



Colorectal cancer screening at community health centers: A survey of clinicians' attitudes, practices, and perceived barriers

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ARTICLE INFO

Available online 21 September 2015

Keywords:

Primary care providers
Preventive medicine
Colorectal cancer screening
Healthcare disparities
Community health centers

ABSTRACT

Objective. Colorectal cancer (CRC) screening rates remain lower among some racial/ethnic groups and individuals with low income or educational attainment who are often cared for within community health centers (CHCs). We surveyed clinicians in a network of CHCs to understand their attitudes, practice patterns, and perceived barriers to CRC screening.

Methods. A clinician survey was conducted in 2013 within the Community Health Applied Research Network (CHARN).

Results. 180 clinicians completed the survey (47.9% response rate). Participants had an average of 11.5 (SD: 9.8) years in practice, 62% were female, and 57% were physicians. The majority of respondents somewhat agreed (30.2%) or strongly agreed (57.5%) that colonoscopy was the best screening test. However, only 15.8% of respondents strongly agreed and 32.2% somewhat agreed that colonoscopy was readily available for their patients. Fecal immunochemical testing (FIT), a type of fecal occult blood test (FOBT), was viewed less favorably; 24.6% rated FIT as very effective.

Conclusions. Although there are no data showing that screening colonoscopy is superior to FIT, CHC clinicians believe colonoscopy is the best CRC screening test for their patients, despite the high prevalence of financial barriers to colonoscopy. These attitudes could be due to lack of knowledge about the evidence supporting long-term benefits of fecal occult blood testing (FOBT), lack of awareness about the improved test characteristics of FIT compared to older guaiac-based FOBT, or the absence of systems to ensure adherence to regular FOBT screening. Interventions to improve CRC screening at CHCs must address clinicians' negative attitudes towards FIT.

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Introduction

The United States Preventive Services Task Force (USPSTF) recommends that average-risk adults age 50–75 be screened for colorectal cancer (CRC) using annual fecal occult blood testing (FOBT), flexible sigmoidoscopy every five years, or colonoscopy every ten years (USPSTF, 2008). Currently only 60–65% of the eligible US population is

up-to-date on CRC screening (Liss and Baker, 2014; Shapiro et al., 2012; CDC, 2013). Screening rates are considerably lower among Hispanics, Asians, individuals with low socioeconomic status, and the uninsured (Liss and Baker, 2014; Klabunde et al., 2011; Meissner et al., 2006; Holden et al., 2010).

Community health centers (CHC) can play an important role in addressing these disparities, and this has long been a high national priority for the Health Resources and Services Administration (HRSA), which requires reporting of CHC-level CRC screening rates (HRSA, 2012). However, achieving high screening rates within CHCs is challenging. We found that among CHCs participating in the Community Health

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Applied Research Network (CHARN), the median CRC screening rate was 31%, and the screening rate ranged from 10% to 67% (Baker et al., 2015). Most screenings were by colonoscopy, despite its cost. Only one of twelve participating CHCs had most screenings done by FOBT.

The heavy reliance on colonoscopy for CRC screening is consistent with national data showing that even among individuals living in poverty and those who are uninsured, the most common CRC screening test is colonoscopy (CDC, 2013). The overwhelming reliance on colonoscopy for CRC screening is contrary to the available evidence on the effectiveness of different CRC screening modalities. The Minnesota Colorectal Cancer Control Study randomized patients to no screening or annual guaiac-based FOBT screening (Mandel et al., 1993). Annual FOBT screening decreased CRC mortality by 33%. In contrast, no randomized controlled trial has examined the effect of colonoscopy on mortality. A recent nested case control study followed participants from the Nurses' Health Study and the Health Professionals Follow-up Study and found that those who had screening colonoscopy had a multivariate hazard ratio for death from CRC of 0.32 compared those who did not have any form of endoscopy (Nishihara et al., 2013). Thus, although there is evidence that colonoscopy reduces CRC mortality, there is no evidence that colonoscopy is more effective than FOBT, especially with the improved test performance characteristics of fecal immunochemical tests (FIT) compared to older guaiac-based FOBT. The USPSTF has not recommended one screening modality over another (Pignone et al., 2002; USPSTF, 2008). When patient preferences for screening modality are formally elicited, approximately equal numbers choose colonoscopy and FOBT (Hawley et al., 2008, 2012; DeBourcy et al., 2008). This has led some to suggest the "best" CRC screening modality is the one the patient completes (Woolf, 2000; Sarfaty et al., 2013).

Few previous studies have examined attitudes about CRC screening among clinicians caring for vulnerable populations (O'Malley et al., 2004; Haverkamp et al., 2011; Rim et al., 2009; Hatcher et al., 2011; Kelly et al., 2007), and we are not aware of any study reporting on clinician attitudes and CRC screening practices within a network of CHCs. There are possible challenges to achieving high rates of CRC screening at CHCs, including knowledge and attitudes towards screening (Berkowitz et al., 2008; Jun and Oh, 2013), inadequate time and resources to counsel patients (Yarnall et al., 2003), and a high prevalence of patients with barriers to endoscopy (Beydoun and Beydoun, 2008). There are also potential barriers to screening with FOBT, including the need for annual testing (Liss et al., 2013) and the need to complete diagnostic colonoscopy for those with positive results (Nadel et al., 2010). Consequently, some clinicians may not believe that FOBT is effective for many of their patients.

We conducted this study to understand CHC clinicians' perceptions of the importance of CRC screening relative to other preventive services, perceived effectiveness of different screening modalities, patient and system-level barriers to CRC screening, quality improvement (QI) and population health management methodologies used to improve CRC screening, and QI methodologies perceived to produce the greatest improvements in CRC screening. To accomplish this, we surveyed adult medicine clinicians at CHCs that were part of CHARN.

Methods

Study setting

Twelve CHCs in the CHARN network from around the country participated in this study: Near North Health Service Corporation, Erie Family Health Center, Heartland Health Outreach, Howard Brown Health Center, and PCC Community Wellness Center in Chicago, Illinois; North Country Healthcare in Flagstaff, Arizona; Fenway Health in Boston, Massachusetts; Beaufort Jasper Hampton Comprehensive Health Services in South Carolina; Chase Brexton Health Care in the Baltimore, Maryland area; Virginia Garcia Memorial Health Center in Hillsboro, Oregon; OHSU Richmond Family Medicine in Portland, Oregon; and Open Door

Community Health Centers in northern California. Participating CHCs serve a variety of vulnerable and historically underserved groups that reflect the geographic and cultural heterogeneity of CHARN, including (but not limited to) African Americans, Hispanics and Latinos, American Indians, the LGBT community, the uninsured and underinsured, and people living near or below the federal poverty level. All sites agreed to participate with the understanding that only aggregate data would be shared (i.e., no linkage to patient-level data) and screening rates would be reported anonymously. The Kaiser Permanente Center for Health Research houses the CHARN Data Coordinating Center (DCC). Study protocols were approved by the Institutional Review Board or internal research committee at all participating sites and organizations.

Survey instrument

CHARN created a CRC Screening Workgroup ("workgroup") with representatives from these participating health centers to identify ways to improve CRC screening rates. In 2012, the workgroup collaboratively developed the survey instrument. Many items were adapted from previous provider surveys about CRC screening (Hoffman et al., 2011; Klabunde et al., 2003, 2009). In addition, the survey included items aimed at understanding barriers and facilitators to screening within the CHC environment specifically.

The DCC created a web-based survey and corresponding data collection/tracking systems using SURVEYGEN software. The survey instrument was pilot tested by study authors and minor revisions were made to improve survey clarity and flow. The survey contained 32 items and took approximately 10 minutes to complete. The survey had five main domains: (1) perceived importance of CRC screening relative to other preventive services; (2) perceived effectiveness of different CRC screening modalities; (3) usual CRC screening practices; (4) perceived barriers to screening; and, (5) beliefs about the effectiveness of strategies to improve screening. We specified that all items referred to screening procedures to reduce CRC mortality in average-risk patients 50 years and older. Based on current USPSTF recommendations, (2008) the survey included items regarding FOBT, flexible sigmoidoscopy, and colonoscopy. For items relating to FOBT, we specified whether we were referring to FOBT (any method or test) or specifically to guaiac-based FOBT or fecal immunochemical tests (FIT).

Survey administration

All primary care clinicians (physicians, advanced practice nurses, and physician assistants) at participating CHCs who cared for adult patients age 50 and older were invited to participate. A site champion at each CHC identified eligible clinicians at their site and shared clinicians' email addresses with the CHARN DCC.

The online survey was administered in April–June 2013. Shortly following the site champion's study introduction email, automated recruitment emails were sent to all eligible clinicians. Each email contained a unique survey hyperlink to track survey completion. The survey did not ask for any identifying information. Two weeks after this initial invitation, the site champion sent a general reminder email and DCC resent recruitment emails to clinicians who had not yet responded. A final reminder was sent four weeks following initial invitation. Following a poor response to the online survey, one health center also included a paper-based survey completion option. Participants were emailed a \$5 e-gift card within a week of survey completion. The CHARN DCC matched each completed survey back to each participant's CHC. The study team was blind to CHC identity.

Statistical analysis

We calculated descriptive statistics to summarize provider characteristics, beliefs about CRC screening and screening practice patterns.

Missing data ranged from 0–2% across survey items. Analyses were stratified by provider type (e.g., MD vs. other) and CHC site. All analyses were done using SAS V 9.3 (SAS Institute Inc., NC, USA).

Results

Of 376 eligible clinicians, 180 participated in the survey (response rate 47.9%). The response rate varied between 17–80% by site (AAPOR, 2011). Participants had an average of 11.5 (SD: 9.8) years in practice, saw a mean of 58.5 (SD: 23.7) patients each week, 62% were female, and 57% were MDs.

CRC screening importance

The majority of clinicians thought CRC screening was as or more important than other preventive services. Most clinicians said CRC screening was *as important as breast and cervical cancer screening* (73.3% for both screenings); of the remaining 26.7%, approximately equal numbers rated CRC screening as *less important or more important*. Approximately half (47.7%) said CRC screening was *more important* than Tdap immunization, and 39.4% said it was *more important* than pneumococcal vaccination for patients age ≥ 65 . Conversely, 44.3% said smoking cessation counseling was *more important* than CRC screening.

Self-reported rates of CRC screening recommendations

Participants reported that they recommend CRC screening to the majority of eligible patients; 63.3% said that they recommended screening to over 75% of eligible patients, and 21.7% reported advising 51–75% of eligible patients. Of note, most clinicians reported that a markedly lower percentage of their patients are actually up-to-date on CRC screening; 29.4% reported 26–50% of patients are up-to-date; 37.2% reported 51–75% are up-to-date, and; 7.2% reported greater than 75% were up-to-date. The most common screening modality recommended was colonoscopy; 37% reported they recommend colonoscopy without discussing other modalities.

Perceptions of CRC screening modalities

Table 1 shows clinicians' perceptions of each screening modality's effectiveness. The vast majority (92.7%) believed that colonoscopy is very effective. Far fewer reported FIT and flexible sigmoidoscopy as very effective (24.6% and 24.0% respectively). Less than 10% of participants reported guaiac-based FOBT as very effective, though only 12.8% reported it as not effective. Of note, 15.6% of participants responded "don't know" for FIT, far more than any other modality. When asked specifically about *in-office* FOBT, over one-fourth of respondents said this was a somewhat effective screening strategy. Perceptions of screening modality varied by provider type (MD vs. other provider); physicians believed guaiac-based FOBT and FIT to be more effective than other clinicians.

The overwhelming majority somewhat agreed (30.2%) or strongly agreed (57.5%) that colonoscopy was the best screening test (Table 2). This finding was consistent across all sites, and did not significantly

differ by provider type. Respondents reported numerous patient-level barriers to colonoscopy. Only 15.8% strongly agreed and 32.2% somewhat agreed that colonoscopy was readily available for their patients. Lack of insurance or inadequate insurance was commonly mentioned as a barrier to colonoscopy; 75% of participants said this was sometimes or usually a barrier to screening colonoscopy and 47.2% reported this was sometimes or usually a barrier to diagnostic colonoscopy. Only 13.9% reported that a shortage of local endoscopists was sometimes or usually a barrier to screening colonoscopy.

Perceived patient knowledge and attitude barriers to CRC screening

Clinicians reported that patients' knowledge and attitudes about CRC screening were often barriers (Table 3), including patients not perceiving CRC as a serious health threat, lack of awareness of CRC screening, lack of desire to discuss CRC screening, and difficulty understanding the information clinicians present about CRC screening. However, these perceived patient barriers did not affect most clinicians' screening practices; only 8.6% said they sometimes or usually did not order a CRC screening test because they thought a patient was unlikely to complete it.

Strategies being used to facilitate CRC screening

System-level supports for CRC screening were available to a minority of respondents (Table 4). Approximately one third (36.9%) received regular quality reports on their screening rates. Patient education about CRC screening was done mostly by clinicians (96.1%). Only 44.4% of respondents said that staff conduct patient education, and 32% mail letters to patients. Most clinicians (89.2%) reported availability of health maintenance flow sheets in their electronic health record (EHR) that could be reviewed to determine patients' screening status. However, only 37.3% reported having EHR alerts to remind them that a patient being seen is due for CRC screening. Approximately one third (30.5%) reported their practice has a mechanism to offer screening without their direct involvement; the most common mechanism was distribution of FOBT kits by clinic staff.

Strategies to facilitate completion of home FOBTs

A total of 152 respondents (84.4%) said they give patients FOBTs to complete at home. Among these respondents, only 29 (19.1%) reported they had mechanisms to ensure patients returned completed FOBTs, including reminder calls (7.2%), mailed reminders (4.6%), chart reminders for next visit (8.6%), or other mechanisms (3.9%). Only 62 (40.8%) reported having a mechanism to ensure patients with positive FOBT results completed follow-up diagnostic colonoscopy; the most common mechanisms included telephone calls (23.7%), tracking or scheduling systems (21.1%), and mailed reminders (13.2%).

Perceived helpfulness of interventions

When asked about perceived helpfulness of potential interventions to improve CRC screening, the majority responded it would be

Table 1
Perceptions of CRC screening modality effectiveness^a.

	Very effective n (%)	Somewhat Effective n (%)	Not effective n (%)	Don't know n (%)
Guaiac-based FOBT ^b	16 (8.9)	135 (75.4)	23 (12.8)	5 (2.8)
Immunochemical FOBT (FIT)	44 (24.6)	101 (56.4)	6 (3.4)	28 (15.6)
Flexible Sigmoidoscopy	43 (24.0)	126 (70.4)	7 (3.9)	3 (1.7)
Colonoscopy	166 (92.7)	13 (7.3)	0	0
In-office FOBT	0	48 (26.8)	125 (69.8)	6 (3.4)

^a A total of 179 participants completed these items. One skipped all items in this section.

^b FOBT = fecal occult blood test; FIT = fecal immunochemical test.

Table 2
Provider perceptions about screening colonoscopy^a.

	Strongly disagree n (%)	Somewhat disagree n (%)	Somewhat agree n (%)	Strongly agree n (%)
It is the best screening test (n = 179)	4 (2.2)	18 (10.1)	54 (30.2)	103 (57.5)
It is readily available for my patients (n = 177)	40 (22.6)	52 (29.4)	57 (32.2)	28 (15.8)
It is available, but many of my patients face financial barriers to screening colonoscopy (n = 178)	13 (7.3)	18 (10.1)	63 (35.4)	84 (47.2)
I worry that I might be sued if I do not offer this test to my patients (n = 178)	67 (37.6)	65 (36.5)	38 (21.3)	8 (4.5)

^a Some of the 180 respondents did not complete one or more of these questions. The actual number of respondents is shown in parentheses.

somewhat or very helpful to implement an EHR alert to notify staff (93.7%) and clinicians (87.9%) of which patients need screening (Table 5). Improving access to diagnostic colonoscopy was reported as somewhat or very helpful by 147 clinicians (84.5%). Only 57.1% said that mailing FOBTs to patients would be somewhat or very helpful.

Discussion

This study provides important information about attitudes of CHC clinicians regarding CRC screening. Respondents overwhelmingly believe that colonoscopy is the best CRC screening modality, which is consistent with previous reports across a variety of settings (Hoffman et al., 2011; Klabunde et al., 2003, 2009; Hawley et al., 2001; Guerra et al., 2007; Levy et al., 2007; Nichols et al., 2009; Feeley et al., 2009). This perception among providers is probably a major reason why colonoscopy is the predominant screening modality across the U.S. and the CHARN CHC network. The reasons why clinicians hold colonoscopy in such high regard are unclear. Randomized controlled studies have shown that guaiac-based FOBT screening substantially reduces CRC mortality (Mandel et al., 1993), while screening colonoscopy has not been studied as rigorously. It may seem intuitive that a visual inspection of the colon would be a better test than FOBT, but recent studies have shown wide variability in the quality of colonoscopy based on adenoma detection rates (Corley et al., 2014). In addition, FOBT has greatly improved with the introduction of FIT, which has better test characteristics than older guaiac-based tests (Lee et al., 2014). There is no evidence that colonoscopy is more effective than FOBT, although studies are underway. Efforts are needed to provide physicians with a more accurate picture of CRC screening options.

Clinicians' belief in colonoscopy as the gold standard is juxtaposed against the high level of access barriers to colonoscopy reported by many CHC clinicians. Unless the Affordable Care Act initiates dramatic growth in CHC patients' access to colonoscopy, substantially increasing colonoscopy use among CHC patients will be difficult. CHCs may be able to reduce colonoscopy access barriers by developing networks of gastroenterology specialists to provide free colonoscopies (including costs of biopsy pathology and polyp removal) or through creation of

Table 3
Perceived patient knowledge and attitude barriers to CRC screening^a.

	Report encountering barrier "Sometimes" or "Usually" n (%)
My patients do not perceive colorectal cancer as a serious health threat. (n = 175)	141 (80.6)
My patients are unaware of colorectal cancer screening (n = 177)	102 (57.6)
My patients do not want to discuss colorectal screening (n = 177)	82 (46.3)
My patients have difficulty understanding the information I present about colorectal cancer screening (n = 174)	79 (45.4)
You do not order a CRC screening test because you think the patient is unlikely to complete test. (n = 175)	15 (8.6)

^a Some of the 180 respondents did not complete one or more of these questions. The actual number of respondents is shown in parentheses.

state or local programs to provide financial support for screening colonoscopy.

Given the reported barriers to colonoscopy, and the difficulty of overcoming these barriers for the majority of CHC patients, wider FOBT use is likely the most practical solution to improving CRC screening rates among CHC patients. However, there are multiple challenges. Most survey participants do not think FOBT is very effective, even when FIT is used. Also, over a quarter of them thought that in-office FOBT (e.g., following a rectal exam) is somewhat effective for screening, in contrast to current recommendations (Collins et al., 2005). It is possible some clinicians think in-office FOBT is better than no screening at all for patients with barriers to other modalities. Thus, efforts are needed to educate clinicians about proper FOBT use, especially with regard to improved accuracy and convenience of FITs. Even if most clinicians still think colonoscopy is most effective, they should understand that FOBT is a reasonable alternative if preferred by the patient or if colonoscopy is unavailable. However, for screening with FOBT to reduce CRC mortality, CHCs will need to implement programs that ensure high adherence to annual FOBT and, among patients with positive tests, high rates of diagnostic colonoscopy. Currently, many clinicians do not have these programs in place.

Our findings highlight the need for CHCs to have system-level approaches to educating patients about CRC screening. In addition to reporting numerous financial barriers to screening, clinicians also report perceived patient barriers such as lack of awareness of the need for screening, and the majority lack systems to educate patients outside of provider discussions. These barriers place a large burden on CHC clinicians to educate patients about their CRC risk, the importance of screening, and available screening options. It may also be beneficial

Table 4
Facilitators to CRC screening^a.

	n (%)
<i>Regularly receives quality reports on CRC screening, (n = 179)</i>	66 (36.9)
<i>Currently uses the following strategies to educate patients about CRC screening: (n = 178)</i>	
Posters/brochures in waiting room	43 (24.2)
Brochures given to patients	21 (11.8)
Clinicians discuss screening with patients	171 (96.1)
Staff discuss screening with patients	79 (44.4)
Electronic media in waiting room	5 (2.8)
Letters mailed to patients	57 (32.0)
Other	3 (1.7)
None of the above	2 (1.1)
<i>Have access to the following to remind me who is due for CRC screening:</i>	
Health maintenance flow sheet (n = 176)	157 (89.2)
Alert or prompt in electronic health record (n = 177)	66 (37.3)
Staff reviews patient record and notifies me (n = 177)	68 (38.4)
Other (n = 177)	9 (5.1)
None (n = 177)	3 (1.7)
Practice has a mechanism to offer screening w/o my direct involvement (e.g., MAs give out FOBTs, standing orders) (n = 177)	54 (30.5)
Medical assistant or other staff hands out an FOBT kit	40 (22.6)
Standing orders to refer for endoscopy	5 (2.8)
Other	10 (5.6)

^a Some of the 180 respondents did not complete one or more of these questions. The actual number of respondents is shown in parentheses.

Table 5
Perceived helpfulness of interventions to increase CRC screening rates^a.

	Report intervention would be "somewhat" or "very" helpful, n (%)
Implement EHR alert to notify staff which patients need screening (n = 174)	163 (93.7)
Implement EHR alert to notify clinicians which patients need screening (n = 174)	153 (87.9)
Improve access to diagnostic colonoscopy for patients with a positive FOBT (n = 174)	147 (84.5)
Generate a list of patients coming in each day who need screening (n = 175)	136 (77.7)
Mail FOBT test kits to patients who are due for screening (n = 175)	100 (57.1)

^a Some of the 180 respondents did not complete one or more of these questions. The actual number of respondents is shown in parentheses.

for communities to launch educational initiatives so patients are exposed to CRC screening messages prior to clinician encounters. These initiatives may help establish CRC screening as a social norm so patients are more likely to accept clinicians' screening recommendations.

In previous studies, clinicians have reported perceived patient barriers more often affect CRC screening than system-level barriers (Hoffman et al., 2011; Hawley et al., 2001; Klabunde et al., 2005). The most commonly reported perceived patient barrier is concern regarding patient compliance or the belief that patients are unlikely to complete screening (Hawley et al., 2001; Zapka et al., 2011; Dulai et al., 2004; Sewitch et al., 2006). Clinicians in our study claim that patient barriers do not affect practice and most believe they recommend CRC screening to the vast majority of eligible patients. However, these perceived patient barriers could subtly influence provider recommendations. For example, it may be difficult to annually motivate patients to complete FOBT if clinicians know many patients struggle to adhere to this recommendation, and when organizational supports are less than ideal.

Our study has several limitations. The response rate was 47%, and respondents could be more likely than other clinicians to believe in CRC screening's importance. We had no data on non-responders' individual characteristics, so we cannot assess how they differed from respondents. One major limitation is our inability to match respondents' estimated CRC screening adherence rates to their actual screening rates. Clinicians probably overestimate how often they offer CRC screening to patients. Finally, we did not survey patients. The perceived barriers reported by clinicians could differ substantially from the actual barriers reported by patients. However, our interest was in clinician's perceptions and how that might affect their delivery of CRC screening.

This study provides insight regarding CHC clinician perspectives on CRC screening. The twelve participating sites are geographically diverse and have unique patient populations. Additionally, inclusion of non-MD clinicians in our sample is a strength, given that CHCs are relying more on team-based care, in accordance with recommended strategies to improve overall screening rates (Klabunde et al., 2007). It is therefore important to understand non-MD clinicians' perspectives and practice patterns.

This study has several important implications. Results highlight the need to address patient, provider, and system-level barriers to CRC screening. First, educational efforts are needed to inform CHC clinicians about the 18–33% reduction in CRC mortality that have been achieved with FOBT in randomized controlled trials (Mandel et al., 1993; Kronborg et al., 1996), advantages of newer FITs (Vart et al., 2012; Liles et al., 2012), and successful strategies to increase adherence to CRC screening using FIT among patients at CHCs. Second, nationwide programs are needed to help CHCs implement successful strategies to improve CRC screening, including point-of-care electronic reminders, patient reminders, outreach programs, and access to screening colonoscopy. Care management programs to navigate patients with positive FOBTs to diagnostic colonoscopy are also critical, as is funding to reduce

financial barriers to both colonoscopy and pathology tests to evaluate biopsy specimens. This is an opportune time to augment efforts to improve CRC screening at CHCs given HRSA's requirement that CHCs publicly report their CRC screening rates (HRSA, 2012) and the likelihood that CRC screening will be a major QI target at many CHCs.

Conflict of interest

The authors declare that there are no conflicts of interests.

Acknowledgments

Funding support was provided by the Health Resources and Services Administration (#UB3HA20236) and by the Agency for Healthcare Research and Quality (#P01HS21141). The sponsors had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the article for publication. The authors gratefully acknowledge the members of CHARN's community health centers, research node centers, and data coordinating center for their support throughout this project and the preparation of this article.

References

- AAPOR, 2011. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. The American Association for Public Opinion Research 7th ed.
- Baker, D.W., Liss, D.T., Alperovitz-Bichell, K., Brown, T., Carroll, J.E., Crawford, P., Harigopal, P., Henley, E., Nelson, C.A., Rittner, S.S., 2015. Colorectal cancer screening rates at community health centers that use electronic health records: a cross sectional study. *J. Health Care Poor Underserved* 26, 377–390.
- Berkowitz, Z., Hawkins, N.A., Peipins, L.A., White, M.C., Nadel, M.R., 2008. Beliefs, risk perceptions, and gaps in knowledge as barriers to colorectal cancer screening in older adults. *J. Am. Geriatr. Soc.* 56, 307–314.
- Beydoun, H.A., Beydoun, M.A., 2008. Predictors of colorectal cancer screening behaviors among average-risk older adults in the United States. *Cancer Causes Control* 19, 339–359.
- Centers for Disease Control and Prevention (CDC), 2013. *Vital signs: colorectal cancer screening test use—United States, 2012*. *Morb. Mortal. Wkly Rep.* 62, 881–888.
- Collins, J.F., Lieberman, D.A., Durbin, T.E., Weiss, D.G., 2005. Accuracy of screening for fecal occult blood on a single stool sample obtained by digital rectal examination: a comparison with recommended sampling practice. *Ann. Intern. Med.* 142, 81–85.
- Corley, D.A., Jensen, C.D., Marks, A.R., Zhao, W.K., Lee, J.K., Doubeni, C.A., Zauber, A.G., De Boer, J., Fireman, B.H., Schottinger, J.E., Quinn, V.P., Ghai, N.R., Levin, T.R., Quesenberry, C.P., 2014. Adenoma detection rate and risk of colorectal cancer and death. *N. Engl. J. Med.* 370, 1298–1306.
- Debourcy, A.C., Lichtenberger, S., Felton, S., Butterfield, K.T., Ahnen, D.J., Denberg, T.D., 2008. Community-based preferences for stool cards versus colonoscopy in colorectal cancer screening. *J. Gen. Intern. Med.* 23, 169–174.
- Dulai, G.S., Farmer, M.M., Ganz, P.A., Bernaards, C.A., Qi, K., Dietrich, A.J., Bastani, R., Belman, M.J., Kahn, K.L., 2004. Primary care provider perceptions of barriers to and facilitators of colorectal cancer screening in a managed care setting. *Cancer* 100, 1843–1852.
- Feeley, T.H., Cooper, J., Foels, T., Mahoney, M.C., 2009. Efficacy expectations for colorectal cancer screening in primary care: identifying barriers and facilitators for patients and clinicians. *Health Commun.* 24, 304–315.
- Guerra, C.E., Schwartz, J.S., Armstrong, K., Brown, J.S., Halbert, C.H., Shea, J.A., 2007. Barriers of and facilitators to physician recommendation of colorectal cancer screening. *J. Gen. Intern. Med.* 22, 1681–1688.
- Hatcher, J., Dignan, M.B., Schoenberg, N., 2011. How do rural health care providers and patients view barriers to colorectal cancer screening? Insights from Appalachian Kentucky. *Nurs. Clin. N. Am.* 46, 181–192 (vi).
- Haverkamp, D., Perdue, D.G., Espey, D., Cobb, N., 2011. A survey of Indian Health Service and tribal health providers' colorectal cancer screening knowledge, perceptions, and practices. *J. Health Care Poor Underserved* 22, 243–257.
- Hawley, S.T., Levin, B., Vernon, S.W., 2001. Colorectal cancer screening by primary care physicians in two medical care organizations. *Cancer Detect. Prev.* 25, 309–318.
- Hawley, S.T., Volk, R.J., Krishnamurthy, P., Jibaja-Weiss, M., Vernon, S.W., Kneuper, S., 2008. Preferences for colorectal cancer screening among racially/ethnically diverse primary care patients. *Med. Care* 46, S10–S16.
- Hawley, S.T., McQueen, A., Bartholomew, L.K., Greisinger, A.J., Coan, S.P., Myers, R., Vernon, S.W., 2012. Preferences for colorectal cancer screening tests and screening test use in a large multispecialty primary care practice. *Cancer* 118, 2726–2734.
- Hoffman, R.M., Rhyne, R.L., Helitzer, D.L., Stone, S.N., Sussman, A.L., Bruggeman, E.E., Viera, R., Warner, T.D., 2011. Barriers to colorectal cancer screening: physician and general population perspectives, New Mexico, 2006. *Prev. Chronic Dis.* 8, A35.
- Holden, D.J., Jonas, D.E., Porterfield, D.S., Reuland, D., Harris, R., 2010. Systematic review: enhancing the use and quality of colorectal cancer screening. *Ann. Intern. Med.* 152, 668–676.

- Hrsa, 2012. Approved Uniform Data System Changes for 2012: Program Assistance Letter 2012–03. Health Services and Research Administration, Rockville, MD.
- Jun, J., Oh, K.M., 2013. Asian and Hispanic Americans' cancer fatalism and colon cancer screening. *Am. J. Health Behav.* 37, 145–154.
- Kelly, K.M., Phillips, C.M., Jenkins, C., Norling, G., White, C., Jenkins, T., Armstrong, D., Petrik, J., Steinkuhl, A., Washington, R., Dignan, M., 2007. Physician and staff perceptions of barriers to colorectal cancer screening in Appalachian Kentucky. *Cancer Control* 14, 167–175.
- Klabunde, C.N., Frame, P.S., Meadow, A., Jones, E., Nadel, M., Vernon, S.W., 2003. A national survey of primary care physicians' colorectal cancer screening recommendations and practices. *Prev. Med.* 36, 352–362.
- Klabunde, C.N., Vernon, S.W., Nadel, M.R., Breen, N., Seeff, L.C., Brown, M.L., 2005. Barriers to colorectal cancer screening: a comparison of reports from primary care physicians and average-risk adults. *Med. Care* 43, 939–944.
- Klabunde, C.N., Lanier, D., Breslau, E.S., Zapka, J.G., Fletcher, R.H., Ransohoff, D.F., Winawer, S.J., 2007. Improving colorectal cancer screening in primary care practice: innovative strategies and future directions. *J. Gen. Intern. Med.* 22, 1195–1205.
- Klabunde, C.N., Lanier, D., Nadel, M.R., McLeod, C., Yuan, G., Vernon, S.W., 2009. Colorectal cancer screening by primary care physicians: recommendations and practices, 2006–2007. *Am. J. Prev. Med.* 37, 8–16.
- KLABUNDE, C.N., CRONIN, K.A., BREEN, N., WALDRON, W.R., AMBS, A.H., NADEL, M.R., 2011. Trends in colorectal cancer test use among vulnerable populations in the United States. *Cancer Epidemiol. Biomark. Prev.* 20, 1611–1621.
- Kronborg, O., Fenger, C., Olsen, J., Jorgensen, O.D., Sondergaard, O., 1996. Randomised study of screening for colorectal cancer with faecal-occult-blood test. *Lancet* 348, 1467–1471.
- Lee, J.K., Liles, E.G., Bent, S., Levin, T.R., Corley, D.A., 2014. Accuracy of fecal immunochemical tests for colorectal cancer: systematic review and meta-analysis. *Ann. Intern. Med.* 160, 171–181.
- Levy, B.T., Nordin, T., Sinift, S., Rosenbaum, M., James, P.A., 2007. Why hasn't this patient been screened for colon cancer? An Iowa Research Network study. *J. Am. Board Fam. Med.* 20, 458–468.
- Liles, E.G., Perrin, N., Rosales, A.G., Feldstein, A.C., Smith, D.H., Mosen, D.M., Schneider, J.L., 2012. Change to FIT increased CRC screening rates: evaluation of a US screening outreach program. *Am. J. Manag. Care* 18, 588–595.
- Liss, D.T., Baker, D.W., 2014. Understanding current racial/ethnic disparities in colorectal cancer screening in the United States: the contribution of socioeconomic status and access to care. *Am. J. Prev. Med.* 46, 228–236.
- Liss, D.T., Petit-Homme, A., Feinglass, J., Buchanan, D.R., Baker, D.W., 2013. Adherence to repeat fecal occult blood testing in an urban community health center network. *J. Community Health* 38, 829–833.
- Mandel, J.S., Bond, J.H., Church, T.R., Snover, D.C., Bradley, G.M., Schuman, L.M., Ederer, F., 1993. Reducing mortality from colorectal cancer by screening for fecal occult blood. Minnesota Colon Cancer Control Study. *N. Engl. J. Med.* 328, 1365–1371.
- Meissner, H.J., Breen, N., Klabunde, C.N., Vernon, S.W., 2006. Patterns of colorectal cancer screening uptake among men and women in the United States. *Cancer Epidemiol. Biomark. Prev.* 15, 389–394.
- Nadel, M.R., Berkowitz, Z., Klabunde, C.N., Smith, R.A., Coughlin, S.S., White, M.C., 2010. Fecal occult blood testing beliefs and practices of U.S. primary care physicians: serious deviations from evidence-based recommendations. *J. Gen. Intern. Med.* 25, 833–839.
- Nichols, C., Holt, C.L., Shipp, M., Eloubeidi, M., Fouad, M.N., Britt, K., 2009. Physician knowledge, perceptions of barriers, and patient colorectal cancer screening practices. *Am. J. Med. Qual.* 24, 116–122.
- Nishihara, R., Wu, K., Lochhead, P., Morikawa, T., Liao, X., Qian, J.R., Inamura, K., Kim, S.A., Kuchiba, A., Yamauchi, M., Imamura, Y., Willett, W.C., Rosner, B.A., Fuchs, C.S., Giovannucci, E., Ogino, S., Chan, A.T., 2013. Long-term colorectal-cancer incidence and mortality after lower endoscopy. *N. Engl. J. Med.* 369, 1095–1105.
- O'Malley, A.S., Beaton, E., Yabroff, K.R., Abramson, R., Mandelblatt, J., 2004. Patient and provider barriers to colorectal cancer screening in the primary care safety-net. *Prev. Med.* 39, 56–63.
- Pignone, M., Rich, M., Teutsch, S.M., Berg, A.O., Lohr, K.N., 2002. Screening for colorectal cancer in adults at average risk: a summary of the evidence for the U.S. Preventive Services Task Force. *Ann. Intern. Med.* 137, 132–141.
- Rim, S.H., Zittleman, L., Westfall, J.M., Overholser, L., Froshaug, D., Coughlin, S.S., 2009. Knowledge, attitudes, beliefs, and personal practices regarding colorectal cancer screening among health care professionals in rural Colorado: a pilot survey. *J. Rural. Health* 25, 303–308.
- Sarfaty, M., Doroshenk, M., Hotz, J., Brooks, D., Hayashi, S., Davis, T.C., Joseph, D., Stevens, D., Weaver, D.L., Potter, M.B., Wender, R., 2013. Strategies for expanding colorectal cancer screening at community health centers. *CA Cancer J. Clin.* 63, 221–231.
- Sewitch, M.J., Burtin, P., Dawes, M., Yaffe, M., Snell, L., Roper, M., Zanelli, P., Pavilanis, A., 2006. Colorectal cancer screening: physicians' knowledge of risk assessment and guidelines, practice, and description of barriers and facilitators. *Can. J. Gastroenterol.* 20, 713–718.
- Shapiro, J.A., Klabunde, C.N., Thompson, T.D., Nadel, M.R., Seeff, L.C., White, A., 2012. Patterns of colorectal cancer test use, including CT colonography, in the 2010 National Health Interview Survey. *Cancer Epidemiol. Biomark. Prev.* 21, 895–904.
- Uspstf, 2008. Screening for colorectal cancer: U.S. Preventive Services Task Force recommendation statement. *Ann. Intern. Med.* 149, 627–637.
- Vart, G., Banzi, R., Minozzi, S., 2012. Comparing participation rates between immunochemical and guaiac faecal occult blood tests: a systematic review and meta-analysis. *Prev. Med.* 55, 87–92.
- Woolf, S.H., 2000. The best screening test for colorectal cancer – a personal choice. *N. Engl. J. Med.* 343, 1641–1643.
- Yarnall, K.S., Pollak, K.I., Ostbye, T., Krause, K.M., Michener, J.L., 2003. Primary care: is there enough time for prevention? *Am. J. Public Health* 93, 635–641.
- Zapka, J.M., Klabunde, C.N., Arora, N.K., Yuan, G., Smith, J.L., Kobrin, S.C., 2011. Physicians' colorectal cancer screening discussion and recommendation patterns. *Cancer Epidemiol. Biomark. Prev.* 20, 509–521.