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Health Care Provider Characteristics Associated With Colorectal Cancer Screening Preferences and Use

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Abstract

Objective: To assess health care provider (HCP) preferences related to colorectal cancer (CRC) screening overall, and by HCP and patient characteristics.

Participants and Methods: We developed a survey based on the Theoretical Domains Framework to assess factors associated with CRC screening preferences in clinical practice. The survey was administered online November 6 through December 6, 2019, to a validated panel of HCPs drawn from US national databases and professional organizations. The final analysis sample included 779 primary care clinicians (PCCs) and 159 gastroenterologists (GIs).

Results: HCPs chose colonoscopy as their preferred screening method for average-risk patients (96.9% (154/159) for GIs, 75.7% (590/779) for PCCs). Among PCCs, 12.2% (95/779) preferred multitarget stool DNA (mt-sDNA), followed by fecal immunochemical test (FIT), (7.3%; 57/779) and guaiac-based fecal occult blood test (gFOBT) (4.8%; 37/779). Preference among PCCs and GIs generally shifted toward noninvasive screening options for patients who were unable to undergo invasive procedures; concerned about taking time from work; unconvinced about need for screening; and refusing other screening recommendations. Among PCCs, preference for mt-sDNA over FIT and gFOBT was less frequent in larger compared with smaller clinical practices. Additionally, preference for mt-sDNA over FIT was more likely among PCCs with more years of clinical experience, higher patient volumes (> 25/day), and practice locations in suburban and rural settings (compared to urban).

Conclusion: Both PCCs and GIs preferred colonoscopy for CRC screening of average-risk patients, although PCCs did so less frequently and with approximately a quarter preferring stool-based tests (particularly mt-sDNA). PCCs' preference varied by provider and patient characteristics. Our findings underscore the importance of informed choice and shared decision-making about CRC screening options.

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In the United States, colorectal cancer (CRC) is the second most frequent cause of cancer-related death.[1-3] Several screening options are endorsed for average-risk CRC screening and have been shown to favorably affect both incidence and mortality outcomes.[4] The Healthy People 2020 objective for CRC screening is to increase the proportion of adults aged 50 to 75 years receiving guideline-recommended screening to 70.5%, whereas the National Colorectal Cancer Roundtable has set an even more ambitious goal of 80% screening participation in every community.[5,6] However, current CRC screening rates remain well below these national goals, with nearly one-third of eligible adults in the United States reportedly not up to date with their recommended CRC screening.[2] Moreover, reported CRC screening rates are even lower among certain population subgroups, as defined for example by race/ethnicity,

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younger age, or lower socioeconomic status.[7]

The United States Preventive Services Task Force (USPSTF) recommends screening for CRC among average-risk adults aged 50 to 75 years.[4] USPSTF provides guidance on the use of multiple direct visualization and stool-based/noninvasive screening tests for these patients, including colonoscopy every 10 years; flexible sigmoidoscopy every 5 years; or flexible sigmoidoscopy every 10 years with annual fecal immunochemical tests (FITs); multitarget stool DNA (mt-sDNA) test every 1 or 3 years; annual FIT; annual guaiac-based fecal occult blood test (gFOBT); or computed tomography colonography every 5 years.[4] These CRC screening options vary in terms of effectiveness, safety, and cost, supporting the rationale for endorsing multiple strategies, rather than a single, one-size-fits-all approach. Patients may be more likely to complete screening and adhere to recommended screening schedules depending upon the fit between the patient's needs and preferences and available screening options.[8,9] Research has shown that provider recommendation strongly influences CRC screening completion[10-12] and CRC screening recommendations that are aligned with patient preferences may improve CRC screening acceptance and adherence.[13,14]

Although the USPSTF endorses CRC screening strategies with evidence of a high certainty of net benefit, the effectiveness of each of the screening strategies is undermined by population underuse and suboptimal adherence to screening recommendations.[15] Consequently, an additional consideration in weighing the pros and cons of various screening options is patient adherence. The most consistent factor associated with completion of CRC screening is clinician recommendation.[10-12] As new CRC screening strategies emerge, it is critical to evaluate clinician knowledge of the screening tests and to assess relevant attitudes and behaviors that may influence their recommendations to patients.

To further explore health care provider (HCP) preferences for endorsed CRC screening options, we developed and implemented a national survey of relevant knowledge, attitudes, and behaviors among practicing primary care clinicians (PCCs) and gastroenterologists (GIs). The primary aims of the study were to delineate and compare factors associated with CRC screening knowledge, attitudes, and behavior by screening option among PCCs and GIs and to identify factors associated with greater knowledge and use of novel CRC screening technologies. In our analysis, we characterized provider, clinical practice, and patient characteristics associated with CRC screening preferences and practices among PCCs and GIs.

PARTICIPANTS AND METHODS

Survey Development

Following the Theoretical Domains Framework, we developed a survey to assess factors associated with implementation of novel practices or technologies into clinical practice including knowledge; skills; social/professional role and identity; beliefs about capabilities; optimism; beliefs about consequences; intentions; memory, attention, and decision processes; environmental context and resources; and social influences.[16] Additional survey items were adopted from the National Cancer Institute's Physician Survey on Colorectal Cancer Screening.[17-19] Pretest interviews were conducted with 11 clinicians from the panel to validate the survey length, survey programming, and data collection methodology before administering the survey.

Data Collection

Data were collected through a web survey between November 6, 2019, and December 6, 2019, by the National Opinion Research Center at the University of Chicago.[20] National Opinion Research Center worked with a third-party vendor, Dynata, to collect these data. Dynata maintains a panel of physicians, physician assistants, nurse practitioners, nurses, and other HCPs in the United States.[21] Panel respondents were

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TABLE 1. Sociodemographic and Clinical Characteristics of the Survey Participants by Clinical Specialty[a]

	Primary care[b] (n=779)	Gastroenterology (n=159)
Age, years		
27-39	103 (13.2)	41 (25.8)
40-49	240 (30.8)	42 (26.4)
50-60	254 (32.6)	45 (28.3)
60+	182 (23.4)	31 (19.5)
Sex[c]		
Male	563 (72.5)	131 (82.9)
Female	214 (27.5)	27 (17.1)
Race/ethnicity		
White, non-Hispanic	516 (66.2)	88 (55.4)
Black, non-Hispanic	16 (2.1)	4 (2.5)
Hispanic	25 (3.2)	10 (6.3)
Asian/Pacific Islander, non-Hispanic	185 (23.8)	42 (26.4)
Other/Multiple Race, non-Hispanic	37 (4.8)	15 (9.4)
Annual household income		
Less than $74,999	41 (5.3)	4 (2.5)
$75,000 to $124,999	95 (12.2)	9 (5.7)
$125,000 to $174,999	113 (14.5)	12 (7.6)
$175,000 to $199,999	83 (10.7)	16 (10.1)
$200,000 or more	447 (57.4)	118 (74.2)
Board certification		
Internal medicine	403 (51.7)	—
Family medicine	376 (48.3)	—
Gastroenterology	0	159 (100)
Clinical degree		
Physician (MD, DO, MMS)	776 (99.6)	159 (100)
Advanced practice provider (PA/NP)	3 (0.4)	—
Number of years practicing medicine post-residency		
0-9	112 (14.4)	42 (26.4)
10-19	259 (33.3)	53 (33.3)
20-29	264 (33.9)	45 (28.3)
30+	144 (18.5)	19 (12.0)
Average number of patients seen on typical day		
0-15	156 (20.0)	41 (25.8)
16-20	280 (35.9)	49 (30.8)
21-25	181 (23.2)	30 (18.9)
26+	162 (20.8)	39 (24.5)
Number of clinicians in practice		
0-15	572 (73.4)	103 (64.8)
16+	207 (26.6)	56 (35.2)
Characterization of clinical practice location		
Urban	249 (32.0)	81 (50.9)
Suburban	425 (54.6)	69 (43.4)
Rural	105 (13.5)	9 (5.7)

[a]Values are n (%).
[b]Includes Internal Medicine and Family Medicine.
[c]Numbers do not always add to total due to missing responses.

recruited from lists of more than 200,000 HCPs identified and validated through sources including the American Hospital Association, the American Medical Association, and the National Provider Identifier databases. HCPs consent to participate in the

TABLE 2. Preference for Colorectal Cancer Screening Test by Health Care Provider Board Certification[a]

Preferred CRC screening method for average-risk patients	Clinical specialty/board certification, n (%)		P
	Primary care[b] (n=779)	Gastroenterology (n=159)	
gFOBT	37 (4.8)	0	
FIT	57 (7.3)	3 (1.9)	
mt-sDNA	95 (12.2)	2 (1.3)	
Colonoscopy	590 (75.7)	154 (96.9)	

[a]CRC, colorectal cancer; FIT, fecal immunochemical test; gFOBT, guaiac-based fecal occult blood test; mt-sDNA, multitarget stool DNA.
[b]Includes Internal Medicine and Family Medicine.

panel, are asked to complete a profile, and their data is integrated with the American Medical Association and National Provider Identifier databases to inform matches between providers and survey invitations.

Sample

Surveys were sent via email to 3299 PCCs and 538 GIs. Up to two reminders were sent to nonresponders within a 21-day period. Surveys were completed by 779 PCCs (internal medicine n=403; family medicine n=376) and 159 GIs. The survey completion rate for PCCs was 25.3% and for GIs was 29.6%. All participants received remuneration for completing the survey; per the standard remuneration practices of Dynata, based on fair market compensation rates, PCCs received $39, whereas GIs received $51.

Analysis

All data were analyzed using SAS version 9.4. Respondents who indicated that they do not recommend CRC screening to their average-risk patients (n=5), and those who indicated no preference or a primary preference other than colonoscopy, mt-sDNA, FIT, or gFOBT, for average-risk patients (n=42), were excluded from further analyses because other screening options are rarely used in clinical practice and only a small percentage of all respondents selected each alternative modality (<1%).

Frequencies for provider and clinical practice characteristics were calculated and summarized separately for PCCs and GIs. Cross-tabulation with a χ^2 test was used to assess differences in CRC screening test preferences between PCCs and GIs by provider and clinical practice characteristics ($P<.05$). Separately for PCCs and GIs, CRC screening preference by patient characteristics was summarized as direct visualization modalities (eg, colonoscopy and flexible sigmoidoscopy) or noninvasive modalities (eg, stool-based tests and computed tomography colonography). Among PCCs, we conducted a multinomial regression analysis to evaluate provider characteristics (eg, board certification, clinical degree, and years in practice) and practice characteristics (eg, patient volume, clinical practice size, and rural/urban status) associated with CRC screening preference among stool-based tests (eg, FIT, gFOBT, and mt-sDNA), controlling for sociodemographic characteristics. Results of the multinomial model, presented as odds ratios (ORs) with 95% CIs, summarize the odds of preferring mt-sDNA over FIT and the odds of preferring mt-sDNA over gFOBT, separately.

RESULTS

Sociodemographic, Provider, and Practice Characteristics

As summarized in Table 1, most PCCs were aged 50 years or older (56.0%; 436/777), male (72.5%; 563/779), White, non-Hispanic (66.2%; 516/779), and earned $200,000 or more annually (57.4%; 447/779). Only three of the PCCs were advanced practice providers (eg, nurse practitioners or physician assistants) whereas the remaining were physicians. The majority of PCCs reported practicing medicine at least 20 years postresidency (52.4%; 408/779), working in clinics with fewer than 16 clinicians (73.4%; 572/779), and characterized their clinical practice as being in a suburban (54.6%; 425/779) or urban (32.0%; 249/779) location. The majority of PCCs reported seeing, on average, 20 or fewer patients per day (56.0%; 436/779).

Most GIs were younger than 50 years of age (52.2%; 83/159), male (82.9%; 131/158), White, non-Hispanic (55.4%; 88/159), and earned $200,000 or more annually (74.2%;

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TABLE 3. Primary Care Clinician Preference for Colonoscopy Over Stool-Based Tests for Average-Risk Patients by Sociodemographic and Clinical Characteristics

	Primary care clinicians,[a] n (%)		
	Prefer Stool-Based (N=189)	Prefer Colonoscopy (N=590)	*P*
Age in years			.6748
27-39	24 (12.7)	79 (13.4)	
40-49	58 (30.7)	182 (30.9)	
50-60	57 (30.2)	197 (33.4)	
>60	50 (26.5)	132 (22.4)	
Sex			.094
Male	128 (67.7)	435 (74.0)	
Female	61 (32.3)	153 (26.0)	
Race/ethnicity			.6466
White, non-Hispanic	123 (65.1)	393 (66.6)	
Black, non-Hispanic	4 (2.1)	12 (2.0)	
Hispanic	7 (3.7)	18 (3.05)	
Asian/Pacific Islander, non-Hispanic	50 (26.5)	135 (22.9)	
Other/Multiple Race, non-Hispanic	5 (2.7)	32 (5.4)	
Annual household income			.2227
Less than $74,999	11 (5.8)	30 (5.1)	
$75,000 to $124,999	27 (14.3)	68 (11.5)	
$125,000 to $174,999	35 (18.5)	78 (13.2)	
$175,000 to $199,999	20 (10.6)	63 (10.7)	
$200,000 or more	96 (50.8)	351 (59.5)	
Board certification			.4244
Internal medicine	93 (49.2)	310 (52.5)	
Family medicine	96 (50.8)	280 (47.5)	
Gastroenterology			
Number of years practicing medicine post-residency			.6252
0-9	22 (11.6)	90 (15.3)	
10-19	65 (34.4)	194 (32.9)	
20-29	64 (33.9)	200 (33.9)	
30+	38 (20.1)	106 (18.0)	
Average number of patients seen on typical day			.4753
0-15	31 (16.4)	125 (21.2)	
16-20	70 (37.0)	210 (35.6)	
21-25	49 (25.9)	132 (22.4)	
>25	39 (20.6)	123 (20.9)	
Number of clinicians in practice			.8830
0-15	138 (73.0)	434 (73.6)	
16+	51 (27.0)	156 (26.4)	
Characterization of clinical practice location			.6353
Urban	64 (33.9)	185 (31.4)	
Suburban	103 (54.5)	322 (54.6)	
Rural	22 (11.6)	83 (14.1)	

[a]Includes Internal Medicine and Family Medicine.

118/159). The majority of GIs reported practicing medicine fewer than 20 years postresidency (59.7%; 95/159), working in clinics with fewer than 16 clinicians (64.8%; 103/159), and characterized their clinical practice as being in an urban (50.9%; 81/159) or suburban (43.4%; 69/159) location. The majority of GIs reported seeing, on average, 20 or fewer patients per day (56.6%; 90/159).

TABLE 4. Health Care Provider Preference for CRC Screening Options by Specific Patient Characteristics (n=938)[a]

	Primary care clinicians (n=779) (N)			Gastroenterologists (n=159)		
	Prefer direct visualization modalities	Prefer noninvasive modalities	Prefer none of these methods	Prefer direct visualization modalities	Prefer noninvasive modalities	Prefer none of these methods
Patient characteristics/ needs						
Patient unable to undergo invasive procedure	73 (9.4)	689 (88.5)	17 (2.2)	22 (13.8)	126 (79.3)	11 (6.9)
Patient history of polyps	728 (93.5)	51 (6.6)	0	154 (96.9)	5 (3.1)	0
Patient aged 50	600 (77.0)	179 (23.0)	0	149 (93.7)	10 (6.3)	0
Patient aged 65 or older	586 (75.2)	191 (24.5)	2 (0.3)	149 (93.7)	9 (5.7)	1 (0.6)
Patient concerned about taking time away from work	186 (23.9)	593 (76.1)	0	68 (42.8)	90 (56.6)	1 (0.6)
Patient not convinced of need to get screened	151 (19.4)	609 (78.2)	19 (2.4)	69 (43.4)	78 (49.1)	12 (7.6)
Patient fears finding cancer	464 (59.6)	251 (32.2)	64 (8.2)	134 (84.3)	19 (12.0)	6 (3.8)
Patient is overweight	555 (71.3)	220 (28.2)	4 (0.5)	146 (91.8)	13 (8.2)	0
Patient has never been screened before	594 (76.3)	184 (23.6)	1 (0.1)	152 (95.6)	7 (4.4)	0
Patient has refused other screening recommendations	155 (19.9)	590 (75.7)	34 (4.4)	62 (39.0)	82 (51.6)	15 (9.4)

[a]Values are n (%).

CRC Screening Test Preference

Colonoscopy was selected as the preferred screening method for average-risk patients by both groups, with a significantly higher percentage of GIs (96.9%; 154/159) compared with PCCs (75.7%; 590/779) preferring colonoscopy (Table 2). Among PCCs, 12.2% (95/779) selected mt-sDNA as their second most preferred CRC screening test, followed by FIT (7.3%; 57/779) and gFOBT (4.8%; 37/779). Only 3.2% (5/159) of GIs selected a stool-based test as their preferred modality for their average-risk patients. Although PCCs overwhelmingly preferred colonoscopy over stool-based tests, no significant differences in preference for colonoscopy compared with stool-based tests were observed sociodemographic and clinical characteristics among PCCs (Table 3).

In general, CRC screening modality preference by patient characteristics mirrored their overall preference for average-risk patients among both PCCs and GIs (Table 4). However, preference shifted to stool-based or other noninvasive tests for patients unable to undergo an invasive procedure, patients with concerns about taking time away from work, patients not convinced of the need to get screened, and patients who have refused other screening recommendations.

The odds of preferring mt-sDNA over gFOBT did not differ significantly by clinician experience and practice characteristics with the exception of significantly lower likelihood of preference for mt-sDNA over gFOBT (OR=0.12; 95% CI=0.05 to 0.32) among HCPs in practices with 16 or more providers compared with smaller practices (Table 5). A similar pattern was observed in the likelihood of preferring mt-sDNA over FIT (OR, 0.15; 95% CI, 0.06 to 0.36). Preference for mt-sDNA over FIT was more likely among PCCs with 10 to 19 years of experience postresidency (OR, 3.91; 95% CI, 1.22 to 12.52) and those with 20 to 29 years of experience postresidency (OR, 4.76; 95% CI, 1.49 to 15.27) compared with those with fewer years of experience (Table 5). Preference for mt-sDNA over FIT was also more likely among PCCs who saw more than 25 patients per day (OR, 13.6; 95% CI, 2.55 to 72.63) compared with those who saw fewer patients. Finally, compared with clinicians in urban settings, PCCs in suburban (OR, 2.88; 95% CI, 1.35

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TABLE 5. Results of Multinomial Regression Model Evaluating Health Care Provider and Practice Characteristics Associated With CRC Screening Option Preference for Primary Care Clinicians (n=779)[a,b,c]

	Unadjusted		Adjusted[d]	
	Prefer mt-sDNA vs prefer gFOBT	Prefer mt-sDNA vs prefer FIT	Prefer mt-sDNA vs prefer gFOBT	Prefer mt-sDNA vs prefer FIT
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Number of years practicing medicine postresidency				
0-9	Reference	Reference	Reference	Reference
10-19	1.18 (0.29-4.76)	3.33 (1.07-10.43)	1.28 (0.31-5.26)	3.91 (1.22-12.52)
20-29	3.42 (0.78-14.92)	5.47 (1.74-17.17)	3.27 (0.74-14.47)	4.76 (1.49-15.27)
30+	1.50 (0.33-6.82)	3.00 (0.88-10.18)	1.27 (0.27-5.94)	2.06 (0.58-7.28)
Average number of patients seen on typical day				
0-15	Reference	Reference	Reference	Reference
16-20	2.78 (0.82-9.43)	1.53 (0.59-3.95)	3.26 (0.94-11.32)	1.57 (0.59-4.17)
21-25	1.33 (0.41-4.37)	1.81 (0.65-5.09)	1.49 (0.44-5.06)	1.69 (0.58-4.94)
>25	1.50 (0.46-4.90)	15.35 (2.96-79.66)	1.71 (0.51-5.81)	13.6 (2.55-72.63)
Number of clinicians in practice				
0-15	Reference	Reference	Reference	Reference
16+	0.11 (0.04-0.28)	0.14 (0.06-0.34)	0.12 (0.05-0.32)	0.15 (0.06-0.36)
Characterization of clinical practice location				
Urban	Reference	Reference	Reference	Reference
Suburban	2.46 (1.05-5.77)	3.29 (1.58-6.85)	2.38 (0.99-5.71)	2.88 (1.35-6.13)
Rural	3.00 (0.83-10.83)	11.6 (2.40-56.12)	2.33 (0.63-8.66)	9.72 (1.95-48.3)

[a]CRC, colorectal cancer; FIT, fecal immunochemical test; gFOBT, guaiac-based fecal occult blood test; mt-sDNA, multitarget stool DNA; OR, odds ratio.
[b]Values are OR (95% CI).
[c]Includes Internal Medicine and Family Medicine.
[d]Adjusted for age, sex, race, and income of provider.

to 6.13) and rural (OR, 9.72; 95% CI, 1.95 to 48.3) settings had a higher odds of preferring mt-sDNA over FIT (Table 5).

DISCUSSION

Results from our national survey of CRC screening knowledge, attitudes, and behaviors among practicing PCCs and GIs revealed that both groups selected colonoscopy as the preferred screening method for average-risk patients. Whereas nearly all GIs preferred colonoscopy, approximately one in four PCCs selected stool-based CRC screening tests as the preferred option for their average-risk patients, with mt-sDNA selected more than FIT and gFOBT combined. Furthermore, preference for colonoscopy versus stool-based tests did not differ significantly by clinician experience and clinical practice characteristics. These results reveal considerable homogeneity in CRC screening preferences among the HCP respondents, particularly GIs. Previous research has suggested that the common practice of recommending colonoscopy may actually reduce adherence to CRC screening, particularly among racial/ethnic minorities, and that offering stool-based screening or a choice of either stool-based screening or colonoscopy is associated with greater adherence.[14,22]

Although preference for CRC screening options by various patient characteristics largely mirrored the overall preference for colonoscopy among PCCs and GIs, preference shifted to stool-based tests for patients facing barriers to screening, including inability to undergo an invasive procedure, concerns about taking time away from work, uncertainty about the need to get screened, and refusal of other screening recommendations. The availability and recommendation of multiple CRC screening modalities with differences in effectiveness, cost, risk, and patient acceptability highlights the critical need for HCPs to provide patients with accurate

information about all available options to support informed choice and shared decision-making. Prior research has consistently shown that clinician recommendation is a key determinant of CRC screening.[10-12] Our findings suggest that, to some extent, clinicians are attentive to the CRC screening needs and preferences of their patients.

Interestingly, approximately one-quarter of PCCs in our study selected a stool-based test as their preferred CRC screening option, with mt-sDNA selected more frequently than either FIT or gFOBT. Although these data support PCC interest in a noninvasive screening strategy for many average-risk patients, screening colonoscopy remains the most frequently used colon cancer screening test and is considered the gold standard.[23] However, particularly as new CRC screening tests become available, further investigation is needed to clarify the practice, provider, and patient characteristics that influence overall and test-specific preferences and practices for CRC screening.

Study Limitations

Our cross-sectional survey design precludes the evaluation of causal associations. The survey relies upon self-report rather than observed or documented information (eg, medical records data). Finally, although consistent with declining and generally lower response rates of clinician surveys, our completion rate was limited for both PCCs and GIs, which may introduce selection bias.[24-26]

CONCLUSION

In our national survey of PCCs and GIs, colonoscopy was identified as the preferred CRC screening option for average-risk patients. However, approximately one-quarter of PCCs preferred stool-based tests, particularly mt-sDNA. Although few differences in preference by clinician experience and practice characteristics were observed, certain patient characteristics were associated with provider test preference (albeit without broad, discernible patterns). With the availability of multiple CRC screening options with distinct benefits and drawbacks related to effectiveness, cost, risk, and patient acceptability, it is critical to support informed choice and shared decision-making between patients and their providers.

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Abbreviations and Acronyms: **CRC,** colorectal cancer; **FIT,** fecal immunochemical test; **gFOBT,** guaiac-based fecal occult blood test; **HCP,** health care provider; **mt-sDNA,** multi-target stool DNA; **OR,** odds ratio; **PCC,** primary care clinician; **USPSTF,** United States Preventive Services Task Force

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REFERENCES

1. U.S. Cancer Statistics Working Group. United. States cancer statistics: 1999–2010 incidence and mortality web-based report. US Department of Health and Human Services, National Cancer Institute, Centers for Disease Control and Prevention. http://www.cdc.gov/uscs. Published 2013. Accessed January 15, 2016.

2. Klabunde CN, Joseph DA, King JB, White A, Plescia M. Vital Signs: Colorectal Cancer Screening Test Use — United States, 2012. *MMWR Morbid Mortal W*. 2013;62(44):881-888.
3. American Cancer Society. *Cancer Facts and Figures, 2016*. Atlanta, GA: American Cancer Society; 2016.
4. Davidson KW, Barry MJ, Mangione CM, et al. Screening for Colorectal Cancer: US Preventive Services Task Force Recommendation Statement. *JAMA*. 2021;325(19):1965-1977.
5. Office of Disease Prevention and Health Promotion. Healthy People 2020. U.S. Department of Health and HUman Services. https://www.healthypeople.gov/2020/data-search/Search-the-Data?nid=4054. Published 2016. Accessed July 6, 2016.
6. National Colorectal Cancer Roundtable. Working toward the shared goal of 80% screened for colorectal cancer by 2018. American Cancer Society. http://nccrt.org/what-we-do/80-percent-by-2018/. Published 2018. Accessed November 14, 2018.
7. Finney Rutten LJ, Nelson DE, Meissner HI. Examination of population-wide trends in barriers to cancer screening from a diffusion of innovation perspective (1987–2000). *Prev Med*. 2004;38(3):258-268.
8. Kistler CE, Hess TM, Howard K, et al. Older adults' preferences for colorectal cancer-screening test attributes and test choice. *Patient Prefer Adherence*. 2015;9:1005-1016.
9. Hawley ST, McQueen A, Bartholomew LK, et al. Preferences for colorectal cancer screening tests and screening test use in a large multispecialty primary care practice. *Cancer*. 2012;118(10):2726-2734.
10. Vernon SW. Participation in colorectal cancer screening: a review. *J Natl Cancer Inst*. 1997;89(19):1406-1422.
11. Cokkinides VE, Chao A, Smith RA, Vernon SW, Thun MJ. Correlates of underutilization of colorectal cancer screening among U.S. adults, age 50 years and older. *Prev Med*. 2003;36(1):85-91.
12. Zapka JG, Puleo E, Vickers-Lahti M, Luckmann R. Healthcare system factors and colorectal cancer screening. *Am J Prev Med*. 2002;23(1):28-35.
13. Schroy PC, Emmons K, Peters E, et al. The impact of a novel computer-based decision aid on shared decision making for colorectal cancer screening: a randomized trial. *Med Decis Making*. 2011;31(1):93-107.
14. Inadomi JM, Vijan S, Janz NK, et al. Adherence to colorectal cancer screening: a randomized clinical trial of competing strategies. *Arch Intern Med*. 2012;172(7):575-582.
15. Singal AG, Gupta S, Skinner CS, et al. Effect of colonoscopy outreach vs fecal immunochemical test outreach on colorectal cancer screening completion: a randomized clinical trial. *JAMA*. 2017;318(9):806-815.
16. Huijg JM, Gebhardt WA, Crone MR, Dusseldorp E, Presseau J. Discriminant content validity of a theoretical domains framework questionnaire for use in implementation research. *Implement Sci*. 2014;9:11.
17. Meissner HI, Klabunde CN, Breen N, Zapka JM. Breast and colorectal cancer screening: U.S. primary care physicians' reports of barriers. *Am J Prev Med*. 2012;43(6):584-589.
18. Klabunde CN, Vernon SW, Nadel MR, Breen N, Seeff LC, Brown ML. Barriers to colorectal cancer screening: a comparison of reports from primary care physicians and average-risk adults. *Med Care*. 2005;43(9):939-944.
19. Klabunde CN, Frame PS, Meadow A, Jones E, Nadel M, Vernon SW. A national survey of primary care physicians' colorectal cancer screening recommendations and practices. *Prev Med*. 2003;36(3):352-362.
20. National Opinion Research Center (NORC) at the University of Chicago. http://www.norc.org. Accessed April 10, 2020.
21. Dynata. https://www.dynata.com/?utm_medium=cpc&utm_source=google&utm_campaign=dynata&utm_content=searchdy. Published 2020. Accessed April 10, 2020.
22. Liang PS, Wheat CL, Abhat A, et al. Adherence to competing strategies for colorectal cancer screening over 3 years. *Am J Gastroenterol*. 2016;111(1):105-114.
23. Rex DK. Screening tests for colon cancer. *Gastroenterol Hepatol (N Y)*. 2016;12(3):197-199.
24. Asch DA, Jedrziewski MK, Christakis NA. Response rates to mail surveys published in medical journals. *J Clin Epidemiol*. 1997;50(10):1129-1136.
25. Asch S, Connor SE, Hamilton EG, Fox SA. Problems in recruiting community-based physicians for health services research. *J Gen Intern Med*. 2000;15(8):591-599.
26. McLeod CC, Klabunde CN, Willis GB, Stark D. Health care provider surveys in the United States, 2000–2010: a review. *Eval Health Prof*. 2013;36(1):106-126.