

Strategies to Improve Follow-up After Positive Fecal Immunochemical Tests in a Community-Based Setting: A Mixed-Methods Study

Kevin Selby, MD, MAS^{1,2}, Christopher D. Jensen, PhD¹, Wei K. Zhao, MPH¹, Jeffrey K. Lee, MD, MAS¹, Arielle Slam, MPH, MBA³, Joanne E. Schottinger, MD⁴, Peter Bacchetti, PhD⁵, Theodore R. Levin, MD⁶ and Douglas A. Corley, MD, PhD¹

OBJECTIVES: The effectiveness of fecal immunochemical test (FIT) screening for colorectal cancer depends on timely colonoscopy follow-up of positive tests, although limited data exist regarding effective system-level strategies for improving follow-up rates.

METHODS: Using a mixed-methods design (qualitative and quantitative), we first identified system-level strategies that were implemented for improving timely follow-up after a positive FIT test in a large community-based setting between 2006 and 2016. We then evaluated changes in time to colonoscopy among FIT-positive patients across 3 periods during the study interval, controlling for screening participant age, sex, race/ethnicity, comorbidity, FIT date, and previous screening history.

RESULTS: Implemented strategies over the study period included setting a goal of colonoscopy follow-up within 30 days of a positive FIT, tracking FIT-positive patients, early telephone contact to directly schedule follow-up colonoscopies, assigning the responsibility for follow-up tracking and scheduling to gastroenterology departments (vs primary care), and increasing colonoscopy capacity. Among 160,051 patients who had a positive FIT between 2006 and 2016, 126,420 (79%) had a follow-up colonoscopy within 180 days, including 67% in 2006–2008, 79% in 2009–2012, and 83% in 2013–2016 ($P < 0.001$). Follow-up within 180 days in 2016 varied moderately across service areas, between 72% (95% CI 70–75) and 88% (95% CI 86–91), but there were no obvious differences in the pattern of strategies implemented in higher- vs lower-performing service areas.

CONCLUSIONS: The implementation of system-level strategies coincided with substantial improvements in timely colonoscopy follow-up after a positive FIT. Intervention studies are needed to identify the most effective strategies for promoting timely follow-up.

SUPPLEMENTARY MATERIAL accompanies this paper at <http://links.lww.com/CTG/A13>

Clinical and Translational Gastroenterology 2019;10:e-00010. <https://doi.org/10.14309/ctg.000000000000010>

INTRODUCTION

Stool testing for occult blood to screen for colorectal cancer (CRC) has been shown to reduce CRC incidence and mortality (1). The fecal immunochemical test (FIT) has largely replaced guaiac-based fecal screening because of improved sensitivity of FIT screening for CRC and advanced adenomas, specificity for human hemoglobin, and acceptance by screening participants (2). Although colonoscopy remains the dominant CRC screening test in the United States (3), FITs are increasingly recognized as an important component of CRC screening programs, given that

they are noninvasive, can be mailed through outreach and completed at home, and can increase overall screening rates (4,5).

FIT-based screening is a 2-step process that requires timely colonoscopy follow-up after a positive test. European and Canadian guidelines recommend follow-up within 30 and 60 days, respectively (6,7), and delays of longer than 6 months are associated with an increased risk of any CRC and advanced CRC (8). Although rates of colonoscopy follow-up in landmark randomized trials were 80% to 90% (9), multiple screening programs have reported that as few as 50% of test-positive screening participants

¹Kaiser Permanente Division of Research, Oakland, California, USA; ²Department of Ambulatory Care and Community Medicine, University of Lausanne, Lausanne, Switzerland; ³One Medical, San Francisco, California, USA; ⁴Department of Research and Evaluation, Kaiser Permanente Southern California, Pasadena, California, USA; ⁵Department of Epidemiology and Biostatistics, University of California, San Francisco, San Francisco, California, USA; ⁶Kaiser Permanente Medical Offices, Walnut Creek, California, USA. **Correspondence:** Kevin Selby, MD, MAS. E-mail: kevin.selby@hospsvd.ch.

Received August 15, 2018; accepted January 7, 2019; published online February 27, 2019

© 2019 The Author(s). Published by Wolters Kluwer Health, Inc. on behalf of The American College of Gastroenterology

get appropriate follow-up (10–13). Follow-up is challenging in that it requires referral from primary care to gastroenterology, evaluation of patient suitability, explaining the need for an invasive diagnostic test, following complex bowel preparation instructions, and undergoing the invasive procedure itself (14). In addition, participants may misunderstand recommendations, fail to perceive themselves as at increased cancer risk, or be reluctant to undergo an invasive procedure (15). Organized screening programs in Europe usually mail results to both referring physicians and participants, sometimes augmented by personalized telephone calls (16) or default follow-up appointments (17). They typically have higher rates of colonoscopy follow-up than those seen in the United States. A recent systematic review found moderate evidence to support patient navigators and provider reminder systems to improve follow-up, but scant evidence about useful system-level strategies (18). Some studies have suggested that strategies such as automated referral to gastroenterology, electronic registries to track patients, and quality improvement efforts can provide modest improvements, but these studies had significant potential biases (19–21). Given that participant-, provider-, and system-level factors can all contribute to lack of follow-up (22), sustained strategies at multiple levels may be beneficial.

In 2006, Kaiser Permanente Northern California (KPNC) shifted from opportunistic CRC screening (primarily sigmoidoscopy) to an organized annual FIT-based mailed outreach screening program for all screening eligible members complemented by opportunistic screening colonoscopy (by request). This led to substantial improvements in the percentage of eligible adults up to date with screening, reaching >80% (23–25). In the current study, we sought to identify and describe the stepwise implementation of numerous system-level strategies to improve timely colonoscopy follow-up of positive FITs between 2006 and 2016. We then evaluated changes in time to colonoscopy over 3 periods across the 10-year study interval. Finally, for 2016, we compared colonoscopy completion rates and implementation of strategies between service areas.

METHODS

Setting

This mixed-methods study (i.e., using both qualitative and quantitative analyses) was conducted within KPNC, an integrated health plan with approximately 4.1 million current members. KPNC has a diverse membership that resembles the US adult census population in California, except at extremes of income (26). The study was approved by the Institutional Review Board of KPNC, and a waiver for informed consent was obtained. KPNC is served by 24 gastroenterology departments in 15 service areas. Service areas are responsible for KPNC members living in their geographic area; each has its own leadership and considerable autonomy to actualize processes like FIT-positive follow-up. KPNC members aged 50 to 75 years were mailed FIT kits annually if they were identified as due for screening (i.e., did not have a colonoscopy within 10 years or have a diagnosis conferring increased risk of CRC). A preletter preceded the mailed FIT kits by 1 week, followed by an automated telephone call at 5 weeks postmailing and a reminder letter at 7 weeks after. Eligible members then received personalized messages and telephone reminders as needed after FIT kits were mailed. Electronic reminders in the electronic health record also flagged patients due for screening and providers distributed additional FIT kits during

primary care visits. Members mailed their FITs to a regional laboratory, where they were reported as positive if they had >20 μg of hemoglobin per gram of buffer. Colonoscopy was the only recommended follow-up for a positive FIT result.

Characterization of strategies implemented across service areas

Strategies to promote FIT-positive follow-up across service areas between 2006 and 2016 were identified and described through systematic interviews with leaders of the KPNC CRC screening program and gastroenterology departments, followed by site visits to 4 gastroenterology departments (split between service areas with follow-up rates in the highest and lowest quartiles at 180 days) and 1 primary care department using semistructured interviews. During site visits, staff at all levels, from department chiefs to nurse coordinators, medical assistants, and schedulers were interviewed. We used that information to create a conceptual model of FIT-positive follow-up and the various strategies implemented to improve follow-up rates over the study interval. We then identified which service areas implemented which strategies using an electronic, 22-item questionnaire distributed by email to the gastroenterology leadership staff for all 15 KPNC service areas (see Supplement, Supplementary Digital Content 1, <http://links.lww.com/CTG/A13>); 1 questionnaire was completed by the department chief in 13 of 15 service areas, and in 1 service area, both the gastroenterology department chief and a department head responded separately because of differences in the organization between their departments. One service area did not complete the questionnaire. The questionnaire was distributed in fall 2017 and primarily asked leadership about FIT-positive follow-up at the time of the questionnaire, such as whether the gastroenterology department awaited electronic referrals vs directly accessed test results, had a dedicated person assigned to track FIT-positive participants, and had implemented methods to contact FIT-positive participants and close cases when no colonoscopy was performed.

Cohort of screening participants with a positive FIT

To evaluate time to colonoscopy after a positive FIT, we created a cohort of all KPNC members aged 50–76 years on their FIT result date who had a positive FIT between January 1, 2006, and December 31, 2016. A small number of participants (~4%) had more than 1 positive test during follow-up, and to avoid double counting, only their first positive test was included.

Participant measurements

Participant characteristics such as date of birth, sex, and race/ethnicity were obtained from electronic health records in the year of the FIT result. Charlson comorbidity scores were computed with a standard algorithm using ICD-9 (International Classification of Diseases, 9th revision) codes from care episodes in the calendar year before the FIT (27). Previous colonoscopy or sigmoidoscopy was yes/no variables for procedures before the index-positive FIT. Each participant was assigned to a KPNC service area, either by where they had their colonoscopy or, if they did not have a colonoscopy, the service area of their primary care provider.

Analyses

Because discrete dates for strategy implementation were not available (and strategies were often implemented over months across different centers), we stratified participants into 3 time

intervals based on the date of FIT: 2006–2008, 2009–2012, and 2013–2016. These dates coincided with concerted efforts to improve follow-up initiated in 2009–2010 and 2013. We used Cox regression to estimate cumulative incidence curves for each of the 3 time intervals (showing the proportion who received colonoscopy (in days) after a positive FIT), standardized to the overall average covariate profile. The covariates included participant age at FIT result date, sex, race/ethnicity, Charlson comorbidity score, previous colonoscopy, previous sigmoidoscopy, and the season of the year. Nine hundred nineteen participants (0.6%) had missing data and were excluded from the models. In our first model, comparisons between periods focused on the cumulative proportion with a colonoscopy within 180 days because follow-up colonoscopy after 6 months is associated with worse clinical outcomes (8). In 2 sensitivity analyses, we evaluated the time intervals 2006–2009, 2010–2013, and 2014–2016 and repeated the period analysis using a robust sandwich estimator to calculate confidence intervals. In our second model, we calculated the cumulative proportion of FIT-positive participants in 2016 with a colonoscopy at 30 and 180 days for each of the 15 KPNC service areas. We then ranked service areas by colonoscopy completion at 30 and 180 days and qualitatively compared the patterns of strategy implementation in higher- vs lower-performing service areas. For quantitative analyses, $P < 0.05$ was considered statistically significant, and all analyses were performed using STATA version 14.2 (StataCorp, College Station, TX).

RESULTS

Description of system-level strategies implemented to promote FIT-positive follow-up (all service areas)

Successive changes to FIT-positive follow-up between 2006 and 2016 (Table 1) led to the current system noted in Figure 1. System-wide strategies already in existence in 2006 included an integrated electronic health record shared by primary care and gastroenterologists, a focus on preventive health, central management of colonoscopy scheduling in each gastroenterology department, and support staff for managing patient panels. Between 2006 and 2008, in response to large increases in the number of screening participants requiring diagnostic and surveillance colonoscopies following implementation of organized FIT-based screening, several system-level strategies were implemented across all service areas (Table 1):

1. Hiring additional gastroenterology personnel to expand endoscopy capacity.
2. Institution of a policy that participants not responding to telephone calls or secure messages were sent a certified letter informing them of their increased risk of CRC after a positive FIT and their need for follow-up.

Between 2009 and 2012, additional system-level strategies implemented included:

1. Standardization of outreach by gastroenterology department schedulers whereby all FIT-positive participants with a referral received a minimum of 3 repeat telephone attempts at varying times of day and 1 or more personalized secure electronic messages over 10–21 days.
2. A dedicated staff member in each service area, typically a nurse practitioner (NP) or equivalent, was assigned responsibility for ensuring that standard processes were being followed.

Table 1. Strategies implemented between 2006 and 2016 to increase timely colonoscopy follow-up of positive fecal immunochemical tests within KPNC

Period	Strategies
Existing facilitators within KPNC (39)	Integrated electronic health record across all sites Focus on preventive health Support staff for panel management
2006–2008	Hired additional gastroenterologists (increased from 60 to >100) and nurses; built additional endoscopy suites Increased number of colonoscopies from 25,000 to nearly 100,000 per year Adopted a policy that a certified letter be sent if FIT-positive participants could not be reached to schedule a colonoscopy
2009–2012	Health plan designated follow-up colonoscopy a screening examination to avoid copayments Established a goal of ≥80% of FIT-positive participants complete follow-up colonoscopy within 30 d of a positive test; those unreachable by telephone or requiring medical evaluation were not included in the denominator Adopted a policy whereby medical centers had a portion of their annual budget retained and only released if they met colonoscopy access targets Created patient and condition tracking system, a central registry to flag FIT-positive patients without a colonoscopy at 30, 60, and 90 d after a positive FIT. Lists of patients with inadequate action were provided to each service area
2013–2016	Gastroenterology departments directly provided FIT-positive participant lists and assumed direct responsibility for follow-up, even if no referral was placed Identified a designated person responsible for FIT-positive participant tracking at each gastroenterology facility Implemented standardized outreach by navigators: minimum 3 calls, standard letter quoting cancer risk; if no contact, participant flagged as unable to contact and primary care provider notified

FIT, fecal immunochemical test; KPNC, Kaiser Permanente Northern California.

3. Established a goal that ≥80% of FIT-positive participants, accessible by telephone and not requiring medical evaluation, would complete their diagnostic colonoscopy within 30 days of testing positive.
4. A proportion of each medical center’s overall budget was withheld at the beginning of each year and only dispensed if targets for overall colonoscopy access and timely follow-up were met. Physician salaries were not subject to change based on these targets, but the policy encouraged departments to maintain adequate colonoscopy capacity and scheduling flexibility to allow scheduling within about 2 weeks of telephone contact after a positive FIT.

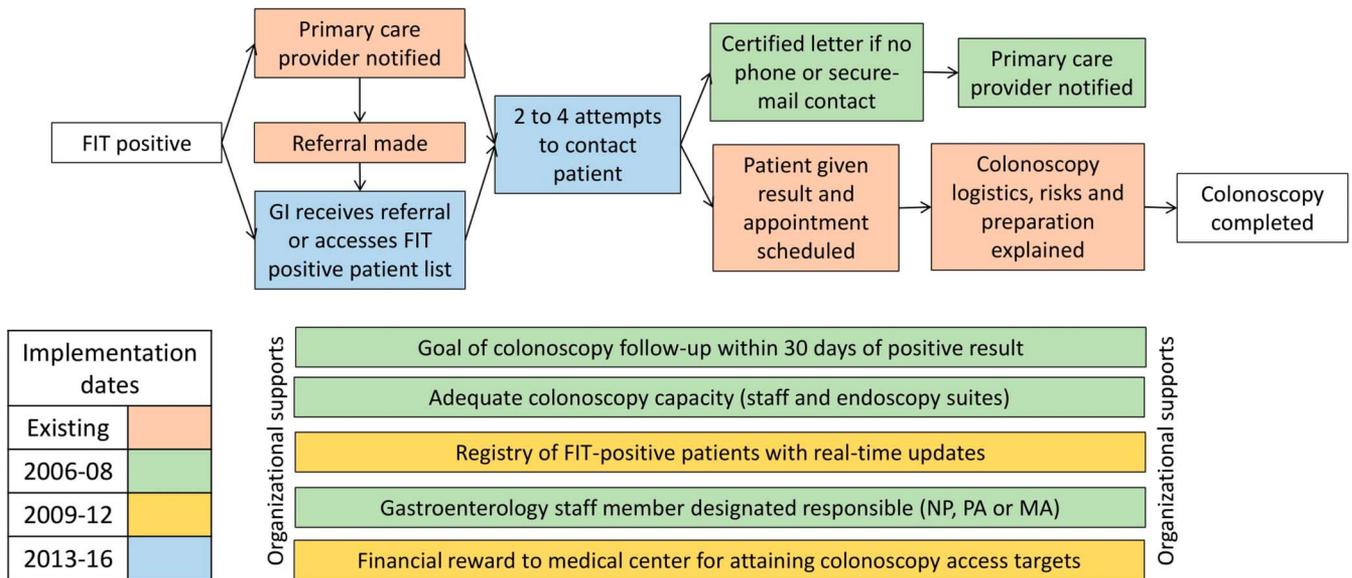


Figure 1. Organization of follow-up of participants with positive FITs. Color coding reflects the period when elements were implemented. FIT, fecal immunochemical test; MA, medical assistant; NP, nurse practitioner; PA, physician assistant; PROMPT, patient reminder, outreach management, patient tracking system.

Between 2013 and 2016, several gastroenterology departments began directly contacting participants by accessing daily lists of FIT-positive participants. FIT results from the central laboratory continued to be sent electronically to the patient's primary care provider. Primary care providers had the option to contact their patients directly to inform them of their FIT result and to place an electronic referral with their local gastroenterology department. However, an increasing proportion of participants were first contacted by a medical assistant or NP from the gastroenterology department, who explained the FIT result and directly booked the colonoscopy. Participants with concerns about the appropriateness of colonoscopy (e.g., severe comorbidities or participant refusal) were flagged for review by a gastroenterologist.

Overall cohort characteristics

Among 160,051 screening participants who had a positive FIT between 2006 and 2016, the mean age of participants was 62 years, 75,594 (47%) were women, and 90,545 (57%) were non-Hispanic white, 26,547 (17%) Asian, 20,388 (13%) Hispanic, 11,101 (7%) African American, and 11,470 (7%) other. There were no substantive differences in participant characteristics across the 3 study time intervals (Table 2).

Changes in time to colonoscopy follow-up after a positive FIT (all service areas)

Time to colonoscopy after a positive FIT significantly improved over the 10-year study period (Figure 2), concordant with the serial implementation of the described strategies (Table 1). After adjusting for participant characteristics, the proportion of participants who completed colonoscopy within 30 days after a positive FIT more than doubled between 2006–2008 and 2009–2012, from 9% (95% CI 9%–10%) to 23% (95% CI 23%–24%), and further to 34% in 2013–2016 (95% CI 34%–35%, $P < 0.001$). The proportion who completed colonoscopy within 180 days increased significantly from 67% in 2006–2008 (95% CI 66%–68%) to 79% in 2009–2012 (95% CI 78%–80%) and 83% in

2013–2016 (95% CI 83%–84%, $P < 0.001$). In sensitivity analyses, we used the time intervals 2006–2009, 2010–2013, and 2014–2016 and repeated the analyses accounting for possible clustering by service areas, but in both cases obtained very similar results (not shown).

Strategies which varied across service areas in 2016

Although the model described in Figure 1 had been implemented in most service areas by the end of the study period, variability remained (Table 3). For example, there was variation in the job title of those contacting participants (i.e., medical assistant or medical assistant team, NP, and physician assistant). In 8 of 14 responding service areas, a licensed provider (i.e., nurse or physician) attempted to contact participants before removing their name from the active list and notifying their primary care provider that no colonoscopy could be scheduled. In addition, only 3 service areas reported regular reviews of FIT-positive follow-up performance metrics, and only 4 reported consistent colonoscopy availability within 2 weeks of contacting participants. To examine whether service areas with higher colonoscopy completion rates at 30 and 180 days could be differentiated by the specific strategies implemented, we ranked service areas by their colonoscopy follow-up performance (Table 3). This analysis involved 21,291 participants who had a positive FIT in 2016. After adjusting for differences in participant characteristics across the 15 service areas, follow-up colonoscopy within 30 days varied between 10% (95% CI 9%–12%) to 59% (95% CI 56%–61%) (Table 3), and follow-up within 180 days varied between 72% (95% CI 70%–75%) and 88% (95% CI 86%–91%), with all but 1 service area having >80% completion within 180 days. However, we did not find any obvious patterns suggesting that higher performing service areas had implemented specific strategies or a greater number of strategies. For instance, two high-performing service areas (ranked first and fifth in Table 3) did not designate a person for tracking FIT-positive participants, neither routinely evaluated follow-up metrics, and only 1 directly accessed FIT-positive results.

Table 2. Patient characteristics stratified by period

Patient characteristic	Period			Overall (N = 160,051)
	2006–2008 (n = 20,693)	2009–2012 (n = 62,736)	2013–2016 (n = 76,622)	
Sex				
Male	9,606 (46%)	29,627 (47%)	36,368 (47%)	75,601 (47%)
Female	11,087 (54%)	33,109 (53%)	40,254 (53%)	84,450 (53%)
Age, yr				
50–59	7,824 (38%)	26,048 (42%)	33,896 (44%)	67,768 (42%)
60–69	8,224 (40%)	25,089 (40%)	30,503 (40%)	63,816 (40%)
70–75	4,645 (22%)	11,599 (18%)	12,223 (16%)	28,467 (18%)
Race/ethnicity				
Non-Latino white	12,252 (59%)	36,035 (57%)	42,258 (55%)	90,545 (57%)
Black	1,205 (6%)	4,378 (7%)	5,418 (7%)	11,101 (7%)
Asian	3,170 (15%)	10,003 (16%)	13,374 (17%)	26,547 (17%)
Hispanic	2,262 (11%)	7,525 (12%)	10,601 (14%)	20,388 (13%)
Other	1,704 (8%)	4,795 (8%)	4,971 (6%)	11,470 (7%)
Participant obese (BMI ≥30 kg/m ²) ^a	7,851 (38%)	25,105 (40%)	30,433 (40%)	63,389 (40%)
Season test completed				
Winter	4,429 (21%)	16,425 (26%)	20,349 (27%)	41,203 (26%)
Spring	5,416 (26%)	20,340 (32%)	23,977 (31%)	49,733 (31%)
Summer	6,065 (29%)	16,287 (26%)	21,836 (29%)	44,188 (29%)
Fall	4,783 (23%)	9,684 (15%)	10,460 (14%)	24,927 (16%)
Previous sigmoidoscopy	7,598 (37%)	23,240 (37%)	23,071 (30%)	53,909 (34%)
Previous colonoscopy	1,342 (6%)	3,356 (5%)	4,421 (6%)	9,119 (6%)
Charlson comorbidity score				
0	12,853 (62%)	38,229 (61%)	47,205 (62%)	98,287 (61%)
1 or 2	6,033 (29%)	17,411 (28%)	19,860 (26%)	43,304 (27%)
≥3	1,807 (9%)	7,096 (11%)	9,557 (12%)	18,460 (12%)

BMI, body mass index.

^aBody mass index missing for 3,508 patients (2%) of the cohort.

DISCUSSION

Over 10 years, KPNC implemented several system-level strategies to improve FIT-positive follow-up rates, including establishing a 30-day goal for colonoscopy follow-up of positive FIT results, increasing colonoscopy capacity, developing a registry add-on to the electronic health record, and initiating early telephone contact with all test-positive participants. The system-wide implementation of these strategies coincided with substantial and significant improvements in timely colonoscopy follow-up between 2006 and 2016, with 84% of test-positive participants receiving a colonoscopy within 180 days of their FIT-positive result in 2016. However, for 2016, we did not find any obvious patterns suggesting that higher performing service areas had implemented specific strategies or a greater number of strategies.

Follow-up colonoscopy rates after positive stool tests vary widely by setting, but little is known about what differentiates programs with higher vs lower follow-up rates. Several US publications have reported 50%–60% follow-up rates after 6 months or 1 year, with gaps in care at multiple levels, including fecal testing of participants for whom colonoscopy is not appropriate

because of age and comorbidities; primary care providers repeating fecal testing or failing to refer to gastroenterology departments; participants failing to present for colonoscopy; and system failures to track participants and adequately document reasons for not coordinating follow-up (10,12,22,28). A recent study reported marked differences in time to colonoscopy after a positive FIT between 4 health systems, including KPNC (11). The authors speculated that better rates of follow-up at KPNC vs 2 other integrated health systems (81% colonoscopy completion at 6 months vs 74% and 63%, respectively) might have been due to system-level factors, such as goal setting, regular performance monitoring, and control over colonoscopy capacity. KPNC chose a 30-day follow-up goal to minimize participant anxiety (consistent with European guidelines (6)) and to promote efficient processes of care. Recent research suggests that follow-up within 180 days after a positive FIT is not associated with adverse CRC outcomes (8), although no consensus exists on the appropriate follow-up interval. The fourth health system, a county-wide safety-net system, had only 50% follow-up at 6 months; the study authors speculated that the absence of a patient registry,

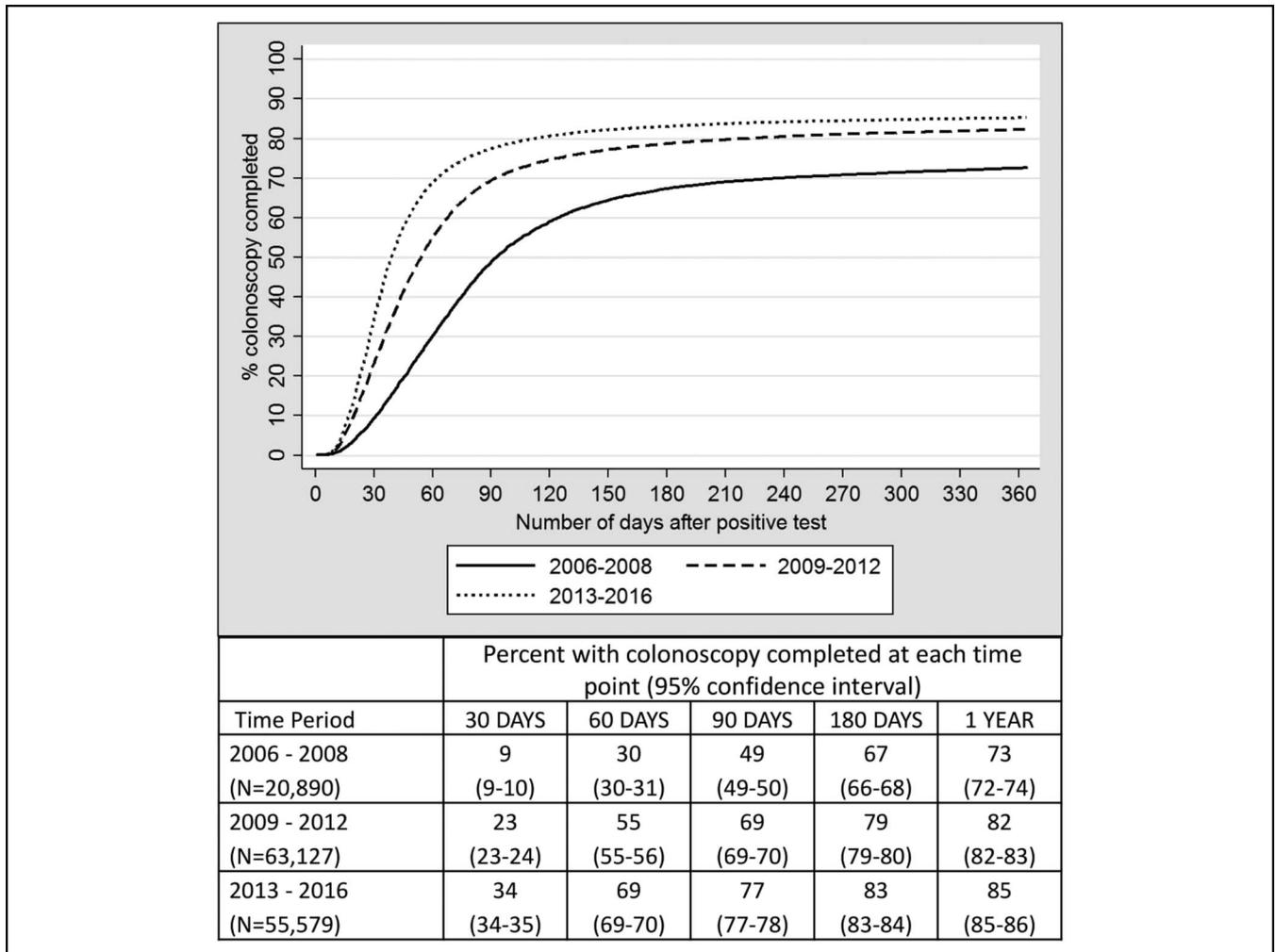


Figure 2. Time to colonoscopy after a positive fecal immunochemical test among all screening participants from Kaiser Permanente Northern California, stratified by period. Curves created using a Cox proportional hazard model of the time to colonoscopy, adjusting for patient characteristics.

inadequate colonoscopy capacity, and patient-level differences may have been contributing factors. Rates of colonoscopy follow-up within 6 months of $>80\%$ have been reported by several international organized screening programs, including a regional program in Italy with follow-up rates over 90% (29). These programs typically inform both participants and providers of FIT results by letter and/or telephone and manage colonoscopy appointments centrally, allowing for direct booking of colonoscopies when reporting test results (17,29,30). Early contact with all FIT-positive participants, as was done at KPNC, may partly explain the higher follow-up rates (31). Follow-up rates may also be lower in health systems with high rates of opportunistic screening colonoscopy, like many US programs; FIT in these settings may be more likely to be completed by participants reluctant to undergo colonoscopy.

Several of the strategies implemented within KPNC between 2006 and 2016 have been reported to be effective in other settings. A systematic review found moderate evidence supporting patient navigators, usually nurses, and reminders to primary care providers to complete colonoscopy referrals for FIT-positive participants (18). In the present study, most telephone contacts with FIT-positive participants were made by medical assistants or schedulers, typically using standardized scripts to educate and motivate patients, similar to randomized trials with nurse

navigators (32,33). In 2 service areas, primary care departments tracked FIT-positive participants and reminded physicians to contact their patients and complete referrals; in the other service areas, staff in gastroenterology departments directly contacted participants to convey results and make electronic referrals, eliminating the need for primary care provider reminders. Two previous studies reported that automatic electronic referral to gastroenterology increased follow-up (34,35). Research from the Veterans Affairs health system found that direct referral to gastroenterology and adequate colonoscopy capacity were associated with shorter times to colonoscopy (20,36). Finally, another US health system achieved follow-up rates of over 80% with a registry and manual nurse audit (37).

Strengths of our study include a systematic qualitative and quantitative evaluation of practice variation within a large, multicenter, diverse community-based setting; evaluation of both system-wide and local strategies to improve follow-up; comprehensive follow-up of many FIT-positive participants; linkage of practice variation with patient outcomes; and the ability to track the same outcome while adjusting for participant characteristics over the study interval.

Limitations include the retrospective observational design, which decreased precision regarding the timing of each strategy's implementation, and the overlap of strategy implementation

Table 3. Implementation of system-level strategies for colonoscopy follow-up of FIT-positive participants in 15 Kaiser Permanente Northern California service areas, ranked by colonoscopy rate by 30 days

Service area rank	Colonoscopy completed			Positive FIT results in 2016 (n)	Changes in last 2 yr ^{2b}	Changes planned ^c	Gastroenterology department		Longest wait for follow-up (wk) ^e	Primary method for patient contact	Patient contacted before close out ^f	Primary care provider notified if closed out	Follow-up metrics reviewed ^g
	By 30 d ^a (%)	By 180 d (%)	Mean time (d)				Direct access to FIT results ^d	Designated person responsible for follow-up					
1	59	88	80	1,779	Yes	Yes	Yes	No	6	Telephone	Yes	Yes	No
2	53	86	84	944	No	No	Yes	RN and MA	6	Telephone	Yes	Yes	No
3	48	85	94	776	No	No	Yes	NP	4	Telephone	No	No	No
4	47	88	76	766	No	No	Yes	MA	2	Telephone	Yes	Yes	Yes
5	46	86	87	2,403	No	No	Await referral	No	3	Telephone	No	Yes	No
6	34	84	104	499	Yes	No	Yes	MA	1	Telephone	Yes	Yes	No
7	30	85	96	1,288	Yes	No	Yes	NP	1	Telephone	Yes	Yes	No
8	28	86	95	779	No	Yes	Await referral	NP	1	Telephone	No	Yes	Uncertain
9	28	81	108	1,684	No	No	Yes	MA team and MD	7	Telephone	No	Yes	No
10	26	84	102	1,079	No	No	Yes	NP	1	Telephone	No	Yes	No
11	26	81	110	1,657	Yes	Yes	Yes	RN and MA	2	Telephone	Yes	Yes	No
12	23	81	119	1,779	No	Yes	Await referral	MD and NP	8	Telephone	No	Yes	Yes
13 ^h	17	83	121	882									
14	13	81	123	3,346	No	No	Await referral	NP	6	Telephone	No	Yes	Yes
15a ⁱ	10	72	155	1,630	No	No	Yes	NP	8	Telephone	Yes	Yes	No
15b ^j	10	72	155	1,630	Yes	Yes	Yes	PA	4	Secure message	Yes	Yes	No

Colonoscopy completion rates for all FIT-positive participants in 2016 calculated using the Cox proportional hazard model of the time to colonoscopy, adjusting for participant characteristics. Less frequent answers are highlighted in gray.

FIT, fecal immunochemical test; MA, medical assistant; NP, nurse practitioner; PA, physician assistant; PCP, primary care provider; RN, registered nurse.

^aKaiser Permanente Northern California regional target was to follow-up ≥80% of FIT-positive patients, accessible by telephone and not requiring medical evaluation, within 30 days.

^bExamples of recent strategies implemented included the gastroenterology department taking responsibility for FIT-positive patient follow-up, accessing results directly, and designating a responsible person for follow-up.

^cExamples of strategies to be implemented included hiring additional gastroenterologists and ongoing quality improvement efforts.

^dAwait referral refers to waiting for a colonoscopy referral from the primary care provider instead of calling patients before receiving a referral.

^eLongest wait (in weeks) for the next available colonoscopy appointment within the last year, with priority given to FIT-positive patients.

^fLicensed providers (i.e., medical doctor and registered nurse) attempted contact before removing the patient from the list of active patients needing follow-up.

^gRefers to the gastroenterology department leadership receiving and sharing performance reports of colonoscopy completion within 30 days.

^hDid not respond to the online survey.

ⁱService area leadership was split between 2 gastroenterology departments.

across service areas, which prevented a rigorous evaluation of the individual influences of the multiple strategies implemented. These factors, and the potential that unmeasured temporal changes could have influenced the results, preclude definitive assessments of causality. For example, we did not ask about the practice of maintaining open colonoscopy slots for semiurgent colonoscopy indications like positive FIT; this approach could decrease colonoscopy wait times (38). In attempting to capture the strategies implemented over time across service areas, we relied on information obtained from gastroenterology department leaders rather than measurable activities of the staff involved (e.g., medical assistant/registered nurses). As such, the findings could be subject to recall bias, and although if nondifferential, the resulting misclassification would be expected to bias results toward the null. Our analyses focused on the role of gastroenterology departments in facilitating follow-up because this was a KPNC-wide emphasis; however, primary care departments may have played a greater role in follow-up, which could have confounded our results. The misclassification of service areas would be expected to be nondifferential, leading to a potential bias toward the null. Our observations are from a single, large health system with an organized screening program, which may limit generalizability to smaller programs or individual practices. However, the impressive improvements in colonoscopy follow-up over time, combined with high plausibility regarding potential effects of the implemented strategies described, suggest that these strategies may be useful for consideration by other FIT programs. Finally, we did not measure the proportion of FIT-positive participants for whom follow-up colonoscopy was inappropriate, either because of a recent normal colonoscopy, informed refusal, or severe comorbidities, and thus may have underestimated the proportion of participants receiving appropriate timely follow-up.

Timely follow-up of positive tests is a critical component of effectiveness for FIT-based CRC screening programs. This large, multicenter qualitative and quantitative study of pragmatic strategies coinciding with improvements in FIT follow-up complements results from small randomized trials and supports goal setting for colonoscopy completion, electronic tracking of participants with positive FITs, organized (including dedicated personnel) primary care provider-directed evaluation/referral or direct referral to gastroenterology for colonoscopy, and scaling of colonoscopy capacity as potential fruitful strategies for improving timely follow-up of FIT-positive participants. Future intervention studies in multiple settings are needed to measure the potential beneficial effects of implementing individual strategies.

CONFLICTS OF INTEREST

Guarantor of the article: Kevin Selby, MD, MAS, accepts full responsibility for the conduct of the study, had access to the data, and had control of the decision to publish.

Specific author contributions: Planning and/or conducting the study: K.S., J.K.L., J.E.S., T.R.L., and D.A.C. Collecting and/or interpreting data: K.S., C.D.J., W.K.Z., and A.S. Statistical analysis: K.S., C.D.J., and P.B. Drafting the manuscript: K.S., C.D.J., J.K.L., J.E.S., T.R.L., and D.A.C. All authors approved the final draft submitted.

Financial support: This study was conducted as part of the National Cancer Institute-supported PROSPR network (U54 CA163262 [D.A.C.]). K.S. received funding from the Swiss Cancer Research Foundation (BIL KFS-3720-08-2015). J.K.L. received funding from the National Cancer Institute (K07 CA212057). The funding sources

had no role in the design and conduct of the study, preparation of the manuscript, or decision to publish.

Potential competing interests: None.

ACKNOWLEDGMENTS

We thank the gastroenterology department chiefs and staff in Kaiser Permanente Northern California for sharing their time and insights.

Study Highlights

WHAT IS KNOWN

- ✓ Rates of timely colonoscopy follow-up after a positive FIT for screening are as low as 50% in some settings
- ✓ The risk of CRC increases with colonoscopy delays of more than 180 days after a positive FIT

WHAT IS NEW HERE

- ✓ The implementation of several system-level strategies coincided with improved timely follow-up including setting a 30-day goal for follow-up, tracking FIT-positive participants, early telephone contact to schedule colonoscopies, and increasing colonoscopy capacity.
- ✓ Over a 10-year period, rates of colonoscopy follow-up within 180 days after a positive FIT improved from 67% to over 80%; intervention studies are needed to identify the most effective strategies for promoting timely follow-up.

TRANSLATIONAL IMPACT

- ✓ Multiple system-level interventions likely improve timely colonoscopy completion after positive FIT.

REFERENCES

1. United States Preventive Services Task Force, Bibbins-Domingo K, Grossman DC, et al. Screening for colorectal cancer: US preventive services task force recommendation statement. *JAMA* 2016;315(23):2564–75.
2. Robertson DJ, Lee JK, Boland CR, et al. Recommendations on fecal immunochemical testing to screen for colorectal neoplasia: A consensus statement by the US multi-society task force on colorectal cancer. *Gastroenterology* 2017;152(5):1217–37.e3.
3. American Cancer Society. Colorectal Cancer Facts & Figures 2017-2019. American Cancer Society: Atlanta, 2017.
4. Inadomi JM, Vijan S, Janz NK, et al. Adherence to colorectal cancer screening: A randomized clinical trial of competing strategies. *Arch Intern Med* 2012;172(7):575–82.
5. Gupta S, Halm EA, Rockey DC, et al. Comparative effectiveness of fecal immunochemical test outreach, colonoscopy outreach, and usual care for boosting colorectal cancer screening among the underserved: A randomized clinical trial. *JAMA Intern Med* 2013; 173(18):1725–32.
6. Segnan N, Patnick J, von Karsa L (eds). European Guidelines for Quality Assurance in Colorectal Cancer Screening and Diagnosis. Publications Office of the European Union: Luxembourg, 2010.
7. Paterson WG, Depew WT, Pare P, et al. Canadian consensus on medically acceptable wait times for digestive health care. *Can J Gastroenterol* 2006;20(6): 411–23.
8. Corley DA, Jensen CD, Quinn VP, et al. Association between time to colonoscopy after a positive fecal test result and risk of colorectal cancer and cancer stage at diagnosis. *JAMA* 2017;317(16):1631–41.
9. Hewitson P, Glasziou P, Watson E, Towler B, Irwig L. Cochrane systematic review of colorectal cancer screening using the fecal occult blood test (hemoccult): An update. *Am J Gastroenterol* 2008;103(6):1541–9.

10. Etzioni DA, Yano EM, Rubenstein LV, et al. Measuring the quality of colorectal cancer screening: The importance of follow-up. *Dis Colon Rectum* 2006;49(7):1002–10.
11. Chubak J, Garcia MP, Burnett-Hartman AN, et al. Time to colonoscopy after positive fecal blood test in four U.S. health care systems. *Cancer Epidemiol Biomarkers Prev* 2016;25(2):344–50.
12. Issaka RB, Singh MH, Oshima SM, et al. Inadequate utilization of diagnostic colonoscopy following abnormal FIT results in an integrated safety-net system. *Am J Gastroenterol* 2017;112(2):375–82.
13. Singal AG, Gupta S, Skinner CS, et al. Effect of colonoscopy outreach vs fecal immunochemical test outreach on colorectal cancer screening completion: A randomized clinical trial. *JAMA* 2017;318(9):806–15.
14. Zapka JM, Edwards HM, Chollette V, Taplin SH. Follow-up to abnormal cancer screening tests: Considering the multilevel context of care. *Cancer Epidemiol Biomarkers Prev* 2014;23(10):1965–73.
15. Yabroff KR, Washington KS, Leader A, Neilson E, Mandelblatt J. Is the promise of cancer-screening programs being compromised? Quality of follow-up care after abnormal screening results. *Med Care Res Rev* 2003;60(3):294–331.
16. Zorzi M, Hassan C, Capodaglio G, et al. Long-term performance of colorectal cancer screening programmes based on the faecal immunochemical test. *Gut* 2017.
17. Toes-Zoutendijk E, van Leerdam ME, Dekker E, et al. Real-time monitoring of results during first year of Dutch colorectal cancer screening program and optimization by altering fecal immunochemical test cut-off levels. *Gastroenterology* 2017;152(4):767–75.e2.
18. Selby K, Baumgartner C, Levin TR, et al. Interventions to improve follow-up of positive results on fecal blood tests: A systematic review. *Ann Intern Med* 2017;167(8):565–75.
19. Powell AA, Nugent S, Ordin DL, Noorbaloochi S, Partin MR. Evaluation of a VHA collaborative to improve follow-up after a positive colorectal cancer screening test. *Med Care* 2011;49(10):897–903.
20. Powell AA, Gravely AA, Ordin DL, Schlosser JE, Partin MR. Timely follow-up of positive fecal occult blood tests strategies associated with improvement. *Am J Prev Med* 2009;37(2):87–93.
21. Singh H, Kadiyala H, Bhagwath G, et al. Using a multifaceted approach to improve the follow-up of positive fecal occult blood test results. *Am J Gastroenterol* 2009;104(4):942–52.
22. Martin J, Halm EA, Tiro JA, et al. Reasons for lack of diagnostic colonoscopy after positive result on fecal immunochemical test in a safety-net health system. *Am J Med* 2017;130(1):93.e1–7.
23. Levin TR, Corley DA, Jensen CD, et al. Effects of organized colorectal cancer screening on cancer incidence and mortality in a large, community-based population. *Gastroenterology* 2018;155(5):1383–91.e5.
24. Jensen CD, Corley DA, Quinn VP, et al. Fecal immunochemical test program performance over 4 rounds of annual screening: A retrospective cohort study. *Ann Intern Med* 2016;164(7):456–63.
25. Levin TR, Jamieson L, Burley DA, Reyes J, Oehrli M, Caldwell C. Organized colorectal cancer screening in integrated health care systems. *Epidemiologic Rev* 2011;33:101–10.
26. Gordon N. How Does the Adult Kaiser Permanente Membership in Northern California Compare With the Larger Community? Kaiser Permanente Northern California Division of Research: Oakland, CA, 2006.
27. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis* 1987;40(5):373–83.
28. Carlson CM, Kirby KA, Casadei MA, Partin MR, Kistler CE, Walter LC. Lack of follow-up after fecal occult blood testing in older adults: Inappropriate screening or failure to follow up? *Arch Intern Med* 2011;171(3):249–56.
29. Zorzi M, Fedeli U, Schievano E, et al. Impact on colorectal cancer mortality of screening programmes based on the faecal immunochemical test. *Gut* 2015;64(5):784.
30. Plumb AA, Ghanouni A, Rainbow S, et al. Patient factors associated with non-attendance at colonoscopy after a positive screening faecal occult blood test. *J Med Screen* 2017;24(1):12–9.
31. Zorzi M, Hassan C, Selby K, Rugge M. Do not leave FIT positives alone! *Am J Gastroenterol* 2018;113(6):913.
32. Raich PC, Whitley EM, Thorland W, Valverde P, Fairclough D. Patient navigation improves cancer diagnostic resolution: An individually randomized clinical trial in an underserved population. *Cancer Epidemiol Biomarkers Prev* 2012;21(10):1629–38.
33. Green BB, Anderson ML, Wang CY, et al. Results of nurse navigator follow-up after positive colorectal cancer screening test: A randomized trial. *J Am Board Fam Med* 2014;27(6):789–95.
34. Humphrey LL, Shannon J, Partin MR, O'Malley J, Chen Z, Helfand M. Improving the follow-up of positive hemoccult screening tests: An electronic intervention. *J Gen Intern Med* 2011;26(7):691–7.
35. Van Kleef E, Liu S, Conn LM, Hoadley A, Ho SB. Improving the effectiveness of fecal occult blood testing in a primary care clinic by direct colonoscopy referral for positive tests. *J Healthc Qual* 2010;32(6):62–9.
36. Partin MR, Burgess DJ, Burgess JF Jr, et al. Organizational predictors of colonoscopy follow-up for positive fecal occult blood test results: An observational study. *Cancer Epidemiol Biomarkers Prev* 2015;24(2):422–34.
37. Miglioretti DL, Rutter CM, Bradford SC, et al. Improvement in the diagnostic evaluation of a positive fecal occult blood test in an integrated health care organization. *Med Care* 2008;46(9 Suppl 1):S91–6.
38. Sharara N, Nolan S, Sewitch M, Martel M, Dias M, Barkun AN. Assessment of a colonoscopy triage sheet for use in a Province-wide population-based colorectal screening program. *Can J Gastroenterol Hepatol* 2016;2016:4712192.
39. McCarthy DM, Mueller K; Issues Research, Inc. Kaiser Permanente: Bridging the Quality Divide with Integrated Practice, Group Accountability, and Health Information Technology. The Commonwealth Fund: New York, NY, 2009.

Open Access This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.