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Testing Interventions to Motivate and Educate (TIME): A multi-level intervention to improve colorectal cancer screening☆

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ABSTRACT

Objective. To test the effectiveness of a colorectal cancer (CRC) screening intervention directed at three levels (clinic, provider, patient) in a primary care setting.

Method. We conducted a group randomized trial (Clinical Trials registration no. NCT01568151) among 10 primary care clinics in Columbus, Ohio that were randomized to a study condition (intervention or usual care). We determined the effect of a multi-level, stepped behavioral intervention on receipt of a CRC screening test among average-risk patients from these clinics over the study period.

Results. Patients (n = 527) who were outside of CRC screening recommendations were recruited. Overall, 35.4% of participants in the intervention clinics had received CRC screening by the end of the study compared to 35.1% of participants who were in the usual care clinics. Time to CRC screening was also similar across arms (HR = 0.97, 95% CI = 0.65–1.45).

Conclusion. The multi-level intervention was not effective in increasing CRC screening among participants who needed a test, perhaps due to low participation of patients in the stepped intervention. Future studies utilizing evidence-based strategies to encourage CRC screening are needed.

Introduction

Recent national data indicate that only 65% of United States (U.S.) residents are within the recommended colorectal cancer (CRC) screening guidelines (Steele et al., 2013). Current guidelines by the U.S. Preventive Services Task Force (USPSTF) recommend adults ages 50–75 complete either an annual fecal occult blood test (FOBT), a flexible sigmoidoscopy every five years combined with FOBT every three years, or a colonoscopy every 10 years (Levin et al., 2008).

CRC screening barriers are complex and occur at the patient, provider, and system levels. Interventions aimed at one level have resulted in limited improvement in CRC screening (Ferreira et al., 2005; Hoffman et al., 2011; Katz et al., 2012). Interventions that target multiple levels may be more effective since individuals respond differently to various intervention strategies. Further, it may be ideal to implement interventions that introduce increasingly intensive components to less motivated individuals over time, as opposed to intervention components with equal intensity that are delivered once to all participants. However, few studies have tested this approach (Christy et al., 2013; Fleisher et al., 2012; Holden et al., 2010).

The study goal was to test the effectiveness of a stepped CRC screening intervention directed at three levels (clinic, provider, patient) in a primary care setting. In addition, we conducted a process evaluation to provide information that may be useful for designing future CRC screening interventions.

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Methods

Study design

The study employed a group randomized trial design. Medical clinics were randomized to conditions (intervention or control), and individual patients and providers from each clinic were followed over time to assess the effect of the multi-level intervention. Study details (including sample size and power calculations) have been previously published (Murray et al., 2013); however, we briefly provide details below.

Clinics

Patients and physicians from 10 primary care clinics at the Ohio State University Primary Care Network participated in the study. The 10 clinics had access to CRC screening modalities and referred patients for screening to gastroenterology. A CONSORT diagram (Fig. 1) outlines the number of participating clinics by study arm and patients recruited and followed throughout the study. Units of assignment were clinics and units of observation were eligible patients receiving care at those clinics, with stratified random assignment of clinics to each study condition (Murray et al., 2013).

Providers

To be eligible for participation, clinicians had to be an attending physician or resident at one of the 10 participating clinics. Potential physician participants were recruited via an email message from the study principal investigator.

Patients

To be eligible for participation, patients had to: 1) be age ≥50; 2) have no prior history of familial/hereditary cancer syndrome, polyps, or inflammatory bowel disease; 3) have current contact information; 4) have two or more clinic visits in the past two years; 5) be at average risk for CRC; 6) be in good health; and 7) be outside CRC screening guidelines.

Once patients were determined to be eligible based upon medical record review (MRR), an email was sent to their physician asking permission to contact the patient. After receiving permission, the patient was called by a research assistant. During the phone call, the study was described; questions were answered; informed consent, HIPAA consent, and a medical release were obtained; and the baseline survey was administered. An exit survey was administered at approximately 24 months from baseline which included the same baseline measures and questions to assess process evaluation measures. Participants received a $20 grocery store gift card after completing each survey.

Informed consent procedures and the study protocol were approved by the Institutional Review Board of Ohio State University and is registered on clinicaltrials.gov (NCT01568151).

Intervention

The multi-level intervention was directed at primary care practices and targeted the clinic, providers, and average-risk patients age 50 and older. The intervention components were based on formative data from focus groups, previous investigator experience, and previous literature (Katz et al., 2007; Paskett et al., 2006; Post et al., 2008). The theoretical framework for the clinic-directed intervention was the Chronic Care Model (Wagner et al., 2005). The patient- and provider-directed interventions were based on health behavior theories, including the Health Belief Model (Rosenstock, 1974), the Transtheoretical Model (Prochaska and Velicer, 1997), and social support (Heaney and Israel, 2002) using lay health advisors (LHAs).

Clinics

The first phase of the intervention focused on the clinic and healthcare providers. It began after the eligible patients were recruited,

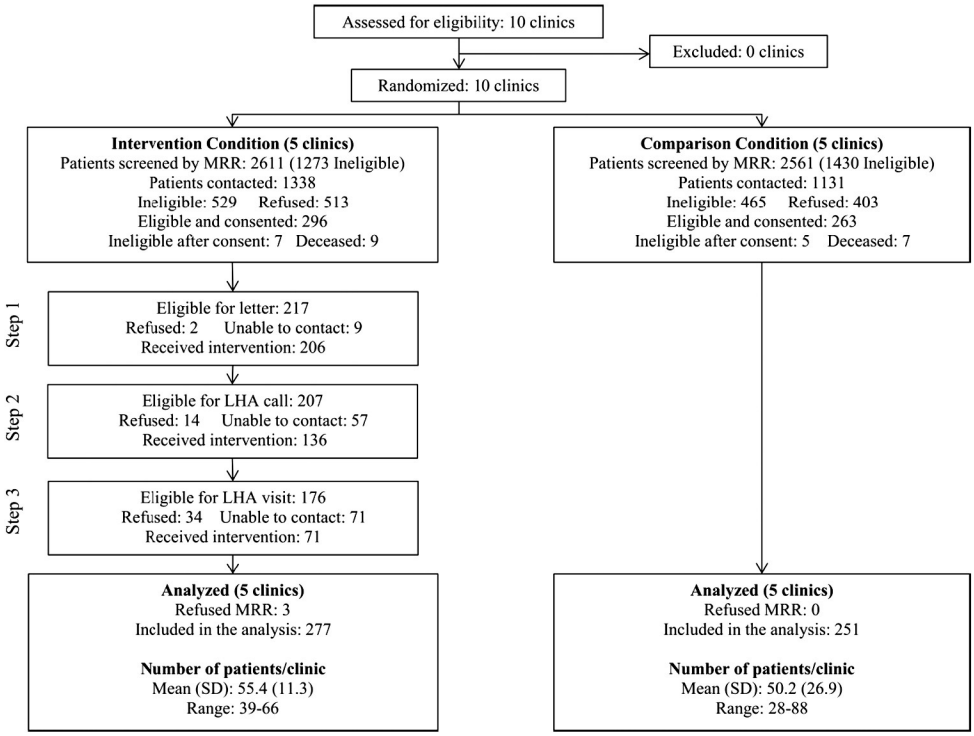


Fig. 1. CONSORT diagram.

consented, and completed the baseline survey. The clinic-level intervention focused on self-management support for CRC screening by having waiting room and examination room posters and brochures for the patients. In the waiting rooms, copies of educational materials (from the National Cancer Institute and American Cancer Society) were available to patients. Informational posters about CRC and CRC screening were displayed in prominent locations in the clinics. In addition, posters that encouraged patient communication with their physician about CRC screening were placed in exam rooms.

Providers

The educational session for the physicians, facilitated by a member of the research team, included a PowerPoint presentation and handouts on current CRC screening literature. The 1-hour presentation focused on current evidence-based CRC screening guidelines and on communication strategies designed to assist physicians in discussing CRC screening with patients. The communication strategies were modified from an evidence-based tobacco cessation program (Fiore et al., 2008). Physicians were asked complete surveys that assessed CRC screening knowledge and attitudes before and after the educational session.

Patients

After the clinic- and provider-level interventions were implemented and completed, a second MRR identified participating patients who were still not within CRC screening guidelines. The patient-level intervention then targeted those participants and was conducted in three increasingly intensive steps. The first step was a personalized letter sent to the participants from their primary care physician telling the patient to get a CRC test. The mailing also included CRC screening brochures from the American Cancer Society about general screening information and a CRC screening study-specific flyer with a photo of an adult similar to the participant's gender and race and the local clinic name and phone number. Three months after the letter and brochures were sent, another MRR determined if the participant completed a CRC screening test. If individuals had not completed screening at that time, they progressed to the second step of the patient-level intervention.

The second step involved a barriers counseling telephone call conducted by a LHA. The three LHAs were women from the Columbus, Ohio area, aged 40–50, not patients from participating clinics, and had no medical training. LHAs received education about CRC, screening tests, and were given the opportunity to observe a video of a colonoscopy. LHA training consisted of a review of the CRC barriers assessment and telephone counseling scripts, assessment techniques, role playing, and practice counseling sessions. On the call, the LHA assessed barriers to CRC screening and offered counseling to eliminate any reported barriers.

If a participant had not completed a CRC screening test within three months after the barriers counseling call (as determined by MRR), they were contacted for a one-on-one, in-person visit with the LHA, the third step of the patient-level intervention. The in-person visit, held at a location chosen by the participant (e.g., home, library), used a structured presentation that included: 1) information about the importance of completing a CRC screening test; 2) CRC screening test options; 3) how to discuss CRC screening with providers; 4) CRC screening barriers; and 5) tips to prevent CRC. The goal was to assess the participant's knowledge about CRC screening, answer questions about screening, address barriers, and provide encouragement and support for screening.

Study timeline

Clinic and physician recruitment began in January 2007 and finished in April 2008. Patient recruitment began in January 2009 and finished in August 2010. The clinic- and provider-level interventions began in January 2011. The provider-level intervention finished in December 2011. At the completion of the provider-level intervention, the patient-level intervention began in January 2012 and finished in December 2012. The clinic-level intervention continued during the patient-level intervention and finished in December 2012. The patient exit surveys and final MRR were completed by August 2013.

Measures

Outcome variable: CRC screening behavior

The primary outcome was whether the participants from the intervention and control clinics completed any CRC screening test (FOBT, flexible sigmoidoscopy, or colonoscopy) by the end of the study as determined by MRR.

Independent variables

Patient demographic characteristics

Participants provided information about their age, gender, race, ethnicity, marital status, education, household income, employment status, health insurance, and smoking status at baseline.

Patient healthcare

Participants were asked about their comorbidities ("do have any medical condition(s) that require you to go to a doctor on a regular basis? If yes, what is the condition(s)?"), past CRC screening history ("have you ever had a FOBT, sigmoidoscopy, or colonoscopy? If yes, when?"), regular source of medical care (clinic name), and most recent CRC test (where it was obtained and results). On the exit survey, participants were asked if they were still a patient at the clinic where they reported receiving care at the beginning of the study.

Patient CRC screening knowledge

Patient CRC screening knowledge was measured by 10 true or false statements about CRC screening (i.e., CRC screening age, susceptibility) (McAlearney et al., 2008). Responses were summed, creating knowledge scores (0–10) with higher scores representing more statements being answered correctly.

Patient beliefs regarding CRC screening

To assess CRC screening beliefs, participants were asked about the importance of CRC screening (e.g., "I think colon cancer screening tests are useful in finding colon cancer early") and potential barriers (e.g., "I am afraid that a screening test will find colon cancer") associated with screening. Participant beliefs were measured by a 5-item scale scored on a 5-point Likert scale ranging from "strongly agree" to "strongly disagree". Responses were summed, creating belief scores (5–25) with higher scores representing more positive CRC screening beliefs.

Patient intention to screen

Participants were asked (yes/no) if they: were willing to have a CRC screening test, have thought about talking to their doctor about completing a CRC screening test in the next 6 months, intended to complete a CRC screening test in the next 6 months, took any actions based on provided CRC information, and made an appointment to get a CRC screening test.

Patient-reported physician actions regarding CRC screening

Participants were asked (yes/no) if their doctor: asked about their family history of CRC and changes in bowel habits, provided information about CRC screening, and recommended a CRC screening test.

Physician CRC screening knowledge

To determine knowledge about CRC screening, physicians were asked about state and national CRC incidence and mortality rates, patient-level predictors of CRC screening, and the USPSTF recommendations. Example items include, "The most important factor for getting patients to complete CRC screening is a recommendation from their healthcare provider" and "CRC incidence and mortality rates are higher in Ohio compared to U.S. rates." Physician knowledge was measured by 5 true/false statements with correct answers representing higher levels of knowledge.

Process evaluation

Process evaluation was conducted during the clinic-, provider-, and each step of the patient-level intervention. Process evaluation of the clinic-level intervention involved confirmation each month that CRC screening posters and brochures were visible in the waiting and examination rooms of the intervention clinics. For the provider-level process evaluation, attendance at the educational session and response rates of the pre-and post-survey were assessed. For the patient-level intervention, the number of participants who completed each step of the patient-level intervention and were exposed to the clinic-level intervention was assessed.

Statistical analyses

The primary outcome was receipt of a CRC screening test (FOBT, flexible sigmoidoscopy, or colonoscopy) at any point during the study period (as determined by MRR). From the 531 patients consented, three patients reported having had a colonoscopy but refused MRR and were eliminated from analyses. A logistic mixed model was used to test for differences in screening at the end of the study between study arms (n = 522 due to 6 patients missing demographic information). The model contained a random clinic effect to account for the clinic-level randomization and fixed effects of study arm and any demographic factors that were not evenly distributed between study arms at baseline. ANCOVA models for clinic rates or means weighed by the number of participants in each clinic at exit were used to explore the effect of the intervention on whether the participant reported his/her doctor requested a CRC screening test, if the doctor asked about family history of CRC and changes in bowel habits, participant CRC screening knowledge score, and participant CRC screening beliefs score.

A Cox regression model with a shared gamma frailty (accounting for clinic effect) was used to compare time to CRC screening across arms. An exploratory analysis was performed to determine if age, insurance, race, income, education, gender, and marital status modified the intervention effect. Predictors of receiving CRC screening were also examined. A backwards selection process was used to build a multivariable prediction model, initially including all variables significant at the 0.1 level, univariately. Patients with missing data on the set of predictors under consideration were excluded from analyses, leaving 483 for these analyses. The logistic mixed model was fit using SAS v9.3 PROC GLIMMIX (SAS Institute, Cary, NC), and the shared frailty model was fit using Intercooled Stata 11 (Stata Corp, College Station, TX).

Results

Patient participants

The demographic characteristics of participants in the intervention and control clinics (n = 531) are presented in Table 1. The majority of the participants were female (58.4%), white (65.3%), college graduates (39.3%), and married (47.7%) with an average age of 56 years. A greater percentage of participants in the control clinics reported having a chronic medical condition (70% versus 54%). All other demographic factors were similar across arms.

Patient-level primary outcome

A total of 98 (35.4%) of the 277 participants from the intervention clinics completed CRC screening during the study compared to 88 (35.1%) of the 251 participants from the control clinics. The odds ratio comparing the CRC screening rate among intervention versus control participants, controlling for clinic and presence of a chronic medical condition was 0.98 (95% CI = 0.52, 1.85), indicating no difference by study arm. Time to CRC screening was also similar across study arms according to the shared frailty model (HR = 0.97, 95% CI = 0.65–1.45) (Fig. 2). None of the demographic factors significantly modified the effect of the intervention on the proportion of participants within CRC screening guidelines or time to CRC screening. In a sensitivity analysis, the rate of screening among participants who were still patients of the study clinic at their exit interview (n = 189), 107 (56.6%) completed CRC screening and the screening rate was similar across study arms (54% control versus 59% intervention, p = 0.57).

Patient-level secondary outcomes

Reported barriers

At the second step of the intervention (phone call), the most common self-reported barriers to CRC screening (n = 109) were: lack of personal and family risk (32.1%), screening was not a priority (22.9%), and other priorities/issues (health, family related) (17.4%). At Step 3 of the intervention (in-person visit), the most commonly self-reported barriers to CRC screening (n = 64) were: lack of personal and family risk (20.3%), no insurance (17.2%), and misconceptions/fear about the test (15.6%).

Intention to screen, knowledge, and beliefs

Participants' intention to be screened was only asked of those who were outside of guidelines by MRR and self-report, thus, among the 144 who were outside of CRC screening guidelines and completed an exit survey, 60 (41.7%) reported intention to receive CRC screening. The odds ratio for intention to screen for the participants from the intervention clinics versus the control clinics was not significant (OR = 1.52; 95% CI = 0.60–3.83). Of the 85 intervention and 67 control arm participants who reported actions based on CRC information they received, 69 (81.2%) intervention and 51 (76.1%) control arm participants reported having made an appointment to get a CRC screening test.

The effect of the intervention on knowledge was not significant with a mean increase in the participants from intervention clinics of 0.46 as compared to 0.51 in the participants from the control clinics (p = 0.83). Similarly, no significant effect was observed for the CRC screening beliefs score with a mean increase of 0.71 for the participants from intervention clinics and 0.49 for the participants from control clinics (p = 0.41).

Table 1
Participants characteristics by study arm (n = 531).[a]

Variable	Level	Control (n = 251) n(%)	Intervention (n = 280) n(%)	Total (n = 531) n(%)
Age (mean ± SD)		56.1 ± 6.8	56.2 ± 6.6	56.1 ± 6.7
Gender	Male	106 (42.2)	115 (41.1)	221 (41.6)
	Female	145 (57.8)	165 (58.9)	310 (58.4)
Race	White	164 (66.1)	181 (64.6)	345 (65.3)
	Black	70 (28.2)	83 (29.6)	153 (29.0)
	Other	14 (5.6)	16 (5.7)	30 (5.7)
Hispanic ethnicity	No	246 (98.8)	272 (97.8)	518 (98.3)
	Yes	3 (1.2)	6 (2.2)	9 (1.7)
Marital status	Married/living as married	123 (49.2)	130 (46.4)	253 (47.7)
	Divorced/separated/widowed	89 (35.6)	94 (33.6)	183 (34.5)
	Single/never married	38 (15.2)	56 (20.0)	94 (17.7)
Education level	High school or less	59 (23.6)	54 (19.4)	113 (21.4)
	Some college/associate's degree	91 (36.4)	117 (41.9)	208 (39.3)
	College graduate/graduate school	100 (40.0)	108 (38.7)	208 (39.3)
Annual household income in last year	Less than $30K	86 (36.3)	98 (36.7)	184 (36.5)
	$30K–$69,999	71 (30.0)	95 (35.6)	166 (32.9)
	$70K+	80 (33.8)	74 (27.7)	154 (30.6)
Employment status	Full/part time	138 (55.2)	176 (62.9)	314 (59.2)
	Retired/volunteer	42 (16.8)	42 (15.0)	84 (15.8)
	Disabled/unemployed	70 (28.0)	62 (22.1)	132 (24.9)
Insurance	Uninsured	36 (14.9)	40 (14.3)	76 (14.6)
	Public	64 (26.4)	68 (24.4)	132 (25.3)
	Private	142 (58.7)	171 (61.3)	313 (60.1)
Smoking status	Current	85 (34.0)	70 (25.3)	155 (29.4)
	Former	60 (24.0)	77 (27.8)	137 (26.0)
	Never	105 (42.0)	130 (46.9)	235 (44.6)
Health compared to others same age	Excellent	31 (12.5)	57 (20.4)	88 (16.7)
	Very good	81 (32.7)	104 (37.1)	185 (35.0)
	Good	81 (32.7)	80 (28.6)	161 (30.5)
	Fair	46 (18.5)	32 (11.4)	78 (14.8)
	Poor	9 (3.6)	7 (2.5)	16 (3.0)
Any chronic medical conditions	No	74 (29.8)	128 (46.2)	202 (38.5)
	Yes	174 (70.2)	149 (53.8)	323 (61.5)
Have you ever done a stool blood test using a home test kit	No	212 (84.5%)	237 (84.6%)	449 (84.6%)
	Yes	39 (15.5%)	43 (15.4%)	82 (15.4%)
Have you ever done a stool blood test using a home test kit?	No	233 (92.8%)	253 (90.4%)	486 (91.5%)
	Yes	18 (7.2%)	27 (9.6%)	45 (8.5%)
Have you ever had a colonoscopy?	No	238 (94.8%)	269 (96.1%)	507 (95.5%)
	Yes	13 (5.2%)	11 (3.9%)	24 (4.5%)
Has your doctor ever asked you to have a FOBT, flexible sigmoidoscopy, or colonoscopy?	No	122 (48.6%)	125 (44.6%)	247 (46.5%)
	Yes	129 (51.4%)	155 (55.4%)	284 (53.5%)
Would you be willing to have a colon cancer screening test if it were recommended by your doctor?	No	58 (23.3%)	61 (21.9%)	119 (22.5%)
	Yes	191 (76.7%)	218 (78.1%)	409 (77.5%)
Do you intend to complete a colon cancer screening test in the next 6 months?	No	165 (66.0%)	168 (60.4%)	333 (63.1%)
	Yes	85 (34.0%)	110 (39.6%)	195 (36.9%)
Since [baseline survey date] have you heard/seen/read anything about CRC?	No	46 (29.9%)	56 (31.8%)	102 (30.9%)
	Yes	108 (70.1%)	120 (68.2%)	228 (69.1%)
Are you currently still a patient at [baseline clinic]?	No	58 (37.7%)	83 (47.2%)	141 (42.7%)
	Yes	96 (62.3%)	93 (52.8%)	189 (57.3%)

[a] Descriptive analyses were conducted for the initial study sample.

Participant-reported physician actions regarding CRC screening

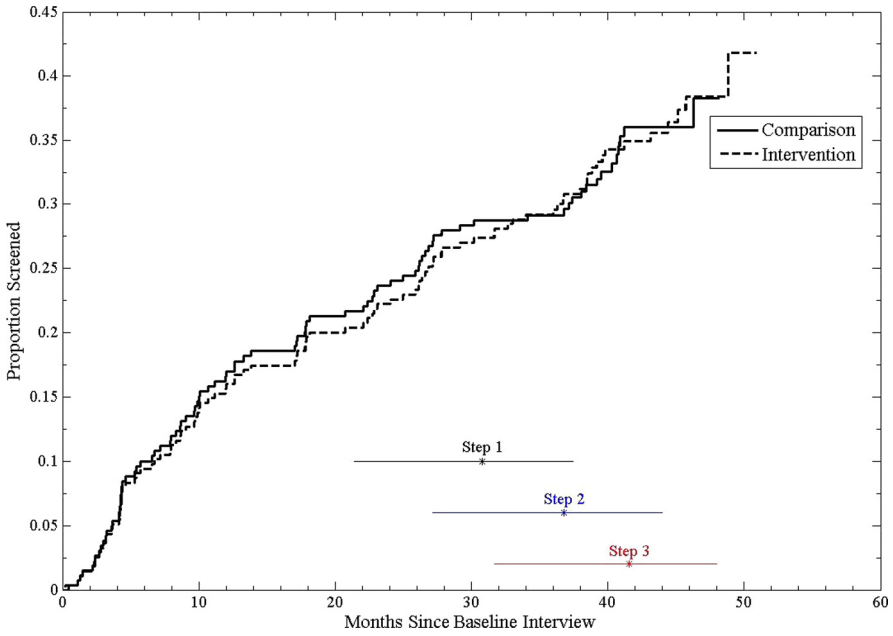
Of the 330 participants who completed the exit survey, 143 (81.3%) intervention and 125 (81.2%) control arm participants reported that their doctor asked them about their family history of CRC ($p = 0.99$). Similarly, 132 (75.0%) intervention and 109 (70.8%) control arm participants reported their doctor asked about changes in their bowel habits ($p = 0.13$). A similar proportion of intervention (68.2%) and control (70.1%) arm participants reported that they received information about CRC screening from their doctor ($p = 0.53$). Lastly, 150 (85.2%) intervention and 133 (86.4%) control arm participants reported that their doctor had recommended a CRC screening test ($p = 0.28$).

Predictors of screening

In the multivariable model, employment status, smoking status, screening beliefs, having completed an FOBT in the past, and thinking of talking to a doctor about completing a CRC test were statistically significant predictors of getting CRC screening (Table 2). Retired and disabled/unemployed participants had lower odds of having a CRC screening test compared to participants with full- or part-time employment. Participants who had completed a FOBT in the past had higher odds of being within CRC screening guidelines at the end of the study. Participants who never smoked were more likely to have a CRC screening test compared to current and former smokers. Participants who thought about talking to their doctor about a test in the next six months and had a more positive belief score regarding CRC screening were also more likely to have a CRC screening test (Table 3).

Provider-level outcomes

There was an increase from pre- to post-intervention in the percentage of correct answers on 4 out of the 5 items measuring CRC screening knowledge. Specifically, there was a significant increase regarding the question, "CRC incidence and mortality rates are higher in Ohio



Note: Curves estimated using shared gamma frailty models fit separately to the intervention and comparison (usual care) data (n=522). Curves assume mean frailty value (frailty = 1). Also depicted in the figure are timeframes over which the different patient-level intervention steps were received; the lines represent the range of times at which patients received that portion of the intervention and the "*"represents the median.

Fig. 2. Cumulative proportion of participants screened within guidelines during the study.

compared to U.S. rates" with percentage correct increasing from 38.5% at pre-intervention to 94.9% post-intervention ($p < .0001$).

Process evaluation

Clinic and provider-level

Project staff conducted monthly checks of the intervention clinics to ensure the educational materials and posters were displayed and to replenish them if needed. At the beginning of the study, 83 posters and 405 brochures were provided to the 5 intervention clinics. All posters were displayed for the entire project duration.

All eligible physicians attended the educational session at their respective clinic. Only two of the 39 physicians left in the middle of the session and one did not complete the post-survey after the session.

Patient-level

At the beginning of the patient-level intervention, 63 participants were found to be within screening guidelines. Of the remaining 217 participants, 206 (94.9%) completed step 1 of the patient-level intervention. Of the 207 participants not within guidelines at the beginning of step 2, 136 (65.7%) received the step 2 intervention. Of the 176 participants not within guidelines at the beginning of step 3 and who did not report being within guidelines at step 2, 71 (40.3%) received the step 3 intervention (Fig. 1).

Of the 108 (38.5%) participants from the intervention clinics who reported seeing posters about CRC screening, 75 (69.4%) reported seeing the posters in the clinic. Of the 174 (62.1%) participants from the intervention clinics who reported seeing the brochures about CRC screening, 126 (72.4%) reported seeing the brochures in the clinic.

Discussion

This group randomized trial sought to assess the impact of a multilevel (clinic, provider, patient) intervention to increase CRC screening among average at-risk patient participants. The findings indicate that the intervention did not have an effect on increasing CRC screening among participants in the intervention clinics compared to participants in the control clinics. These results are similar to previous research that found no significant difference in CRC screening rates after patient, physician, and/or clinic-level interventions (Ganz et al., 2005; Jerant et al., 2014; Ling et al., 2009). Predictors of CRC screening among participants were full-time employment, having a FOBT in the past, being a non-smoker, and thinking about talking to one's doctor about testing were also consistent with previous studies (Ait Ouakrim et al., 2012; Klabunde et al., 2005; Meissner et al., 2006; Seeff et al., 2004).

We considered a number of possible explanations for the null results, including low participation of participants in the stepped intervention, as the participation rate dropped from 94.9% of eligible participants at step 1 to 40.3% of eligible participants at step 3. Also, although the intervention participants reported exposure to the clinic intervention (i.e., 62.1% reported seeing the brochures), CRC screening rates did not differ between the two study arms suggesting that the educational materials did not motivate participants to get screened. More research is needed to identify the proper ways to motivate average at-risk patients to increase CRC screening.

Participants may not have been exposed to the clinic intervention as we found that a large proportion changed their source of healthcare. In the exit survey, approximately 47% of the intervention participants versus 38% of control clinic participants reported they were no longer a patient at the same clinic and more than 67% of intervention participants reported not seeing the posters in the clinics. These results suggest that the patient-oriented aspects of the clinic-level intervention may not have been as effective as designed.

Previous studies have found that the receipt of a recommendation for CRC screening from one's healthcare provider is the most important predictor of participation (Ling et al., 2009; Wee et al., 2005). This study found that thinking about talking to a doctor about completing a CRC test was a significant predictor of CRC screening, which coincides with previous research. While the majority of participants did report that

Table 2
Characteristics associated with being within CRC screening guidelines by medical record review.

Predictor	Level	Test not received n(%)	Test received n(%)	OR (95% CI)	p
Age (mean ± SD)	1-year increase	56.6 ± 7.2	55.3 ± 5.6	0.97 (0.94, 1.00)	0.04
Gender	Female	202 (65.6)	106 (34.4)	0.92 (0.64, 1.32)	0.64
	Male	140 (63.6)	80 (36.4)	1.00 (referent)	
Race	Black	105 (69.1)	47 (30.9)	0.82 (0.54, 1.24)	0.03
	Other	13 (43.3)	17 (56.7)	2.40 (1.13, 5.12)	
	White	222 (64.7)	121 (35.3)	1.00 (referent)	
Marital status	Divorced/Separated/Widowed	132 (73.3)	48 (26.7)	0.50 (0.33, 0.75)	0.003
	Single/Never married	64 (68.1)	30 (31.9)	0.64 (0.39, 1.06)	
	Married/Living as married	146 (57.7)	107 (42.3)	1.00 (referent)	
Education	Some college/associate's degree	145 (69.7)	63 (30.3)	0.94 (0.57, 1.55)	0.04
	College graduate	121 (58.5)	86 (41.5)	1.54 (0.95, 2.51)	
	High school or less	76 (68.5)	35 (31.5)	1.00 (referent)	
Employment Status	Retired/volunteer	57 (67.9)	27 (32.1)	0.68 (0.41, 1.13)	<0.001
	Disabled/unemployed	101 (77.7)	29 (22.3)	0.41 (0.26, 0.66)	
	Full/part time	184 (58.8)	129 (41.2)	1.00 (referent)	
Annual Income	$30,000–$69,000	102 (61.8)	63 (38.2)	1.69 (1.07, 2.66)	0.003
	≥$70,000	85 (55.6)	68 (44.4)	2.19 (1.38, 3.46)	
	<$30,000	134 (73.2)	49 (26.8)	1.00 (referent)	
Insurance	Public	103 (78.6)	28 (21.4)	0.82 (0.42, 1.59)	<0.0001
	Private	176 (56.6)	135 (43.4)	2.30 (1.31, 4.06)	
	Uninsured	57 (75.0)	19 (25.0)	1.00 (referent)	
Smoking status	Current	116 (74.8)	39 (25.2)	0.44 (0.28, 0.69)	0.001
	Former	92 (67.6)	44 (32.4)	0.63 (0.40, 0.97)	
	Never	132 (56.7)	101 (43.3)	1.00 (referent)	
Have any chronic medical conditions	Yes	219 (68.2)	102 (31.8)	0.66 (0.46, 0.96)	0.03
	No	118 (58.7)	83 (41.3)	1.00 (referent)	
Had any tests to check for colon cancer	Yes	264 (63.6)	151 (36.4)	1.26 (0.78, 2.05)	0.34
	No	64 (68.8)	29 (31.2)	1.00 (referent)	
Heard of and completed a FOBT	Yes	42 (51.9)	39 (48.1)	1.90 (1.17, 3.06)	0.009
	No	300 (67.1)	147 (32.9)	1.00 (referent)	
Heard of and completed a flexible sigmoidoscopy	Yes	26 (59.1)	18 (40.9)	1.30 (0.69, 2.45)	0.41
	No	316 (65.3)	168 (34.7)	1.00 (referent)	
Heard of and completed a colonoscopy	Yes	15 (62.5)	9 (37.5)	1.11 (0.48, 2.60)	0.80
	No	327 (65.0)	176 (35.0)	1.00 (referent)	
Indicated 50 as age for CRC screening to begin	Yes	202 (60.1)	134 (39.9)	1.79 (1.21, 2.63)	0.003
	No	140 (72.9)	52 (27.1)	1.00 (referent)	
Willing to have a CRC screening test if it were recommended by your doctor	Yes	250 (61.4)	157 (38.6)	2.02 (1.26, 3.23)	0.004
	No/don't know	90 (76.3)	28 (23.7)	1.00 (referent)	
Thought about talking to your doc about completing a CRC in next 6 months	Yes	109 (52.4)	99 (47.6)	2.45 (1.69, 3.54)	<.0001
	No/don't know	232 (73.0)	86 (27.0)	1.00 (referent)	
Intending to complete a CRC screening test in the next 6 months	Yes	115 (59.0)	80 (41.0)	1.49 (1.03, 2.15)	0.03
	No/don't know	225 (68.2)	105 (31.8)	1.00 (referent)	
CRC knowledge score (mean ± SD)	1-unit increase	7.1 ± 2.1	7.5 ± 1.7	1.13 (1.02, 1.25)	0.015
CRC screening beliefs score (mean ± SD)	1-unit increase	17.4 ± 2.9	18.5 ± 2.7	1.14 (1.07, 1.22)	0.0001

their doctors provided information about CRC screening, more research is needed as to why this did not increase CRC screening. Encouraging physicians to address patient concerns (e.g., access, emotional barriers) about CRC screening and offer different types of screening tests may help increase CRC screening rates.

Table 3
Multivariate logistic regression model for being within CRC screening guidelines by medical record review, n = 483.

Predictor	Level	OR (95% CI)	p
CRC screening belief scale (5-item, higher = more positive)	1-unit increase	1.11 (1.04, 1.20)	0.003
Employment	Disabled/unemployed	0.49 (0.29, 0.82)	0.02
	Retired/volunteer	0.72 (0.41, 1.27)	
	Full/part time	1.00 (referent)	
Heard of and completed an FOBT	Yes	1.90 (1.10, 3.28)	0.02
	No	1.00 (referent)	
Smoking status	Current	0.47 (0.29, 0.78)	0.006
	Former	0.58 (0.36, 0.95)	
	Never	1.00 (referent)	
Thought about talking to your doctor about completing a CRC test in next 6 months	Yes	2.33 (1.55, 3.48)	<0.0001
	No/don't know	1.00 (referent)	

Limitations

The current study had several limitations. First, the overall CRC screening rates in the clinics during the study were not measured. This would have provided more information about the potential for changing physician behavior and increasing rates of patient CRC screening. In addition, no environmental audits were conducted at control sites nor were physicians compared regarding their actual screening behaviors. It is unknown whether control sites had similar posters and brochures available. Also, some of the participants from the intervention clinics did not receive all of the patient-directed stepped interventions in the proper order. For example, 14 participants were exposed to steps 1 (letter) and 3 (in-person visit), but not step 2 (phone call). The time interval between recruitment and patient interventions may not have been ideal which suggests that future studies could compare this sequential approach to delivering an intervention with a more integrated (and shorter timeframe) approach. Lastly, the results may have limited generalizability because participants lived in one region of the U.S. and were primarily non-Hispanic white.

Conclusion

This study tested the effectiveness of a CRC screening intervention directed at three levels (clinic, provider, patient) in a primary care

setting. The stepped patient-level intervention included a letter from a physician and a call and in-person visit from LHAs to promote CRC screening. The results found that there was no difference in CRC screening rates among participants from the intervention clinics versus control clinics, and no significant increase in intention to screen in the intervention participants from baseline to exit. Future studies examining how motivation, health-behaviors, and type of supportive environments would enhance participation in CRC screening programs are needed.

Conflict of interest statement

There are no actual, potential, or perceived conflict of interest by any of the authors.

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