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Colorectal Cancer Screening in Primary Care: Translating Research into Practice

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Abstract

Background: Colorectal cancer (CRC) screening is recommended for all adults 50-75 years old, yet only slightly more than one-half of eligible people are current with screening. Since CRC screening is usually initiated upon recommendations of primary care physicians, interventions in these settings are needed to improve screening.

Objectives: To assess the impact of a quality improvement (QI) intervention combining electronic medical record (EMR) based audit and feedback, practice site visits for academic detailing and participatory planning, and “best-practice” dissemination on CRC screening in primary care practice.

Research Design: Two year group-randomized trial.

Subjects: Physicians, mid-level providers and clinical staff members in 32 primary care practices in 19 States caring for 68,150 patients 50 years of age or older.

Measures: Proportion of active patients up to date (UTD) with CRC screening (colonoscopy within 10 years, sigmoidoscopy within 5 years, or at home fecal occult blood testing within 1 year) and having screening recommended within past year **among those not UTD**.

Results: Patients 50-75 years in intervention practices exhibited significantly greater improvement (from 60.7% to 71.2%) in being UTD with CRC screening than patients in control practices (from 57.7% to 62.8%), the adjusted difference being 4.9% (95% CI: 3.8% to 6.1%). Recommendations for screening also increased more in intervention practices with the adjusted

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difference being 7.9% (95%CI: 6.3% to 9.5%). There was wide inter-practice variation in CRC screening throughout the intervention.

Conclusions: A multi-component QI intervention in practices that use EMR can improve colorectal cancer screening.

Keywords

Colorectal Cancer Screening; EMR; Quality Improvement

Introduction

Colorectal cancer (CRC) is the second leading cause of death from cancer in the United States. Screening can reduce mortality from CRC and is recommended for all adults 50-75 years old.¹ Yet, survey data which likely over-estimate actual receipt of screening suggests that only 55.5% of eligible adults have ever been screened.² The relatively low prevalence of CRC screening is particularly problematic, since it is the only cancer screening recommended for men by the U.S. Preventive Services Task Force (USPSTF), and along with breast and cervical cancer screening the only cancer screening recommended for women.

CRC screening is usually initiated on the recommendation of a primary care clinician, mostly through referral for endoscopy or orders for fecal occult blood testing (FOBT). Surveys indicate that these clinicians report widely recommending CRC screening for their eligible patients; however less than one-third use chart reminders, only 15% use outreach mechanisms to contact patients needing screening, and 12% receive audits of their screening rates.³ Research is needed to develop and assess the impact of primary care practice-level interventions designed to increase the proportion of eligible patients up to date with CRC screening recommendations. Recognizing this need, the United States National Cancer Institute and Agency for Healthcare Research and Quality have funded a number of studies in this area, one of which is the subject of this report.⁴

The Colorectal Cancer Screening in Primary Care Practice, Translating Research into Practice (C-TRIP) study is a group-randomized implementation trial assessing the impact of a quality improvement intervention combining electronic medical record (EMR) based audit and feedback, practice site visits for academic detailing and participatory planning, and “best-practice” dissemination on CRC screening in primary care practice. We have previously published manuscripts discussing the theoretical model for our study⁵ and approaches taken by practices with high rates of screening at baseline.⁶ This manuscript will present primary findings from the two-year intervention.

Methods

Study practices

The C-TRIP study was approved by the Institutional Review Board at the Medical University of South Carolina. It was conducted in the Practice Partner Research Network (PPRNet), a primary care research network across the United States, whose members use a

common EMR (Practice Partner® by McKesson, Inc., San Francisco, CA) and pool data quarterly for quality improvement and research projects. All internal medicine and family medicine practices active in PPRNet as of June 2006 (N=111) were invited to participate in the study by electronic mail. Practices that returned consent agreements hosted site visits conducted by two of us (SO, LN) between August 2006 and May 2007 to discuss the rationale for the study and study procedures. An adaptation of a Center for Disease Control slide presentation outlining the epidemiology of CRC and screening guidelines was shown during the site visit. Each practice appointed a physician and nursing staff liaison who agreed to lead the project activities within their respective practices.

After this visit, practices that wanted to continue in the study conducted an EMR review for all active patients 50 years of age or older. In small practices, the review was completed by the practice physician and/or nurse study liaison; in larger practices these individuals coordinated the review in collaboration with other practice staff. Patients were considered “active” if a progress note was recorded in the EMR within the previous year. Reviewers were asked to assure that any information concerning completed colonoscopy within 10 years, flexible sigmoidoscopy within 5 years, or at home FOBT within one year recorded anywhere in the EMR, was documented in the health maintenance section. They were also asked to include in the health maintenance section information about these procedures that had been ordered and not completed, refused by patients, and if CRC screening was not indicated due to significant co-morbidity, such as dementia or terminal illness. Subsequent to the review, liaisons were asked to complete a survey documenting their approach to the EMR review. Practices that did not complete the review or conduct it according to the protocol were excluded from the study. Remaining practices were randomized to either an intervention or control group using a process that has been reported elsewhere⁷. The process ensured balance on 7 practice-level covariates that were thought potentially relevant to CRC screening (Table 1). Because of the nature of the study, neither the providers at the participating practices nor the investigators were blinded to the group assignment after randomization.

Intervention

The **quality improvement (QI)** intervention **was conducted between** July 1, 2007 and June 30, 2009 and had three components: electronic medical record (EMR) based audit and feedback, practice site visits for academic detailing and participatory planning, and “best-practice” dissemination during annual meetings of study participants. All participating practices continued the usual PPRNet procedure of quarterly data extracts. After the extract, practices in the intervention group received reports with practice and provider level information on the proportion of their patients up to date with CRC screening and a registry of patients not up to date with screening. Intervention group practices also hosted 4 half-day site visits (one during each six months of the two-year intervention). The practice site visits were conducted by two of us (SO, LN) **and** designed to help **practices** implement the PPRNet improvement model⁸ and adopt proven strategies to improve CRC screening used by participating practices with high baseline adherence or in a published review^{6, 9} (Table 2). These strategies included enhancing communication among physicians and clinical staff about the importance of screening, encouraging FOBT (especially single specimen

immunochemical testing) for patients who refused endoscopy, adopting standing orders for screening, and conducting outreach to unscreened patients. All practice physicians and clinical staff, and many administrative staff participated in the site visit activities, which included both didactic sessions and small group or individual training. During the site visits, practices reviewed their progress and evaluated and refined their improvement strategies. The nursing staff liaisons also had regular follow-up correspondence with one of us (LN) to maintain momentum for planned improvements. Two annual project meetings were also held during the intervention, attended by the physician and nursing staff liaisons of each practice. These meetings provided an opportunity to share “best practice” approaches for improving screening. Both intervention and control group practices also received quarterly PPRNet practice reports and patient registries which contained information on adherence with many other preventive services, chronic disease, and acute illness guidelines.¹⁰

Following the 2 year intervention all study practices repeated the structured EMR review and update in a manner similar to that done prior to baseline. Reviewers from each practice participated in an hour long training telephone call with one of us (RJ) to assure that the review process was consistent across all practices. They also returned documentation indicating the outcome of the review for each patient, i.e., whether the health maintenance section correctly represented the CRC screening status and, if not, that they had updated this section. A review was considered complete if this documentation was provided for each active patient in the practice patients 50 years of age or older as of July 1, 2009.

Statistical analyses

The outcomes for this study were binary at the patient level and were expressed as percentages at the practice level. There were 2 *a priori* primary patient-level outcomes: being up-to-date (UTD) with CRC screening and being UTD with CRC screening or having it recommended within the prior year. **At a given point in time, a patient was considered UTD if a colonoscopy had been completed within 10 years, sigmoidoscopy within 5 years, or FOBT within 1 year.** A patient was considered to have screening recommended if there was documentation of an order or patient refusal for colonoscopy, sigmoidoscopy, or FOBT. Among patients UTD with screening a secondary outcome was the method of screening. A patient only contributed to the outcome calculations at a given point in time if he/she was eligible for that measure (i.e. active as defined above, in an appropriate age group, and [for the secondary outcome] being UTD with CRC screening).

All statistical analyses were performed using SAS versions 9.1 and 9.2 (SAS Institute, Inc., Cary, NC). Baseline practice-level covariates were compared between the intervention and control groups using chi-square tests and Fisher’s exact tests. Baseline characteristics of the practice’s patients (age, gender, and complexity score) were compared between the intervention and control groups using either general linear mixed effects models (for continuous variables) or generalized linear mixed effects models (for dichotomous variables), both of which included random practice effects to account for clustering of patients within practices. The complexity score is an aggregate measure of a patient’s number of recommended preventive services and needed chronic disease monitoring and medication management.¹¹ Age and patient complexity score were assessed as of the month

when the patient first became active in one of the study practices; for most patients (72.9%), this was the study baseline (7/1/2007).

To account for the clustering of patients within practices, we used the SAS procedure GLIMMIX to conduct generalized linear mixed effects modeling for both primary outcomes. The models contained fixed effects for treatment group, time (i.e. study month), a group by time interaction, and the practice-level baseline characteristics, along with random practice effects to account for the clustering of patients within practices. These types of hierarchical analyses also accounted for patients transitioning from being eligible to being ineligible, or vice versa (e.g. leaving/joining the practice, aging into or out of an age group). The main independent variable of interest was the group by time interaction term, to determine whether any increases in study outcomes observed in the treatment group were significantly greater than any observed in the control group. **Baseline practice level characteristics (Table 1)** were included as covariates in the models. From these models we were able to establish adjusted differences between treatment groups in the 24-month change in CRC screening performance. **Separate** analyses were conducted for 3 age cohorts: 50-75 years, 76-85 years, and greater than 85 years. For all analyses, an alpha level of 0.05 with 2-sided hypothesis testing was used, and no correction was made for multiple comparisons.

Sensitivity analyses were performed to determine whether our key study findings changed to any significant degree when we removed observations on certain patients for whom we could not verify that their **July 1, 2009** CRC screening statuses had been audited by the practice. This group of patients included all patients (n=2,309) from one control practice, 155 of 4,766 (3.3%) patients from another control practice, and 831 of 5,841 (14.2%) patients from an intervention practice.

The study was designed to have 80% power to detect an absolute difference of 8% between intervention and control practices in the change in the proportion of patients UTD during the two-year intervention. With an alpha level of 0.05, 2-sided hypothesis testing, and an anticipated intraclass correlation coefficient of 3.4% based on preliminary data, the necessary sample size was 42,570 patients at least 50 years old from 30 practices¹²⁻¹³

Results

The CONSORT flow diagram is presented in Figure 1. Fifty of the 111 eligible practices returned consent agreements. Six practices withdrew prior to an introductory site visit and 1 practice was excluded for non-adherence to prior research protocols; introductory site visits were made to the other 43 practices. Subsequent to the introductory visit, seven practices withdrew from the study, largely for reasons related to the work involved in conducting the EMR chart review. The remaining 36 practices conducted an EMR review; however three practices did not adhere to the review protocol and were withdrawn. Baseline data were received from the remaining 33 practices. One practice had very little data on CRC screening recorded in their EMR, and was excluded from further participation in the study.

Characteristics of the 32 study practices are summarized in Table 1. There were no significant differences across treatment groups with respect to practice characteristics (geographic region, state-mandated insurance coverage for CRC screening, baseline CRC screening performance tertile, prior PPRNet research involvement, specialty, number of providers, and residency program). The median duration of use of Practice Partner® at the beginning of the study intervention was 6 years. Characteristics of 68,150 patients who were considered active patients during the study and who did not die or otherwise become inactive during the study time period are summarized in Table 3. The mean age, age group distribution, gender, and patient complexity score were similar in the intervention and control groups.

Figure 2 illustrates the trend over time in the proportion of patients 50-75 years UTD with CRC screening during the two-year intervention as assessed after the final EMR review. At baseline, the proportion of patients UTD in intervention practices was slightly higher than that among patients in control group practices. As shown in Table 4, after 24 months patients 50-75 years in intervention practices exhibited significantly greater improvement (from 60.7% to 71.2%) over the 24-month time period in being UTD with any form of CRC screening than patients in control practices (from 57.7% to 62.8%, **a crude difference of 5.1%**), the adjusted difference being 4.9% (95% CI: 3.8% to 6.1%). Findings for 76-85 year-olds were similar, with greater improvement among patients in intervention group practices, whereas there was no change in screening in either group for patients older than 85 years. For the two younger age cohorts, there were also significantly greater improvements in the intervention group for the combined measure of being UTD with CRC screening or having it recommended in the prior year. None of these findings were significantly altered in the sensitivity analyses, which excluded patients whose records were not audited at the endpoint of the study.

Endoscopy, which in the vast majority of cases was colonoscopy, was the predominant method of screening accounting for 89.3% or more of the patients screened in the intervention and control groups, across the three age cohorts, and at the baseline and endpoint of the study. However, for patients 50-75 years in the intervention group, there was a significantly greater increase in the proportion of patients UTD by at-home FOBT over the 24-month study than in the control group.

There was substantial inter-practice variation in CRC screening that persisted throughout the study. Figure 3 highlights the practice-specific trends over the 24-month study time period, separately for intervention and control practices. During the study 13 of the 16 control practices exhibited an increase in the proportion of 50-75 year olds UTD with CRC screening, compared with all 16 of the intervention practices.

Discussion

The major finding from this study is that a multi-component quality improvement intervention combining EMR based audit and feedback, practice site visits for academic detailing and participatory planning, and “best-practice” dissemination can improve recommendations for and receipt of CRC screening among patients in primary care

practices. This finding is particularly notable given that at baseline the proportion of patients screened was higher than that reported in national samples.² Consistent with other recent studies, colonoscopy and at home FOBT were the most widely used screening tests, with colonoscopy by far the most common screen.³ However, the increased use of FOBT in intervention group practices suggests that this is a viable alternative for patients not screened by endoscopy, a finding supported by other investigators.¹⁴

Although current recommendations support routine screening only for average risk 50-75 year-olds, at the time the study began there was no commonly agreed upon upper age limit for CRC screening. Therefore information about screening for all patients 50 years of age or older were included in reports provided to practices, though our experience was that there was little enthusiasm for screening patients older than 75-80 years. We advised all practices of the October 2008 report from the USPSTF which affirmed routine screening for 50-75 year-olds, screening selected patients 76-85 years and not screening those over age 85.¹ It is gratifying that this recommendation seemed to be widely adopted by our practices, as evidenced by increased screening for those only in the two younger cohorts.

Notable among our findings is the wide variability in screening among the participating practices throughout the study with the best performing practices having 80% of their eligible patients screened while the worst performing practices had less than 50% screened. Although underlying differences in patient populations, access to endoscopy services, and insurance coverage may account for some of these findings, it is likely that greater adoption of best practices could improve screening even more.

There are several important limitations of this study. Although practices performed EMR audits to assure complete data were extracted, information in the EMR may not have been complete with regard to CRC screening. Ascertainment bias may have occurred if patients in intervention practices were asked more consistently about screening that occurred previously than those in control practices; however we re-calculated our baseline screening performance and improvement based on the final audit to compensate for this possibility. Since all practices use an EMR, joined a research network and enrolled in an improvement project, our findings may not generalize across all primary care practices. Finally, the study had no pure control group since control group practices received an introductory site visit to discuss CRC screening and had the same EMR functionality as those in the intervention group.

The findings from this study are consistent with those of a recent systematic review which found that one-on-one patient interactions with practice staff, patient reminders, and system level interventions improve CRC screening.¹⁵ A recent study in a large multispecialty group practice in eastern Massachusetts found that mailed patient reminders but not EMR physician reminders improved CRC screening.¹⁶ Focus on reminding physicians rather than the entire care team may have contributed to absence of benefit from EMR reminders.

The implications of this study are straightforward. Practices with EMR that review performance reports on CRC screening, meet as a team to plan evidence-based improvement strategies, and participate in a learning network to help adopt evidence-based improvement

strategies can increase the proportion of patients screened and achieve much higher levels of screening than typically reported. In 2008, the U.S. Census Bureau estimated that there were approximately 74.1 million Americans between the age of 50 and 74. Increasing CRC screening by the absolute difference of 4.9% found in this study would result in 3.6 million Americans in this age group being current with screening and a gain of 439,000 life years, based on the most conservative estimates of the benefit of screening.¹⁷ Given the burden of CRC these approaches, if replicated in other environments, should be widely adopted.

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Figure 1.
Consort Study Diagram

Figure 2.
Proportion of patients UTD with CRC screening over the study time period

Figure 3.
Practice Specific Changes in CRC Screening

Table 1

Characteristics of study practices as of July 1, 2007.

Characteristic	Intervention Group (n=16)	Control Group (n=16)
Geographic region		
East: N (%)	3 (18.8)	4 (25.0)
South: N (%)	3 (18.8)	2 (12.5)
Midwest: N (%)	5 (31.3)	5 (31.3)
West: N (%)	5 (31.3)	5 (31.3)
State-mandated insurance coverage for CRC screening: N (%)	4 (25.0)	4 (25.0)
Baseline CRC screening performance tertile		
Low: N (%)	6 (37.5)	5 (31.3)
Middle: N (%)	5 (31.3)	5 (31.3)
High: N (%)	5 (31.3)	6 (37.5)
Prior PPRNet research involvement: N (%)	4 (25.0)	4 (25.0)
Specialty		
Internal Medicine: N (%)	2 (12.5)	3 (18.8)
Family Medicine: N (%)	14 (87.5)	13 (81.3)
Number of providers	5 (31.3)	6 (37.5)
1 or 2: N (%)	5 (31.3)	5 (31.3)
3 or 4: N (%)	6 (37.5)	5 (31.3)
5: N (%)		
Residency program: N (%)	1 (6.3%)	1 (6.3%)

Table 2**Colorectal Cancer (CRC) Screening Improvement Strategies Promoted at Site Visits and Network Meetings**

<u>Improvement Model Category</u>	<u>Specific Strategies</u>
Prioritize Performance	<ul style="list-style-type: none"> • Commit to practice changes needed to improve • Have regular practice meetings to review improvement approaches and their impact • Encourage fecal occult blood testing for patients who choose not to have endoscopy • Use single specimen immunochemical fecal occult blood testing to increase adherence
Delivery System Design	<ul style="list-style-type: none"> • Adopt and publicize recommendation for regular health maintenance visits • Have standing orders for CRC screening • Review CRC screening status at all patient visits
Electronic Medical Record Tools	<ul style="list-style-type: none"> • Maintain accurate CRC screening information in Health Maintenance tables • Use reports to identify and contact patients not current with CRC screening
Patient Activation	<ul style="list-style-type: none"> • Repeat messages to patients who do not initially agree to screening • Provide patient education materials to those who do not readily accept screening • Contact patients that have not completed ordered screening

Table 3

Characteristics of patients within study practices

Characteristic	Intervention Group (n =30,892)	Control Group (n =37,258)	P Value [†]
Age: mean (SD), y	63.7 (10.8)	61.9 (10.1)	0.73
Age group			0.89
50-75 years old: n (%)	25,908 (83.9)	32,927 (88.4)	
76-85 years old: n (%)	3,861 (12.5)	3,372 (9.1)	
> 85 years old: n (%)	1,123 (3.6)	959 (2.6)	
50-75 years old: mean (SD), y	60.1 (7.4)	59.2 (7.1)	0.69
76-85 years old: mean (SD), y	80.5 (2.8)	80.3 (2.8)	0.85
> 85 years old: mean (SD), y	89.6 (3.0)	89.4 (2.8)	0.22
Men, %			
All patients 50 years old	42.1	45.2	0.88
50-75 years old	43.3	46.3	0.87
76-85 years old	38.6	38.6	0.97
> 85 years old	27.3	30.7	0.07
Complexity score: mean (SD)			
All patients 50 years old	13.6 (4.5)	13.3 (4.7)	0.73
50-75 years old	13.0 (4.4)	12.9 (4.5)	0.67
76-85 years old	16.5 (4.1)	17.2 (4.3)	0.14
> 85 years old	16.3 (3.8)	16.6 (4.0)	0.87

* For this purpose, age and patient complexity score were determined as of the patient's entry into the study. For most patients (72.9%), this was the study baseline (7/1/2007).

[†] P values were derived from mixed-effects models, including random practice effects to account for clustering.

Table 4

Summary of primary and secondary analyses

Study outcome	Age Group (Years)	Percent of Patients (number of eligible patients)				Unadjusted [Adjusted] Difference in 24-Month Change (95% CI), percentage points	P Value
		Intervention Group at Baseline (n = 21,863)	Intervention Group at 24 Months (n = 26,160)	Control Group at Baseline (n = 27,796)	Control Group at 24 Months (n= 31,076)		
Primary Outcomes							
UTD with CRC screening	50-75	60.7% (17,966)	71.2% (21,128)	57.7% (24,103)	62.8% (26,676)	5.4% [4.9%] (3.8% to 6.1%)	<0.0001
	76-85	59.0% (3,055)	69.4% (3,735)	56.5% (2,891)	63.8% (3,319)	3.1% [3.5%] (0.1% to 7.0%)	0.027
	> 85	39.8% (842)	42.6% (1,297)	37.2% (802)	43.8% (1,081)	−3.7% [−4.1%] (−10.3% to 2.7%)	0.995
UTD with CRC screening or had CRC screening recommended in prior year	50-75	62.3% (17,966)	78.5% (21,128)	60.0% (24,103)	67.6% (26,676)	8.6% [7.9%] (6.3% to 9.5%)	<0.0001
	76-85	60.2% (3,055)	73.8% (3,735)	58.4% (2,891)	68.4% (3,319)	3.6% [4.4%] (0.8% to 8.0%)	<0.0001
	> 85	40.7% (842)	45.8% (1,297)	40.1% (802)	47.7% (1,081)	−2.5% [−2.8%] (−9.0% to 3.5%)	0.998
Secondary Outcomes (Method of Screening)							
UTD by (colonoscopy and/or flexible sigmoidoscopy) with/without FOBT	50-75	93.0% (10,913)	89.3% (15,036)	94.4% (13,917)	96.6% (16,744)	−5.8% [−5.7%] (−9.2% to−2.3%)	<0.0001
	76-85	91.4% (1,803)	91.3% (2,593)	93.5% (1,632)	96.0% (2,116)	−2.5% [−1.5%] (−2.7% to−0.4%)	0.008
	> 85	90.4% (335)	89.5% (553)	90.9% (298)	94.3% (473)	−4.3% [−2.0%] (−7.2% to 3.2%)	0.690
UTD by FOBT alone	50-75	7.0% (10,913)	10.6% (15,036)	5.6% (13,917)	3.4% (16,744)	5.8% [5.7%] (2.3% to 9.2%)	<0.0001
	76-85	8.6% (1,803)	8.7% (2,593)	6.5% (1,632)	4.0% (2,116)	2.5% [1.5%] (0.4% to 2.7%)	0.008
	> 85	9.5% (335)	10.5% (553)	9.1% (298)	5.7% (473)	4.3% [2.0%] (−3.2% to 7.2%)	0.690