Research Article

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Patterns of Colorectal Cancer Screening Uptake in Newly Eligible Men and Women

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Abstract

Background: We describe patterns of colorectal cancer screening uptake in a U.S. insured population as individuals become newly eligible for screening at age 50 and assess temporal trends and patient characteristics with screening uptake.

Methods: We identified a cohort of 81,223 men and women who were members of Group Health and turned 50 years old from 1996 to 2010. We ascertained receipt of colorectal cancer screening within five years. Time to screening was estimated by year of cohort entry using cumulative incidence curves and Cox proportional hazards models–estimated patient characteristics associated with screening uptake.

Results: Stool-based screening tests were the most common, 72% of first screening tests. The proportion of individuals initiating colorectal cancer screening via colonoscopy increased from 8% in 1996 to 1998 to 33% in 2008 to 2010. Patient factors associated with increased colorectal cancer screening were: turning 50 more recently (2008–2010; $P_{trend} < 0.0001$) or Asian race [HR, 1.14; 95% confidence interval (CI), 1.10–1.19]. Patient factors associated with decreased screening were: being a woman (HR, 0.70; 95% CI, 0.68–0.72), Native American (HR, 0.68; 95% CI, 0.60–0.78), or Pacific Islander race (HR, 0.82; 95% CI, 0.72–0.95), and having prevalent diabetes (HR, 0.78; 95% CI, 0.75–0.82) and higher body mass index ($P_{trend} < 0.0001$).

Conclusions: Patient characteristics associated with initiation of colorectal cancer screening in a newly eligible population are similar to characteristics associated with overall screening participation in all age-eligible adults. Our results identify patient populations to target in outreach programs.

Impact: Disparities in receipt of colorectal cancer screening are evident from onset of an age-eligible cohort, identifying key groups for future interventions for screening. *Cancer Epidemiol Biomarkers Prev; 23(7); 1230–7.* ©*2014 AACR.*

Introduction

Colorectal cancer screening is an effective way to reduce colorectal cancer mortality (1). Nearly 2 decades ago, the U.S. Preventive Services Task Force first recommended colorectal cancer screening for average risk adults using flexible sigmoidoscopy and fecal occult blood testing (FOBT) beginning at age 50 years (2). Since the announcement of this recommendation, colorectal cancer screening in the United States has risen dramatically (3, 4), particularly with the availability of screening colonoscopy for average risk-individuals (3, 4).

However, colorectal cancer screening use remains low. Only 63% of U.S. age-eligible adults report receiving colorectal cancer screening with FOBT in the prior 2 years or endoscopy in the prior 10 years. Reporting of recent screening differs by age; only 54% of adults ages 50 to 59 years report recent screening compared with 76% of older adults ages 70 to 75 year olds (4). Factors routinely associated with colorectal cancer screening include having health insurance, access to a usual source of care and a primary care doctor, and use of other preventive services (5–8). Men are also more likely to be screened for colorectal cancer than women (9). However, most of the evidence on factors associated with screening were conducted in all-age eligible populations. No studies have evaluated patient factors associated with screening initiation among adults that are newly eligibly at age 50 for colorectal cancer screening, which is important in understanding who might need additional outreach to improve colorectal cancer screening participation.

We describe patterns of colorectal cancer screening uptake in an insured population of men and women as they become newly eligible for screening at age 50 years, including temporal trends of colorectal cancer screening initiation over a 15-year period and patient characteristics associated with screening uptake.

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Materials and Methods

Study population

We identified 83,777 men and women who were enrolled for at least 1 year in Group Health before their 50th birthday from 1996 to 2010. Group Health is a mixed model health insurance and care delivery system in Washington State. Our study is focused on average risk adults; hence we excluded participants who had prior diagnoses of colorectal cancer ($n = 380$; ref. 10), Crohn disease or colitis ($n = 760$), a colectomy ($n = 258$), or individuals with colonoscopy for any reason at age 49 ($n = 1{,}849$). Our final sample included 81,223 eligible individuals during the study timeframe.

The study protocol received Institutional Review Board approval for a waiver of consent to enroll participants, link study data, and perform statistical analyses.

Colorectal cancer screening outreach

Colorectal cancer screening guidelines at Group Health follow the recommendations of the U.S. Preventive Services Task Force (11), and hence during this 15-year study period, providers could have recommended FOBT yearly, sigmoidoscopy every 5 years with or without interval FOBT, or colonoscopy every 10 years (12). From 1996 to 2006, patients learned about colorectal cancer screening from their providers during office visits or brochures in the clinics. In 2007, the Group Health Screening and Outreach Program began to send annual letters on individual's birthdays as a reminder of upcoming clinical preventive services, including colorectal cancer screening. With the implementation of the Patient-Centered Medical Home in 2009, medical assistants or nurses sought to identify individuals not up-to-date for preventive services, and used electronic medical record alerts during patient visits (13). Finally, beginning in 2002, average-risk patients were able to self-refer to gastroenterology to receive a colonoscopy.

Identification and indication of colorectal cancer screening tests

For each eligible individual, we identified the first colorectal cancer screening test within 5 years of their 50th birthday up to their 55th birthday. Data were available from administrative claims and electronic medical records. From clinical laboratory data, we identified the date of receipt of either guaiac FOBT or fecal immunochemical testing (FIT) with Current Procedural Terminology (CPT) codes (i.e., 82270, 82271, 82272, 82273, 82274) and Health Common Procedure Coding System (HCPCS) codes (i.e., G0107, G0328, G0394).

We identified colonoscopy based on CPT codes (45378–45386, 45391–45392), HCPCS (G01005, G0122), and International Classification of Diseases and Ninth Revision, Clinical Modification (ICD-9-CM) codes (45.23). We identified flexible sigmoidoscopy based on CPT (45300–45345), HCPCS (G0104), and ICD-9-CM codes (45.24, 48.21, 48.22, 48.23, 48.24, 48.36). We ascertained receipt of barium enema (CPT: 74270, 74280, HCPC G0106, G0120, G0122, ICD-9 87.64) and CT colonography (HCPCS 0066T and 0067T) through radiology imaging.

We assumed that all colorectal tests were conducted for the purpose of screening except for colonoscopy procedures. Colonoscopy is used for both screening and diagnostic evaluation of signs and symptoms, and the indication of the exam is not captured in administrative data. Therefore, we used an algorithm to identify screening colonoscopies using patient symptoms, prior procedures and patient demographics (14). The algorithm was developed using Group Health administrative data available, including patient symptoms, prior procedures, and demographics, and performs better than those in the existing literature (15). We dichotomized the predicted probabilities, categorizing colonoscopy exams with a probability of >0.261 as screening exams, which maximized the sensitivity and specificity at 88% and 90%, respectively.

Patient characteristics

Patient characteristics of interest were selected based on identified risk factors for colorectal cancer (16) and availability within our data systems (17). We identified patient characteristics through administrative patient files including sex (female/male), year of 50th birthday, and race/ethnicity (white, black, Hispanic, Asian, Pacific Islander, Native American, biracial, unknown), prior diagnosis of type I or II diabetes mellitus (yes/no; ref. 18), and a primary care visit in the year before their 50th birthday (yes/no). Additional patient characteristics were identified by the closest clinical encounter before their 50th birthday, including any family history of colorectal cancer (yes/no; ICD9 code v16.0) and body mass index (kg/m^2).

Statistical analysis

We developed an inception cohort of individuals newly eligible for colorectal cancer screening at age 50 to evaluate patterns of screening tests and factors associated with initiation of screening. We described patient characteristics among men and women for the total population and by receipt of screening within 5 years of their 50th birthday.

To evaluate temporal trends among individuals who received colorectal cancer screening test, we calculated the distribution of colorectal cancer screening tests received, specifically stool-based, colonoscopy, flexible sigmoidoscopy, and other tests, stratified by year of 50th birthday (i.e., 1996–1998, 1999–2001, 2002–2004, 2005–2007, 2008–2010) in the entire age-eligible cohort. Barium enema and CT colonography are categorized as other screening tests because there were so few tests received ($n = 312$ combined tests).

We also constructed cumulative incidence curves to demonstrate the time to receipt of the first screening test up to 5 years across all cohorts by year of 50th birthday (i.e., 1996–1998, 1999–2001, 2002–2004, 2005–2007, and 2008–2010).

Cox proportional hazards models were used to evaluate the association between time to first colorectal cancer screening after age 50 and patient characteristics including sex, year of 50th birthday, family history of colorectal cancer, race/ethnicity, prevalent diabetes, body mass index, and a primary care provider visit at age 49. Missing values were categorized as an unknown category and retained within the model. Person-time was calculated from the time of an individual's 50th birthday to time of first colorectal cancer screening test, disenrollment from Group Health, a nonscreening colonoscopy, or end of follow-up at 5 years or December 31, 2010, whichever came first. Fully adjusted models included all variables in the final model. Tests for trend were calculated by including the linear term of the categorical variable in the model. In sensitivity analyses, we evaluated the impact of missing data by rerunning the analysis on individuals with complete data. We also evaluated the impact of the family history variable on the results, and ran the model with this covariate excluded. All analyses were performed using SAS Version 9.2 (SAS Institute), and 2-sided $P < 0.05$ was considered statistically significant.

Results

Overall, the entire cohort contributed 285,450 person-years during follow-up. There were few differences in patient characteristics comparing individuals who initiated colorectal cancer screening after their 50th birthday with those who did not (Table 1). Patient characteristics that differed included the year of 50th birthday, family history of colorectal cancer, and receipt of a primary care visit at age 49 years. Person-time varied by year of 50th birthday and were calculated as 75,817 years for 1996 to 1998 cohort, 70,887 years for 1999 to 2001 cohort, 66,238 years for 2002 to 2004 cohort, 54,207 years for 2005 to 2007 cohort, and 18,301 years for 2008 to 2010 cohort.

Stool-based tests were the most common initial screening test in this population, representing 72% of screening tests among 50 year olds who receive colorectal cancer screening (Fig. 1). However, over time, the proportion of individuals receiving stool-based tests has dropped to about 63% of all tests in 2008 to 2010 cohort (Fig. 1), and colonoscopy represents a larger proportion of screening tests among 50-year olds. The proportion of individuals initiating colorectal cancer screening via colonoscopy increased from 8% in 1996 to 1998 to 33% in 2008 to 2010.

Cumulative incidence curves demonstrate a substantial increase in colorectal cancer screening rates over time (Fig. 2). At 2 years since 50th birthday, approximately 17% of the 1996 to 1998 cohort had received colorectal cancer screening compared with about 30% of the individuals in the 2008 to 2010 cohort. By 5 years, approximately 36% of the 1996 to 1998 cohort had received colorectal cancer screening compared with 49% of the individuals in the 2005 to 2007 cohort.

In multivariable adjusted models (Table 2), there was a statistically significant increasing trend in use of colorectal cancer screening among men and women who turned 50 more recently compared with 1996–1998 ($P < 0.0001$), with a 2-fold increased receipt of colorectal cancer screening among 2008 to 2010 cohort compared with the 1996 to 1998 cohort. Other patient factors associated with an increase in uptake of colorectal cancer screening included having a family history of colorectal cancer (HR, 1.78; 95% CI, 1.71–1.84) and a primary care visit at age 49 years (HR, 1.42; 95% CI, 1.38–1.45). There were also racial/ethnic differences in uptake of colorectal cancer screening. Asian men and women were 14% more likely to screen for colorectal cancer compared with whites; however, men and women who were black, Pacific Islander, or Native American were less likely to screen for colorectal cancer. Individuals with diabetes were 21% less likely to screen for colorectal cancer compared with individuals without diabetes. There is also a significant inverse trend in the relationship between increasing body mass index and use of colorectal cancer screening ($P < 0.0001$). Individuals with a BMI $\geq$35 were 28% less likely to screen for colorectal cancer compared with normal weight individuals.

From our sensitivity analyses, there were no differences in the magnitude or direction of results in a population with complete data or when family history was dropped in the model.

Discussion

Our results suggest that characteristics of newly eligible individuals who initiate colorectal cancer screening are similar to the characteristics of all U.S. adults who receive colorectal cancer screening tests. That is, the disparity in receipt of colorectal cancer screening that occurs in all age-eligible adults is present within the first years of eligibility for colorectal cancer screening. Our study population is unique in that all study participants had health insurance, which offset patient costs for screening tests and subsequent diagnostic evaluations, removing some economic barriers. Even so, we still observed differences in the use of colorectal cancer screening across patient characteristics.

We demonstrated that individuals turning 50 more recently (i.e., 2008–2010) were more likely to receive colorectal cancer screening within 5 years of their 50th birthday compared with individuals who turned 50 in 1996 to 1998. Improvements in the initiation of colorectal cancer screening such as protocols for screening referral, tracking of patient outcomes, and addressing patient barriers, have demonstrated to increase colorectal cancer screening by 18% among adults <64 years (19). These types of initiatives could also have impacted our populations. A recent study at Group Health used mailings and additional telephone support to improve colorectal cancer screening (20). Furthermore, Group Health's implementation of the Patient Centered Medical Home in 2009 also may have led to improved colorectal cancer screening among younger adults in the most recent timeframe (13). Finally, national efforts to meet quality standards established by the National Committee for Quality Assurance (NCQA) have increased the need of all stakeholders to meet HEDIS performance measures (21). The increased

Table 1. Descriptive characteristics of Group Health members newly eligible for colorectal cancer screening from 1996 to 2010 by receipt of screening and total population

	Colorectal cancer screening		
	No	Yes	Total
Characteristics	***N* (%)**	***N* (%)**	***N* (%)**
	47,950	33,275	81,225
Person-time (years)	147,400	138,050	285,450
Sex			
Female	25,322 (53%)	18,443 (55%)	43,765 (54%)
Male	22,628 (47%)	14,832 (45%)	37,460 (46%)
Year of 50th birthday			
1996–1998	11,796 (24%)	6,641 (21%)	18,437 (23%)
1999–2001	12,100 (25%)	6,767 (21%)	18,867 (24%)
2002–2004	8,249 (17%)	7,242 (23%)	15,671 (19%)
2005–2007	7,284 (15%)	7,371 (23%)	14,655 (18%)
2008–2010	9,438 (19%)	4,155 (13%)	13,593 (17%)
Race			
White	25,411 (80%)	22,954 (80%)	48,365 (80%)
Black	1,544 (5%)	1,237 (4%)	2,781 (5%)
Asian	2,174 (7%)	2,288 (8%)	4,462 (7%)
Hispanic	1,346 (4%)	1,232 (4%)	2,578 (4%)
Pacific Islander	220 (1%)	142 (<1%)	362 (1%)
Native American	309 (1%)	166 (1%)	475 (1%)
Biracial	594 (2%)	529 (2%)	1,123 (2%)
Unknown	16,352 (34%)	4,727 (14%)	21,079 (26%)
Family history of colorectal cancer			
No	46,392 (97%)	30,424 (91%)	76,816 (95%)
Yes	1,558 (3%)	2,851 (9%)	4,409 (5%)
Body mass index (kg/m^2)			
<18.5	194 (1%)	184 (1%)	378 (1%)
18.5–24.9	6,552 (29%)	7,262 (34%)	13,814 (32%)
25–29.9	7,003 (31%)	6,798 (32%)	13,801 (32%)
30.0–34.9	4,578 (20%)	3,782 (18%)	8,360 (19%)
≥35	4,367 (19%)	3,035 (14%)	7,402 (17%)
Unknown	25,256 (53%)	12,214 (37%)	37,470 (46%)
Diagnosis of diabetes mellitus			
No	44,466 (93%)	31,233 (94%)	75,699 (93%)
Yes	3,484 (7%)	2,042 (6%)	5,526 (7%)
Geographic location			
Urban	45,237 (94%)	32,377 (97%)	77,614 (96%)
Rural	1,471 (3%)	564 (2%)	2,035 (3%)
Suburban	823 (2%)	201 (1%)	1,024 (1%)
Unknown	419 (1%)	133 (<1%)	552 (1%)
Primary care visit at age 49 y			
No	18,092 (38%)	7,237 (22%)	25,329 (31%)
Yes	29,858 (62%)	26,038 (78%)	55,896 (69%)

initiation in cancer screening within our study population mimic similar trends in increased adherence to cancer screening in all age-eligible individuals (3) and changes in choice of colorectal cancer screening test nationally (4).

Women and some racial minority groups were less likely to initiate colorectal cancer screening within 5 years of their 50th birthdays. Women participate in screening for breast and cervical cancer at higher rates than colorectal cancer (22). Furthermore, prior studies have demonstrated that younger men (41.0%) report higher rates of receipt of any recommended colorectal cancer screening compared with women (31.4%), which aligns with our study results (9). In assessing women's perspectives for colorectal cancer screening, women report being more

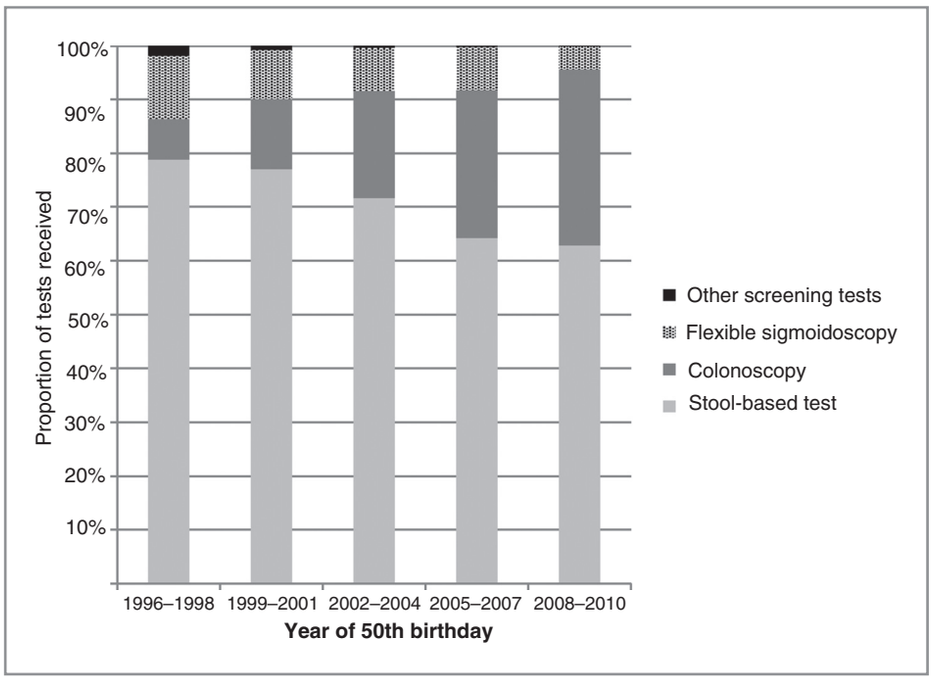

Figure 1. The distribution of colorectal cancer screening test received during follow-up by year of 50th birthday.

afraid or fearful of colorectal cancer screening and the unpleasant preparation compared with men (23). Several studies have documented that racial/ethnic minorities are less likely to receive colorectal cancer screening, even in insured populations. Recent analysis of Behavioral Health Risk Factor Survey data demonstrates that Hispanics, Asians, and American Indians/Alaska Natives have prevalent screening rates 11% to 15% below whites and blacks (24). In our analysis, Asian men and women were most likely to receive screening within 5 years compared with Whites. Reasons for differences by racial/ethnic groups are not clear in our study population and should be further investigated.

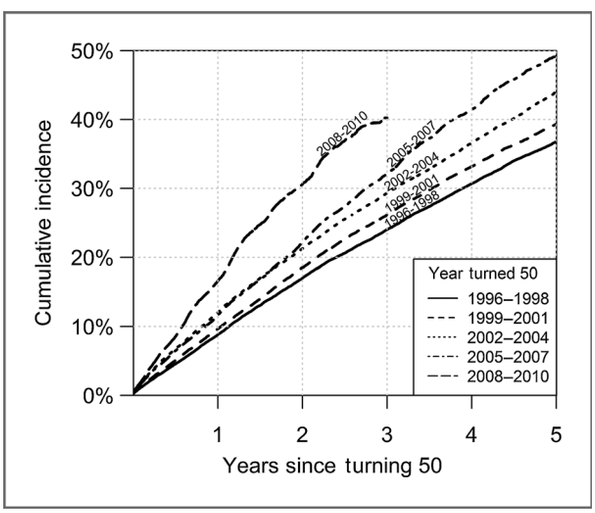

Figure 2. Cumulative incidence curves for time to first colorectal cancer screening test by year individuals turned 50 years old.

Despite having health insurance, only 69% of patients in our study population had seen a primary care provider at age 49 years. Contact with the health care system is an important first step to receiving cancer screening. A recent study of Group Health members evaluated receipt of FOBT among men and women ages 50 to 54 years and found that up to 4.5% of women and 10.1% of men remain unscreened for colorectal cancer because of infrequent primary care visits (defined as $\leq$1 visit in 2 years; ref. 25). Currently preventive well-care visits are recommended for men and women every 2 years at age 50, and attendance at well-care visits could influence the initiation of colorectal cancer screening (26).

Obesity was associated with reduced colorectal cancer screening. The majority of research suggests that being overweight and obese is associated with reduced participation in colorectal cancer screening compared with normal weight individuals (27, 28), particularly in women (29, 30). In the Reducing Barriers to Colorectal Cancer Screening study, Messina and colleagues (31) determined that women who were overweight or obese were 40% less likely to have had recent screening compared with normal weight women, whereas for men, there were no differences in recent screening by BMI category. A recent systematic review and meta-analysis demonstrated similar findings associating decreasing rates of colorectal cancer screening with increasing obesity class (30). When evaluating perceptions about colorectal cancer and screening, obese women were less likely to report that obesity was a risk factor for colorectal cancer and to express worry about colorectal cancer. There were no

Table 2. Patient characteristics associated with initiation of colorectal cancer screening in members of Group Health, 1996 to 2010

Patient characteristics	HR[a] (95% CI)
Year of 50th birthday	
1996–1998	Referent
1999–2001	1.12 (1.09–1.15)
2002–2004	1.32 (1.28–1.36)
2005–2007	1.42 (1.42–1.52)
2008–2010	2.04 (1.95–2.12)
P_{trend}	<0.0001
Sex	
Male	Referent
Female	0.71 (0.70–0.73)
Race	
White	Referent
Black	0.96 (0.91–1.01)
Asian	1.14 (1.10–1.19)
Hispanic	1.01 (0.96–1.07)
Pacific Islander	0.80 (0.69–0.92)
Native American	0.70 (0.61–0.80)
Multiracial	0.98 (0.90–1.05)
Unknown	0.66 (0.64–0.68)
Family history of colorectal cancer	
No	Referent
Yes	1.78 (1.71–1.84)
Diagnosis of diabetes mellitus	
No	Referent
Yes	0.79 (0.76–0.82)
Body mass index (kg/m^2)	
<18.5	0.98 (0.85–1.12)
18.5–24.9	Referent
25–29.9	0.90 (0.87–0.93)
30–34.9	0.81 (0.78–0.84)
≥35	0.72 (0.69–0.75)
Unknown	0.56 (0.54–0.58)
P_{trend}	<0.0001
Primary care visit at age 49 y	
No	Referent
Yes	1.42 (1.38–1.45)

[a]Analyses are adjusted for all variables presented in the table.

significant differences in perceptions about colorectal cancer for overweight or obese men (31).

Prior studies have demonstrated that individuals with a family history of colorectal cancer are strongly motivated to receive screening, and in our analysis, a prior family history was associated with increased use of screening. Carney and colleagues recently documented that both men and women with a positive family history are significantly more likely to be up-to-date for colorectal cancer screening compared with individuals with a negative family history of cancer (32). The American Cancer Society recommends that individuals with a first-degree family history screen at an earlier age before 50 (33). In our analysis, we only evaluated screening at age 50 and older and did not evaluate screening among individuals in their 40s.

We found decreased use of colorectal cancer screening among individuals with diagnosis of diabetes. Individuals with a diabetes diagnosis are similarly up-to-date for colorectal cancer screening compared with national averages, near 60% (34). However, women with diabetes are less likely to be up-to-date compared with men with diabetes. Furthermore, women with diabetes tend to participate less in clinical preventive services (i.e., mammography screening) compared with women without diabetes (35). We did not specifically evaluate interactions between patient characteristics, but important subgroups, such as overweight women with diabetes could be potential target populations for screening outreach.

Our study has several strengths including a large cohort to evaluate temporal trends by test type with ascertainment of all screening tests through our administrative data. Although indication for colonoscopy is routinely missing from administrative data, we were able to assign indication for colonoscopy using a new, accurate algorithm based on administrative data (14). Although this is the first study to describe colorectal cancer screening uptake in a large cohort of newly eligible 50-year-old adults, there are several limitations to our analysis. First, we ascertained patient characteristics as close to age 50 as possible; however, because of the limitations of administrative data and irregular timing of contact with the health care system, we were not always able to document patient characteristics that resulted in missing data, particularly for race and body mass index. In our analyses, we included missing data as an "unknown" category in multivariable models. When we restricted our analysis to members with complete data, we observed similar patterns of association as reported results. Second, our estimates of family history of colorectal cancer might be biased because the information was primarily obtained through patient visits. Documentation of family history is difficult because the variable will be documented affirmatively because of a positive family, and when there is no mention of a family history, we assumed this represented a negative family history. However, excluding the variable from our analysis did not widely vary our results. Finally, we ascertained receipt of colonoscopy in the year before individual's 50th birthdays. The trends in use of colonoscopy before age 50 are not well known, so it is not possible to determine what proportion of individuals might have had testing before this period. However, given that colorectal cancer screening is recommended in average risk adults beginning at age 50, we would expect few individuals to receive colonoscopy for screening before age 50 years.

Our results indicate that within 5 years of their 50th birthday almost 50% of men and women have received colorectal cancer screening. Physicians, medical teams, and support staff could focus on reducing disparities access to colorectal cancer screening among 50 year olds by targeting individuals who are most likely to remain nonadherent

(e.g., overweight women, individuals with diabetes, racial/ethnic minorities) to screening with outreach and inreach and interventions to improve participation.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Authors' Contributions

Conception and design: K.J. Wernli, R.A. Hubbard, A. Kamineni, B.B. Green, C.M. Rutter
Development of methodology: K.J. Wernli
Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): A. Kamineni
Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): K.J. Wernli, R.A. Hubbard, E. Johnson, J. Chubak, A. Kamineni, B.B. Green, C.M. Rutter
Writing, review, and/or revision of the manuscript: K.J. Wernli, R.A. Hubbard, E. Johnson, J. Chubak, A. Kamineni, B.B. Green, C.M. Rutter
Study supervision: K.J. Wernli, C.M. Rutter

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