past one year, Cologuard in the past three years, flexible sigmoidoscopy/virtual colonoscopy in the past five years, or colonoscopy in the past ten years. Data on patient socioeconomic status,

was approved.

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comorbid conditions, and other determinants of health compliance were included as covariates.

**RESULTS**

Age [odds ratio (OR) = 1.058;  $P = 0.017$ ], no-show rate percent (OR = 0.962;  $P < 0.05$ ), patient history of obstructive sleep apnea (OR = 1.875;  $P = 0.025$ ), compliance with flu vaccinations (OR = 1.673;  $P < 0.05$ ), compliance with screening mammograms (OR = 2.130;  $P < 0.05$ ), and compliance with screening pap smears (OR = 2.708;  $P < 0.05$ ) were important factors in determining whether a patient will receive CRC screening. Race, gender, insurance or employment status, use of blood thinners, family history of CRC, or other comorbid conditions including diabetes, hypertension, congestive heart failure, chronic obstructive pulmonary disease, and end-stage renal disease were not found to have a statistically significant effect on patient adherence to CRC screening.

**CONCLUSION**

Patient age, history of sleep apnea, and compliance with other health maintenance tests were significant facilitators to CRC screening, while no-show rate percent was a significant barrier in our patient population. This study will be of benefit to physicians in addressing and improving the CRC screening rates in our community.

**Key Words:** Colorectal cancer screening; Screening colonoscopy; Health maintenance; Colonoscopy; Colorectal cancer; Patient adherence

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**Core Tip:** Only about 2 of 3 adults from ages 50 to 75 are up-to-date with colorectal cancer screening. Factors which influenced screening adherence included patient age, history of obstructive sleep apnea, clinic no-show rate and adherence to other health screening exams. Gender, ethnicity, tobacco use, and other common comorbid conditions did not correlate with the rate of colorectal cancer screening adherence.

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**INTRODUCTION**

Colorectal cancer (CRC) is the fourth most common cancer[1] and the second leading cause of cancer-related deaths[2] in the United States. The U.S. Preventive Services Task Force recommends screening average-risk adults who are between 50 years and 75 years old for CRC. Despite this recommendation, less than 70% of eligible adults in the United States were up-to-date on CRC screening in 2018[2]. Groups who were less likely to be screened include Hispanics, American Indians, Alaska Natives, people who are 50 years to 64 years old, those who don't live in a city, and who belong to a lower socioeconomic status[2]. Lower rates of screening are associated with cancer deaths. Estimated value of life lost due to cancer deaths in the United States is significant and projected to rise, even if mortality rates remain constant, because of anticipated population changes[3]. However, projected annual decreases of cancer mortality rates of 2% reduced the expected value of life lost in the year 2020 from \$140.1 billion to \$93.5 billion for CRC[3].

Screening helps to identify precancerous polyps, so they can be excised before turning into cancer. Screening also detects CRC at an early stage, when treatment often leads to a cure. Risk factors for CRC include tobacco use, obesity, sedentary lifestyle, Western diet, as well as consumption of red meat[4]. Nevertheless, medications such as aspirin and postmenopausal hormones for women are associated with marked

reductions in CRC risk, though their utility may be limited by associated risks[4]. The incidence and overall mortality of CRC in patients over the age of 55 has been down-trending over the past several decades, which is in part due to improved screening and subsequent early detection and removal of precancerous lesions[5].

There are multiple acceptable forms of CRC screening: guaiac-based fecal occult blood testing (FOBT), fecal immunohistochemical testing (FIT), multitarget stool DNA test (Cologuard), virtual colonoscopy [computed tomography (CT) colonography], flexible sigmoidoscopy, and colonoscopy[5,6]. Stool-based testing including FOBT, FIT, and Cologuard are useful, noninvasive screening tests which can identify patients who are in need of further endoscopic surveillance, and if negative can allow patients to avoid an invasive procedure. FOBT detects peroxidase activity of the heme portion of hemoglobin. While this form of screening is convenient for patients, there is a high risk for false-positives caused by ingestion of red meats, fruits or vegetables[6]. FOBT also does not differentiate upper gastrointestinal bleeding from colonic bleeding. FIT, however, detects the globin component of hemoglobin. This test is not influenced by diet and is more specific for lower gastrointestinal bleeding, as globin from the upper gastrointestinal tract is degraded prior to being expelled in feces. Both FOBT and FIT are recommended yearly for CRC screening. Cologuard is a multi-target stool DNA test which detects hemoglobin as well as inappropriately methylated proteins which are commonly found with CRC. These features make Cologuard significantly more sensitive for CRC (92.3%) compared to FIT (73.8%)[5]. Cologuard should be performed every 3 years for CRC screening.

Virtual colonoscopy is another less invasive approach to CRC screening and is recommended at a longer interval of every 5 years[7]. This test involves the same bowel regimen as a colonoscopy, but does not require anesthesia. In this test, CT is used to examine the lumen of the colon and rectum for abnormal growths, much like colonoscopy. In fact, CRC detection rate is similar to colonoscopy with adequate bowel preparation. Johnson *et al*[7] determined that the sensitivity for detecting adenomas and malignancies > 10 mm was equal to that of colonoscopy, however these values decreased with smaller sized lesions. The most prominent drawbacks to this examination are its relative inability to detect polyps smaller than 5-6 mm, as well as its lack of therapeutic intervention. A patient with positive virtual colonoscopy will need to undergo same-day colonoscopy or repeat the bowel preparation for confirmatory and therapeutic colonoscopy at a later date. CT colonography can also exhibit incidental extracolonic findings which may need to further unnecessary testing for the patient[7].

Flexible sigmoidoscopy is an endoscopic technique which allows for direct visualization and therapeutic resection of adenomas or malignancies located in the rectum or left-sided colon. This test requires a less cumbersome bowel regimen compared to colonoscopy and has adequate CRC detection rates distal to the splenic flexure. This test does not visualize the right-sided colon, however, and therefore carries a risk of missed malignancies proximal to its visual field. Flexible sigmoidoscopy is an acceptable form of CRC screening and should be repeated every 5 years. Finally, colonoscopy is the gold standard for CRC screening. This is mostly due to its direct visualization of premalignant or malignant lesions and combined diagnostic and therapeutic capabilities. This modality examines the entire colon as well as the cecum. It does require a full bowel preparation as well as anesthesia, and therefore can be inconvenient for patients. Other risks involve perforation, post-polypectomy bleeding, and post-polypectomy syndrome. As a result of its high detection rates with a proper bowel regimen, patients with normal screening colonoscopies are considered up-to-date for CRC screening for 10 years[5,6].

Vidant Health is a not-for-profit, 1447-bed hospital system that serves more than 1.4 million people in 29 Eastern North Carolina counties. The health system is made up of nine hospitals which provide services to a sizable number of patients who don't live in a city and who often belong to a low socioeconomic status. Given the potential for health disparity in this unique group of patients, we decided to embark on a study to assess the screening rate amongst our patient population.

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## MATERIALS AND METHODS

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IRB-approved (UMCIRB 19-000848) retrospective review of electronic medical records (EMR) was conducted for patients ages 50 years to 75 years who were seen in the East Carolina University Internal Medicine clinic between July 1, 2018 and June 30, 2019. Eligible adults were considered up-to-date with CRC screening if they had

documentation of FOBT or FIT performed in the past 1 year, Cologuard in the past 3 years, flexible sigmoidoscopy or virtual colonoscopy in the past 5 years, or colonoscopy in the past 10 years. For each patient included in the study, the demographic variables collected included age (recorded as integers from 50-75), gender (male, female, unknown/not reported), race (White/Caucasian, Black/African American, Hispanic, Asian, Native American/Alaska native, Native Hawaiian or other Pacific Islander, more than one race/unknown/not reported), marital status (married, not married, divorced, widowed, unknown), family history of CRC (yes/no), smoking status (prior smoker, current smoker, never smoker) and information suggestive of socioeconomic status such as employment status (employed/unemployed/unknown), insurance status (private insurance/public insurance/uninsured), level of education (no formal education/high school or equivalent/college or above/not reported), and travel distance to clinic (in miles, calculated using zip code in Google Maps).

Common comorbidities such as hypertension, diabetes mellitus, congestive heart failure, end-stage renal disease on hemodialysis or peritoneal dialysis, obstructive sleep apnea (OSA) and chronic obstructive pulmonary disease were also included if previously documented within the EMR. The use of aspirin was also assessed. Post-graduate year (PGY) level of training of the most recent provider (PGY1/PGY2/PGY3/PGY4/PGY5/fellow/attending) was also documented. Finally, data suggestive of overall healthcare adherence such as no-show rate (percentage of missed visits out of all scheduled visits as listed in Epic EMR) and compliance with influenza vaccine, screening Papanicolaou exam, and screening mammogram (up-to-date at time of qualifying visit) were collected and stored in a secure RedCap database. A logistic regression model was then constructed to determine which of these variables would serve as facilitators or barriers to CRC screening. This multivariate analysis was performed using STATA v.15. Only statistically significant results ( $P < 0.05$ ) are discussed.

## RESULTS

Total 2428 patients were included in this retrospective cross-sectional study. **Table 1** presents the frequency distributions, mean, and standard deviation (SD) (where appropriate), showing the characteristics of patients included in the sample. Majority of patients, 66.9% ( $n = 1624$ ), were up-to-date on CRC screening. Data on the type of CRC screening test performed were available for 1618 of 1624 patients who were up-to-date. In this subset of patients, 92.82% ( $n = 1502$ ) had their CRC screening performed *via* colonoscopy, 2.97% ( $n = 48$ ) were screened using Cologuard, 1.79% ( $n = 29$ ) were screened using flexible sigmoidoscopy, 1.42% ( $n = 23$ ) had documented screening with FOBT, and 0.99% ( $n = 16$ ) were screened with CT Colonography.

The study sample was made up of 53.6% females and 46.4% males. The median age was 61 years. The majority of patients were Black/African American (60.9%,  $n = 1479$ ) followed by White/Caucasian (35.5%,  $n = 861$ ), Hispanic (1.6%,  $n = 38$ ), and less than 1% of the study population were Asian, American Indian/Alaska native, Native Hawaiian/Pacific Islander. 39 patients were documented as multiple ethnicities or did not have ethnicity recorded. Nearly half of the patients were married (45.3%). 26.6% were not married, 18.4% divorced, and 9.1% were widowed. Family history of CRC was documented in 8.7% ( $n = 212$ ) patients.

As **Table 2** shows, the logistics regression analysis revealed that age [odds ratio (OR) = 1.058;  $P = 0.017$ ], no-show rate percent (OR = 0.962;  $P < 0.05$ ), patient history of OSA (OR = 1.875;  $P = 0.025$ ), compliance with flu vaccinations (OR = 1.673;  $P < 0.05$ ), compliance with screening mammograms (OR = 2.130;  $P < 0.05$ ), and compliance with screening pap smears (OR = 2.708;  $P < 0.05$ ) were significant factors in determining whether a patient will receive CRC screening.

## DISCUSSION

Barriers experienced by patients influence their receptiveness of CRC screening. In a 2005 study, primary care physicians and patients completed a survey which ranked barriers to CRC screening. Patients believed their lack of awareness and limited knowledge of CRC and screening methods were the most noteworthy barriers[8]. Both physicians and patients ranked patient-related barriers as the most significant. Similarly, Jones *et al*[9] determined through mail-out surveys and focus groups that

Table 1 Characteristics of patients in study

Variables	Categories	Patients who were up-to-date on CRC screening		Patients in study <i>n</i> (%)
		No	Yes	Total = 2424
Age (yr) <sup>b</sup>	mean ± SD	60.23 ± 7.12	62.05 ± 6.77	61.45 ± 6.94
No-show rate <sup>b</sup>	mean ± SD	13.75 ± 12.08	8.43 ± 8.33	10.19 ± 10.05
History of COPD	No	725	1486	2211 (91.21)
	Yes	77	136	213 (8.79)
History of CHF <sup>a</sup>	No	686	1439	2125 (87.67)
	Yes	116	183	299 (12.33)
History of diabetes	No	506	1000	1506 (62.13)
	Yes	296	622	918 (37.87)
History of hypertension	No	203	382	585 (24.13)
	Yes	599	1240	1839 (75.87)
History of ESRD on dialysis (HD or PD)	No	777	1584	2361 (97.4)
	Yes	25	38	63 (2.60)
History of OSA <sup>b</sup>	No	685	1299	1984 (81.85)
	Yes	117	323	440 (18.15)
Use of blood thinners	No	384	749	1133 (46.74)
	Yes	418	873	1291 (53.26)
Smoking status <sup>b</sup>	Current smoker	214	291	505 (20.83)
	Former smoker	269	645	914 (37.71)
	Never smoker	319	686	1005 (41.46)
Family history of colorectal cancer <sup>b</sup>	No	750	1462	2212 (91.25)
	Yes	52	160	212 (8.75)
Compliance with flu vaccination <sup>b</sup>	No	390	486	876 (36.14)
	Yes	412	1136	1548 (63.86)
Compliance with mammogram <sup>b</sup>	No	193	150	343 (27.75)
	Yes	237	656	893 (72.25)
Compliance with screening pap <sup>b</sup>	No	162	119	281 (42.38)
	Yes	103	279	382 (57.62)
Race/ethnicity <sup>a</sup>	White	278	582	860 (35.48)
	Black/African America	483	994	1477 (60.93)
	Hispanic	17	21	38 (1.57)
	Asian	2	7	9 (0.37)
	American Indian/Alaska Native	1	1	2 (0.08)
	More than one race/unknown/not reported	21	17	38 (1.57)
Gender	Male	351	775	1126 (46.47)
	Female	451	846	1297 (53.53)
Employment status <sup>a</sup>	Employed	236	561	797 (32.88)
	Unemployed	197	405	602 (24.83)
	Unknown	369	656	1025 (42.29)

Education	College or above	26	66	92 (3.80)
	High school/equivalent	65	125	190 (7.84)
	No formal education	16	32	48 (1.98)
	Unknown/not reported	695	1,399	2094 (86.39)
Insurance status <sup>b</sup>	Private insurance	273	640	913 (37.67)
	Public insurance (medicaid/medicare)	465	938	1403 (57.88)
	Uninsured	64	44	108 (4.46)
Marital status <sup>a</sup>	Married	334	763	1097 (45.26)
	Divorced	153	294	447 (18.44)
	Not married	237	408	645 (26.61)
	Widowed	70	149	219 (9.03)
	Unknown	8	8	16 (0.66)

Chi-square test was used with categorical variables and two sample T-test was used with continuous variables.

<sup>a</sup> $P < 0.05$ .

<sup>b</sup> $P < 0.01$ . CRC: Colorectal cancer; OSA: Obstructive sleep apnea; COPD: Chronic obstructive pulmonary disease; CHF: Congestive heart failure; ESRD: End-stage renal disease; HD: Hemodialysis; PD: Peritoneal dialysis.

patients considered their own lack of knowledge regarding CRC and screening as a major barrier. Many participants felt as though they didn't fully understand their instructions, both for at-home FOBT as well as pre-procedure bowel preparation. Furthermore, patients shared many misconceptions about CRC which were holding them back from screening. Some patients preferred to remain ignorant about their colon health because they considered CRC as a death sentence due to past experiences with sick family members. While death rates are declining in patients  $> 55$ , they are increasing in patients  $< 55$ [10]. Our study aligns with this information, as increasing age was associated with greater adherence to CRC screening. Knowing this, there is a pressing need to determine, and overcome the barriers to screening, in order to increase CRC screening rates in all patients ages 50 to 75.

Embarrassment and fear were barriers which were reported by physicians and patients, although fear was more commonly reported by females than males[8,9]. Patients were able to expand upon these factors in focus groups, stating that the topic of colonoscopy or manipulating their own stool for home FOBT was a taboo topic compared to other cancer screening tests; conversely, though, our study showed that patients who were up-to-date on other health maintenance including screening mammogram, screening pap smear, and annual influenza vaccination were more likely to be up-to-date with CRC screening. Some male participants suggested that colonoscopies took away their manhood. They not only feared the invasive procedure itself, but also pain associated with colonoscopy/sigmoidoscopy, possible diagnosis of CRC, and uncomfortable bowel preparation.

Another possible barrier discussed in other studies was the providers' failure to recommend CRC screening. In the study by Klabunde *et al*[8], provider's failure to recommend CRC screening as a significant barrier. Conversely, Jones *et al*[9] reported only 5 of 317 participants reported lack of physician recommendation as a barrier to CRC screening. Gennarelli *et al*[11] tested providers on their knowledge of the American Cancer Society recommendations for CRC screening. Medical students answered only 32% of questions correctly, residents scored 49%, and attending physicians scored 56%. With the notion that increased knowledge of the recommendations for CRC screening should align with higher screening rates, we studied the level of provider training to determine if more experienced physicians were more likely to enforce CRC screening. There was no significant relationship between provider level of training and patient compliance with CRC screening in our patient population.

Neither of the above studies mentioned comorbidities which could play a role in adherence to CRC screening. Our study showed that a history of OSA was a significant facilitator to CRC screening. One thought as to why these patients are more adherent with CRC screening is that patients with OSA likely have other underlying comorbidities related to obesity and therefore visit their primary care physicians more frequently. This gives the patient more opportunities to be counseled by their doctor(s) about the importance of CRC screening. More evidence for this hypothesis is the

**Table 2 Logistic regression showing facilitators or barriers to colorectal cancer screening**

Variables	Odds ratio	95% confidence interval	
Age (yr)	1.0581 <sup>a</sup>	1.0103	1.1083
Race ethnicity (ref: White/ Caucasian)			
Black/ African American	1.0562	0.6759	1.6506
Hispanic	0.9418	0.1601	5.5396
More than one race/unknown/not reported	0.5142	0.1084	2.4391
Employment status (ref: Employed)			
Unemployed	0.7664	0.4316	1.3611
Unknown	0.7667	0.4855	1.2107
Years of Education (ref: College or above)			
High school/equivalent	1.1055	0.3516	3.4761
No formal education	1.3413	0.2381	7.5564
Unknown/not reported	1.4783	0.5826	3.7509
Insurance status (ref: Private insurance)			
Public insurance (Medicaid/Medicare)	1.1679	0.7422	1.8377
Uninsured	0.5161	0.2420	1.1006
Provider Years of Training (ref: Attending)			
Resident PGY1	0.7212	0.3967	1.3113
Resident PGY2	1.1487	0.6445	2.0473
Resident PGY3	0.6222	0.3733	1.0370
Resident PGY4	0.5764	0.1727	1.9234
No-show rate percent	0.9616 <sup>b</sup>	0.9444	0.9793
Marital status (ref: Married)			
Divorced	0.8826	0.5257	1.4819
Not married	0.9425	0.5921	1.5002
Unknown	0.5473	0.0920	3.2549
Widowed	0.7585	0.3632	1.5840
History of COPD			
Yes	0.5648	0.2816	1.1328
History of diabetes			
Yes	1.1078	0.7182	1.7088
History of CHF			
Yes	0.6007	0.3131	1.1527
History of hypertension			
Yes	0.9223	0.5936	1.4328
History of ESRD on dialysis HD or PD			
Yes	0.6247	0.1291	3.0223
History of OSA			
Yes	1.8752 <sup>a</sup>	1.0838	3.2444
Use of blood thinners			
Yes	1.0809	0.7148	1.6345
Family history of colorectal cancer			

Yes	0.9013	0.4736	1.7154
Smoking status (ref: Current smoker)			
Former smoker	0.9741	0.5849	1.6223
Never smoker	0.9415	0.5697	1.5559
Compliance with flu vaccination			
Yes	1.6729 <sup>a</sup>	1.1255	2.4867
Compliance with mammogram			
Yes	2.1295 <sup>b</sup>	1.3904	3.2614
Compliance with screening pap			
Yes	2.7081 <sup>b</sup>	1.8213	4.0267
Travel distance from clinic	1.0016	0.9996	1.0037

<sup>a</sup> $P < 0.05$ .

<sup>b</sup> $P < 0.01$ . PGY: Post-graduate year; OSA: Obstructive sleep apnea; COPD: Chronic obstructive pulmonary disease; CHF: Congestive heart failure; ESRD: End-stage renal disease; HD: Hemodialysis; PD: Peritoneal dialysis.

inverse relationship between patient no-show rate and CRC screening adherence in our study. Less visits to the patient's primary care doctor results in less adherence to CRC screening. Another thought is that in order to have a diagnosis of OSA, the patient must have completed a sleep study; if a patient is adherent with this type of testing, then perhaps he or she is adherent to other testing, such as CRC screening. This again is supported by our finding that patients are more likely to be compliant with CRC screening if they are up-to-date on other healthcare maintenance. These studies, along with our own, show us that there are a multitude of reasons why patients do or do not adhere with CRC screening.

## CONCLUSION

This study revealed that the age of patient, history of sleep apnea, compliance with other health maintenance tests were significant facilitators to CRC screening, while no-show rate percent was a significant barrier in this patient population. The overarching goal of this study is to enlighten physicians to these barriers, and ultimately improve adherence to CRC screening.

## ARTICLE HIGHLIGHTS

### **Research background**

Colorectal cancer (CRC) remains the third most common cancer in the United States. With appropriate screening, early lesions can be identified before they have developed into malignancy. Unfortunately, only about 2 of 3 Americans between the ages of 50 and 75 are up to date on CRC screening. We developed this study to determine the barriers and facilitators to CRC screening.

### **Research motivation**

By completing this study, we aimed to determine which factors lead to increased or decreased adherence to CRC screening in our patients. By learning these facilitators or barriers to screening, we can implement practices to increase screening rates and hopefully decrease rates of CRC.

### **Research objectives**

The main objective was determining facilitators and barriers to CRC screening. As we established these factors, we are opening our minds to changes that can be generalized to all cancer screening tests, to make a difference in our communities.

### Research methods

We performed a retrospective analysis, reviewing the electronic medical records for every patient between the ages of 50 and 75 who visited our internal medicine clinic in a 1-year period. We recorded data pertaining to demographics, comorbid conditions, and adherence with other medical screening tests to look for correlations with screening adherence or nonadherence. Multivariate analysis was performed using STATA v. 15.

### Research results

Advanced age was associated with increased adherence to CRC screening. A diagnosis of obstructive sleep apnea was also associated with increased adherence to CRC screening, but no other comorbid condition shared this finding. Higher no-show rates to the clinic was consistent with lower CRC screening adherence. Finally, adherence with other health maintenance screenings was associated with increased adherence with CRC screening.

### Research conclusions

We concluded that patients with obstructive sleep apnea likely had multiple providers who encouraged screening for CRC, and were compliant with other outpatient studies (sleep studies for example) which may be why these patients had higher rates of CRC screening. With advanced age likely comes more frequent visits to the physician and hence more opportunities for counseling on cancer screening tests. Conversely, if a patient has a high no-show rate to routine clinic appointments, then they likely will also have poor adherence to screening tests and have less counseling on the importance of these tests. Finally, if a patient is adherent with other health maintenance exams like mammograms or pap smears, then they likely will also be adherent to screening for CRC.

### Research perspectives

We now know some of the factors that influence adherence to CRC screening. Future research should focus on those patients who are not up-to-date on screening, and determine what personal, religious, or physician-related factors have kept them from completing CRC screening.

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