

Organizational Predictors of Colonoscopy Follow-up for Positive Fecal Occult Blood Test Results: An Observational Study

Melissa R. Partin^{1,2}, Diana J. Burgess^{1,2}, James F. Burgess Jr^{3,4}, Amy Gravely¹, David Haggstrom^{5,6}, Sarah E. Lillie^{1,2}, Sean Nugent¹, Adam A. Powell¹, Aasma Shaukat^{1,2}, Louise C. Walter⁷, and David B. Nelson^{1,2}

Abstract

Background: This study assessed the contribution of organizational structures and processes identified from facility surveys to follow-up for positive fecal occult blood tests [FOBT-positive (FOBT⁺)].

Methods: We identified 74,104 patients with FOBT⁺ results from 98 Veterans Health Administration (VHA) facilities between August 16, 2009 and March 20, 2011, and followed them until September 30, 2011, for completion of colonoscopy. We identified patient characteristics from VHA administrative records, and organizational factors from facility surveys completed by primary care and gastroenterology chiefs. We estimated predictors of colonoscopy completion within 60 days and six months using hierarchical logistic regression models.

Results: Thirty percent of patients with FOBT⁺ results received colonoscopy within 60 days and 49% within six months. Having gastroenterology or laboratory staff notify gastroenterology providers directly about FOBT⁺ cases was a significant predictor of 60-day [odds ratio (OR), 1.85; $P = 0.01$] and six-month follow-up (OR, 1.25; $P = 0.008$). Additional

predictors of 60-day follow-up included adequacy of colonoscopy appointment availability (OR, 1.43; $P = 0.01$) and frequent individual feedback to primary care providers about FOBT⁺ referral timeliness (OR, 1.79; $P = 0.04$). Additional predictors of six-month follow-up included using guideline-concordant surveillance intervals for low-risk adenomas (OR, 1.57; $P = 0.01$) and using group appointments and combined verbal-written methods for colonoscopy preparation instruction (OR, 1.48; $P = 0.0001$).

Conclusion: Directly notifying gastroenterology providers about FOBT⁺ results, using guideline-concordant adenoma surveillance intervals, and using colonoscopy preparations instruction methods that provide both verbal and written information may increase overall follow-up rates. Enhancing follow-up within 60 days may require increased colonoscopy capacity and feedback to primary care providers.

Impact: These findings may inform organizational-level interventions to improve FOBT⁺ follow-up. *Cancer Epidemiol Biomarkers Prev*; 24(2); 422–34. ©2014 AACR.

Introduction

Colorectal cancer is the third most common cancer and the third leading cause of cancer-related death among men and

women in the United States (1). The best known defense against colorectal cancer is early detection and prevention through routine screening. Current guidelines endorse multiple colorectal cancer screening methods (2–4), but fecal occult blood testing (FOBT) and colonoscopy are the most widely used (5). Two of the largest integrated health care systems in the United States [Kaiser Permanente and the Veterans Health Administration (VHA)] have achieved high colorectal cancer screening rates using screening programs emphasizing FOBT (6, 7). Although randomized controlled trials have demonstrated that FOBT can be a highly efficacious screening method if FOBT-positive (FOBT⁺) results are followed by diagnostic colonoscopy (8–10), many FOBT-based screening programs document challenges assuring that FOBT⁺ results receive follow-up colonoscopy in a timely manner (11–14). Proportions of FOBT⁺ cases failing to receive follow-up colonoscopy reported in prior studies range from 35% to 63% (11–14), and the median waiting times from FOBT⁺ to colonoscopy range from 105 to 202 days (11–13, 15).

Both the VHA and the Canadian Association of Gastroenterology Wait Time Consensus Group recommend performing a colonoscopy within 60 days of FOBT⁺ results (16, 17). However, recent data from the VHA documenting that 50% of FOBT⁺ cases fail to receive follow-up colonoscopy within this window (18),

¹Center for Chronic Disease Outcomes Research, Minneapolis Veterans Affairs Health Care System, Minneapolis, Minnesota. ²Department of Medicine, University of Minnesota, Minneapolis, Minnesota. ³Center for Healthcare Organization and Implementation Research, Boston Veterans Affairs Health Care System, Boston, Massachusetts. ⁴Department of Health Policy and Management, Boston University School of Public Health, Boston, Massachusetts. ⁵VA Health Services Research and Development Center for Health Information and Communication, Roudebush VAMC, Indianapolis, Indiana. ⁶Division of General Internal Medicine and Geriatrics, Department of Medicine, Indiana University School of Medicine, Indianapolis, Indiana. ⁷Division of Geriatrics, San Francisco VA Medical Center and University of California, San Francisco, San Francisco, California.

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Corresponding Author: Melissa R. Partin, Minneapolis Veterans Affairs Medical Center, 1 Veterans Drive, Minneapolis, MN 55417. Phone: 612-467-3841; Fax: 612-467-5699; E-mail: Melissa.partin@va.gov

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and from a Canadian survey of gastroenterologists documenting an average waiting time from FOBT⁺ results to colonoscopy of 105 days (15), suggest significant gaps remain in assuring timely follow-up. Closing these gaps will require identifying modifiable contributors to persistent FOBT⁺ follow-up delays.

Most prior studies examining contributors to FOBT⁺ follow-up have focused on nonmodifiable individual-level factors (19, 20), identifying significant associations with patient age (21–24), gender (13, 23, 25), race (24), comorbidity (22), personal history of bowel disease (26), family history of colorectal cancer (27), and recent colonoscopy (24). A few have identified modifiable individual-level contributors, including patient fears and worries about colorectal cancer (26, 27), and provider awareness of guidelines (28, 29) and intentions to order diagnostic testing for FOBT⁺ results (25). However, very few prior studies have examined the contribution of modifiable organizational-level factors to FOBT⁺ follow-up patterns (20), despite growing recognition that understanding the role that the care environment plays in assuring quality is essential to designing effective interventions and making further improvements in cancer care (30, 31).

We conducted a study to assess the contribution of modifiable organizational-level factors to FOBT⁺ follow-up rates. We hypothesized that higher follow-up rates would be associated with: (i) organizational structures designed to facilitate quality improvement (i.e., leadership support, resource alignment, feedback, and incentives), and (ii) organizational processes that control system-wide demand for colonoscopy (i.e., "demand efficiency" processes), minimize wasted appointments and the number of steps required to complete a colonoscopy (i.e., "supply efficiency" processes), and address patient barriers to colonoscopy completion (i.e., "patient-centered" processes). We assessed the contribution of these organizational-level factors while controlling for individual-level factors demonstrated to be associated with FOBT⁺ follow-up in prior studies.

Materials and Methods

Setting and participants

We identified a cohort of patients who had outpatient FOBT⁺ results from a VHA facility between August 2009 and March 2011 (1 year prior and 6 months after the start date for the organizational survey, described below) and followed them until September 2011 (6 months after the last FOBT date) for completion of follow-up colonoscopy. To identify patients with FOBT⁺ results, we identified from VHA laboratory records all outpatient FOBT procedures performed at VHA facilities during the sample accrual period, using the codes provided in Supplementary Material S1. We then defined FOBT⁺ cases as any individual card test with a positive result, or any multiple card series with one or more cards with positive results. If an eligible patient had more than one FOBT⁺ result in the sample selection window, the first FOBT⁺ result was selected for the sample. We then excluded patients if they did not receive their FOBT⁺ results from one of 125 VHA facilities that conducted at least 1,400 FOBTs in 2009; were of age <18 years or >100 years at the time the FOBT⁺ result was recorded; had a prior diagnosis of colorectal cancer in VHA medical records; or received their FOBT⁺ from a VHA community-based outpatient clinic that refers less than 70% of colonoscopies to one of the 125 VHA facilities included in the sampling frame, leaving 86,926 eligible FOBT⁺ patients available for analysis. We linked this patient sample to facility-level data on organizational structures

and processes obtained from Web-based surveys (described previously in ref. 32 and in Supplementary Material S2) administered to the chiefs of primary care (73% response rate) and gastroenterology (81% response rate) beginning in August 2010, yielding 74,014 patients from 98 facilities responding to one or both surveys (Fig. 1). We excluded 43 facilities completing <1,400 FOBT procedures in 2009 to ensure an adequate sample (≥ 100) of FOBT⁺ patients from each facility was available for estimating the association between organizational factors and follow-up rates.

Conceptual framework

Our conceptualization of key organizational-level contributors to FOBT⁺ follow-up is informed by Donabedian's framework for understanding the quality of care (33), and prior research documenting the association among specific organizational structures, organizational processes, individual-level factors, and quality outcomes. Organizational structures associated with quality outcomes in prior studies include leadership support (34, 35), personal and frequent feedback (36, 37), incentives (38), and resource alignment to improvement goals (refs. 34, 35, 39; such as tracking systems, ref. 40; and quality improvement training, ref. 14). Organizational processes refer to approaches used to complete each step required to assure FOBT⁺ follow-up (i.e., notification, referral, scheduling, and patient education). For our analysis, we categorized organizational processes into three groups: (i) those that control system-wide demand for colonoscopy, which we refer to as "demand efficiency" processes; (ii) those that minimize wasted appointments and the number of steps required to complete a colonoscopy, which we refer to as "supply efficiency" processes; and (iii) those that address patient barriers to colonoscopy completion, which we refer to as "patient-centered" processes. Individual-level factors we control for in our hypothesis tests related to organizational-level factors include characteristics of patients and FOBT procedures found to be associated with FOBT⁺ follow-up rates in prior studies (i.e., age, race, residence, comorbidities, personal history of polyps, and ordering provider characteristics).

Data sources and measures

Our primary outcome was follow-up colonoscopy completion, identified from VHA administrative records using the codes in Supplementary Material S3. We separately examined correlates of colonoscopy completion within 60 days (the VHA recommended follow-up interval) and 6 months.

Predictors. Table 1 provides the survey question wording, response options, and coding for analysis for all organizational predictors we examined.

Organizational structures. We measured leadership support using two items: (i) a question from the primary care survey asking the extent to which "not a priority to leadership" is a barrier to providing timely FOBT⁺ follow-up, and (ii) an identical question from the gastroenterology survey. We measured resource alignment with two items: (i) "tracking," a question on the primary care chief survey about how frequently their program tracks what happens to patients with FOBT⁺ results, and (ii) a question on the gastroenterology chief survey asking the extent to which "colonoscopy appointment availability" is a barrier to providing timely FOBT⁺ follow-up. Feedback was assessed with two

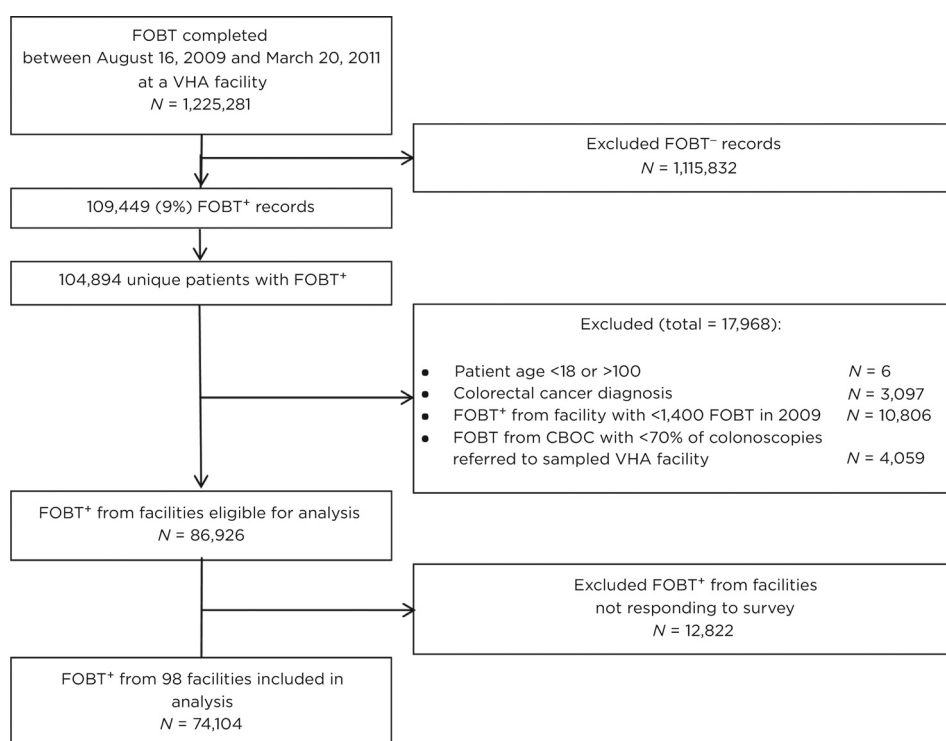


Figure 1.
Subject flowchart.

measures: (i) "primary care feedback," which combined two measures on the type and frequency of feedback (see Table 1) into a single measure, and (ii) "gastroenterology feedback," which combined similar measures from the gastroenterology survey. Incentives were assessed with two items: (i) "primary care incentives," and (ii) "gastroenterology incentives," both of which asked chiefs "which of the following do (providers in your primary care program/staff in your gastroenterology program) receive for their performance on assuring timely follow-up of positive FOBT results" (see Table 1 for response options and coding).

Organizational processes. Measures of demand efficiency processes included: (i) number of contraindications the facility's colorectal cancer screening clinical reminder asks about; (ii) information on the facility's colonoscopy consult template includes contraindications; and (iii) the typical surveillance interval for patients with 1–2 adenomas <1 cm at the facility is guideline-consistent (i.e., 5–10 years; ref. 41). Measures of supply efficiency processes included: (i) Gastroenterology providers are directly notified of FOBT+ cases (either by laboratory or by gastroenterology staff who take responsibility for identifying FOBT+ cases); (ii) patient colonoscopy prep instruction does not require a separate appointment; (iii) a pre-op appointment is not required for colonoscopy; and (iv) overbooking is used to minimize wasted appointments. Measures of patient-centered processes included: (i) patient notification of FOBT+ results includes phone contact; (ii) colonoscopy appointment times are negotiated (using a scheduler or letter requesting the patient call the clinic to set up an appointment) rather than preassigned to patients in a mailed letter; (iii) patient prep instruction procedures include opportunities for questions (i.e., some verbal instruction); and (iv) patients receive colonoscopy appointment reminders that include prep instructions.

We used VHA administrative data to identify the following individual-level factors controlled for in our predictive models: age (<50, 50–64, 65–84, or ≥85); race (non-Hispanic white, Hispanic, African American, American Indian, Asian or Pacific Islander, or Unknown); residence (urban or rural); drive time to the nearest VHA specialty care facility (≤60 or >60 minutes); Charlson comorbidity score for the 1 year before the FOBT+ result; mental health diagnoses (psychiatric only, substance abuse only, dual diagnosis, or none); personal history of colorectal polyps or benign neoplasms (ICD-9 211.3-4, 569.0, v12.72); whether the FOBT was ordered by their primary care provider; what type of provider ordered their FOBT (physician, nurse practitioner or physician assistant, resident, nurse, or other staff); and what type of facility ordered their FOBT (VHA specialty care facility or community-based outpatient clinic).

Analysis

Because the limited number of facilities in the sample precluded the simultaneous inclusion of a large number of facility-level predictors, we pursued the following steps to select predictors for inclusion in the final model. We initially fit separate bivariate hierarchical logistic regression models (with random effects for facility of care) for each organizational structure and process measure. We then included in a base multivariable model all measures with $P < 0.10$, or with more than a 5% difference between model estimated completion rates (among the levels of a categorical measure or between the mean and one standard deviation shift from the mean for a continuous measure). We also included in the base model month of FOBT+ result and any patient-level predictors associated with colonoscopy completion within the respective timeframe (see Supplementary Table S1 for bivariate estimates derived from this step). We then reduced the

Table 1. Question wording, response categories, and coding for analysis of Organizational Structure and Process measures

Measure	Source	Question wording	Coding for analysis
Primary care leadership support	Primary care survey	Please rate each of the following potential barriers to providing timely follow-up for positive FOBTs, where 1 is not a barrier and 5 is a key barrier to providing timely follow-up for positive FOBTs. <div style="display: flex; justify-content: space-around; width: 100%;"> Not a barrier 1 2 3 4 5 Key barrier Don't Know </div> Not a priority to leadership <div style="display: flex; justify-content: space-around; width: 100%;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div>	1 = "key barrier" (category 5) 0 = All other responses
Gastroenterology leadership support	Gastroenterology survey	Please rate each of the following potential barriers to providing timely follow-up for positive FOBTs, where 1 is not a barrier and 5 is a key barrier to providing timely follow-up for positive FOBTs. <div style="display: flex; justify-content: space-around; width: 100%;"> Not a barrier 1 2 3 4 5 Key barrier Don't Know </div> Not a priority to leadership <div style="display: flex; justify-content: space-around; width: 100%;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div>	1 = "key barrier" (category 5) 0 = All other responses
Resource alignment: tracking	Primary care survey	Has your PRIMARY CARE PROGRAM assigned anyone the responsibility of tracking what happens to patients with positive FOBT results? (Select One) <input type="checkbox"/> Yes Approximately how frequently does this person/s check these outcomes? (Select One) <input type="checkbox"/> As needed on an ongoing basis <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> Don't know <input type="checkbox"/> No <input type="checkbox"/> Don't know	1 = Someone is assigned to track "weekly or more frequently" 0 = All other responses
Resource alignment: colonoscopy appointment availability	Gastroenterology survey	Please rate each of the following potential barriers to providing timely follow-up for positive FOBTs. <div style="display: flex; justify-content: space-around; width: 100%;"> Not a barrier 1 2 3 4 5 Key barrier Don't Know </div> Limited availability of colonoscopy appointments <div style="display: flex; justify-content: space-around; width: 100%;"> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> </div>	1 = "key barrier" (category 5) 0 = All other responses
Primary care feedback	Primary care survey	Do primary care providers receive feedback about the amount of time it takes them to refer patients with positive FOBT results for colonoscopy? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know How are primary care providers given this feedback? (Check all that apply) <input type="checkbox"/> Individualized information at provider level <input type="checkbox"/> Aggregate information at the team or clinic level <input type="checkbox"/> Aggregate information at the facility level <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know How frequently are primary care providers given this feedback? (Select One) <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> Annually <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know	0 = No feedback 1 = Aggregate feedback at any frequency 2 = Individual infrequent feedback (less frequently than monthly) 3 = Individual frequent feedback (at least monthly)
Gastroenterology feedback	Gastroenterology survey	How is feedback on the timeliness of follow-up for patients with positive FOBT results given to GI / Endoscopy staff? (Check all that apply) <input type="checkbox"/> Verbally in a staff meeting <input type="checkbox"/> In writing in the form of an aggregate team, clinic or facility report <input type="checkbox"/> Other (specify): <input type="checkbox"/> No feedback provided to GI / Endoscopy staff on this aspect of care <input type="checkbox"/> Don't know Approximately how frequently are GI / Endoscopy staff given this feedback? (Select One) <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Quarterly <input type="checkbox"/> Annually <input type="checkbox"/> Don't know	0 = Written less than monthly 1 = Written feedback at least monthly 2 = Verbal feedback less than monthly 3 = Verbal feedback at least monthly (hypothesized as the optimal category, based on prior research)(42-43)

(Continued on the following page)

Table 1. Question wording, response categories, and coding for analysis of Organizational Structure and Process measures (Cont'd)

Measure	Source	Question wording	Coding for analysis
Primary care incentives	Primary care survey	Which of the following do providers in your primary care program receive from leadership for their performance on assuring TIMELY FOLLOW-UP OF POSITIVE FOBT RESULTS? (Check all that apply) <input type="checkbox"/> Recognition for good performance <input type="checkbox"/> Monetary rewards for good performance <input type="checkbox"/> Counseling or reprimands for poor performance <input type="checkbox"/> None of the above <input type="checkbox"/> Don't know	0 = No rewards or reprimand 1 = Recognition only 2 = Monetary rewards (alone or in combination with other incentives) 3 = Reprimands (alone or in combination with recognition)
Gastroenterology incentives	Gastroenterology survey	Which of the following rewards or reprimands do staff in your GI/Endoscopy program receive for their performance on assuring timely follow-up of positive FOBT results? (Check all that apply) <input type="checkbox"/> Recognition from leadership for good performance <input type="checkbox"/> Monetary rewards for good performance <input type="checkbox"/> Counseling or reprimands for poor performance <input type="checkbox"/> Other (specify): <input type="checkbox"/> None of the above <input type="checkbox"/> Don't know	0 = No rewards or reprimands 1 = Recognition only 2 = Monetary rewards (alone or in combination with other incentives) 3 = Reprimands (alone or in combination with recognition)
Demand Efficiency: number of contraindications on screening reminder	Primary care survey	Does your facility's colorectal cancer screening clinical reminder ask about contraindications? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know Which of the following contraindications are asked about in the reminder? (Check all that apply) <input type="checkbox"/> Life limiting comorbidities/limited life expectancy <input type="checkbox"/> Health issues that increase risk of complications of colonoscopy <input type="checkbox"/> Recent colonoscopy <input type="checkbox"/> Patient not willing to undergo colonoscopy if screen is positive <input type="checkbox"/> Other (specify)	0 = None 1 = 1-2 2 = 3 3 = 4 or more
Demand Efficiency: does colonoscopy consult template include contraindications?	Primary care survey	Does your Primary Care program use a consult template for referrals to Gastroenterology for follow-up of positive FOBT results? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know Which of the following items are included in the template? (Check all that apply) <input type="checkbox"/> Anticoagulant use <input type="checkbox"/> Anti-platelet use <input type="checkbox"/> Diabetic <input type="checkbox"/> Anemia/Iron deficiency <input type="checkbox"/> Life expectancy or comorbidities related to life expectancy <input type="checkbox"/> Previous colonoscopy results <input type="checkbox"/> Physical/cognitive impairments that would make difficult to follow prep instructions <input type="checkbox"/> Lab values <input type="checkbox"/> Other (specify): <input type="checkbox"/> None <input type="checkbox"/> Don't know	0 = Some contraindications 1 = Indications only 2 = Neither
Demand Efficiency: guideline-concordant surveillance	Gastroenterology survey	How soon is a repeat colonoscopy typically scheduled at your facility for the following types of patients: <input type="checkbox"/> 1-2 small adenomas (<1cm) on last colonoscopy: _____ years	0 = Not guideline-concordant (<5 years) 1 = 5 years 2 = 7-10 years
Supply Efficiency: how gastroenterology providers are notified of FOBT+	Gastroenterology Survey	How is the GI/Endoscopy clinic first notified of an FOBT positive result? (Check all that apply) <input type="checkbox"/> Lab sends notification directly to GI/Endoscopy <input type="checkbox"/> Primary care notifies using consult template/referral <input type="checkbox"/> Other(specify):(n = 5 said Gastroenterology identifies FOBT+) <input type="checkbox"/> Don't know	0 = Primary care notifies 1 = Lab notifies 2 = Gastroenterology notifies
Supply efficiency: does prep instruction require a separate appointment?	Gastroenterology survey	What is the most typical way that patients receive their colonoscopy preparation instructions at your facility? (Select One) <input type="checkbox"/> Written instructions provided with prep kit <input type="checkbox"/> Written instructions mailed separate from prep kit <input type="checkbox"/> Verbal instructions provided over the phone <input type="checkbox"/> Individual appointment <input type="checkbox"/> Group appointment <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know	0 = Individual or group appointment (including those indicated in specified "other" responses) 1 = All other categories

(Continued on the following page)

Table 1. Question wording, response categories, and coding for analysis of Organizational Structure and Process measures (Cont'd)

Measure	Source	Question wording	Coding for analysis
Supply efficiency: pre-procedure appointment required?	Gastroenterology survey	Do you require a pre-procedure clinic appointment prior to the colonoscopy appointment? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	0 = Yes 1 = No
Supply efficiency: overbooking is used	Gastroenterology survey	In the past six months, did your GI program implement any of the following processes to keep up with colonoscopy demand? (Check all that apply) <input type="checkbox"/> Added additional clinic hours <input type="checkbox"/> Implemented make up clinics <input type="checkbox"/> Added additional staff <input type="checkbox"/> Increased use of contract providers <input type="checkbox"/> Increased use of fee basis providers <input type="checkbox"/> Overbooked appointments <input type="checkbox"/> Other (specify): <input type="checkbox"/> No change implemented <input type="checkbox"/> Don't know	1 = Overbooking appointments is used 0 = All other responses
Patient-centered process: patient notification of FOBT+ includes phone contact	Primary care survey	How are patients seen in your primary care program typically first notified of a positive FOBT result? (Select One) <input type="checkbox"/> Letter from primary care clinic <input type="checkbox"/> Letter from GI clinic <input type="checkbox"/> Phone call from primary care or GI clerk <input type="checkbox"/> Phone call from primary care or GI nurse <input type="checkbox"/> Phone call from primary care or GI provider <input type="checkbox"/> Email or secure messaging <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know	0 = Notification does not include phone contact 1 = Notification includes some phone contact
Patient-centered process: are colonoscopy appointment times negotiated with patients?	Gastroenterology Survey	Which of the following options best describes the most common way that patients are scheduled for the first appointment to follow-up on a positive FOBT at your facility? (Select One) <input type="checkbox"/> Patient is sent a letter instructing them to come to the clinic at a specific date/time <input type="checkbox"/> Patient is first sent a letter instructing them to call the clinic, and then an appointment date/time is negotiated over the phone <input type="checkbox"/> A scheduler calls the patient to arrange an appointment date/time <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know	1 = Second and third response options, and other responses that include phone contact with patient 0 = All other responses
Patient-centered process: do prep instruction methods include opportunities for questions?	Gastroenterology survey	What is the most typical way that patients receive their colonoscopy preparation instructions at your facility? (Select One) <input type="checkbox"/> Written instructions provided with prep kit <input type="checkbox"/> Written instructions mailed separate from prep kit <input type="checkbox"/> Verbal instructions provided over the phone <input type="checkbox"/> Individual appointment <input type="checkbox"/> Group appointment <input type="checkbox"/> Other (specify): <input type="checkbox"/> Don't know	0 = Written only 1 = Verbal phone and individual appointment 2 = Group appointment and "other" responses that included written and verbal combinations
Patient-centered process: do appointment reminders review prep instruction?	Gastroenterology survey	Are preparation procedures reviewed as part of the [colonoscopy appointment] reminder? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know	0 = No reminders or reminders do not review prep 1 = Reminders review prep

number of predictors in this model in a stepwise fashion, retaining explanatory measures with $P < 0.10$. Using this final multi-variable model, we constructed model-based odds ratios (OR) and least square mean completion rate estimates (using the observed marginal distributions of the other covariates) for each of the organizational structure and process measures included in the model. To explore the impact of potentially valid reasons for not completing a follow-up colonoscopy at a VHA facility on our estimates, we fit a final set of models excluding patients who may not have been appropriate for colorectal cancer screening (i.e., age <45 or >85, with documentation of limited life expectancy in the medical record, or a colonoscopy in the prior 10 years), and treating patients who refused colonoscopy or chose to pursue colonoscopy in the private sector as having adequate follow-up. Supplementary Material S4 provides details on how we estimated

the prevalence of each of these reasons for not completing a colonoscopy.

Human subjects approval

The study was reviewed and approved by the Institutional Review Boards at the Minneapolis VA Medical Center (Minneapolis, MN; approval September 15, 2009), and the Boston VA Medical Center (Boston, MA; approval February 10, 2010).

Results

Patients included in the analysis were primarily non-Hispanic white (65%) married (53%) men (96%) older than 50 years (95%; Table 2). Roughly half (52%) lived in urban areas, and most (61%) lived less than 60 minutes from a VHA medical center

providing specialty services. A total of 20% had a personal history of colorectal polyps or benign neoplasms, 68% had a mental health or substance abuse diagnosis, and the mean Charlson comorbidity score was 1.9. Most participants (58%) had their FOBT procedures ordered at a VHA hospital, by their primary care provider (70%), and most ordering providers were physicians (72%).

Few facilities cited lack of leadership support as a barrier to improving FOBT⁺ follow-up rates, but 38 (49%) considered colonoscopy appointment availability a barrier (Table 3). A total of 36% reported tracking what happens to patients with FOBT⁺ results on a weekly or more frequent basis, but only 11% reported providing individual, frequent feedback to primary care staff about their FOBT⁺ referral practices. A higher percentage (22%) reported providing verbal, frequent feedback to gastroenterology staff about colonoscopy follow-up rates. The majority reported no incentives for primary care (56%) or gastroenterology staff (64%) tied to FOBT⁺ follow-up performance. About half (48%) reported including some information on contraindications on their colorectal cancer screening clinical reminder, and 47% reported including information on contraindications on their colonoscopy consult template.

Table 2. Characteristics of patients included in the analysis (N = 74,104)

Characteristic	N (%)
Race/ethnicity	
Native American	638 (1)
African American	12,866 (17)
Asian/Pacific Islander	1,058 (1)
White, non-Hispanic	48,018 (65)
Hispanic	4,453 (6)
Unknown	7,071 (10)
Marital status	
Married	38,887 (53)
Widowed	4,571 (6)
All others	30,391 (41)
Gender	
Male	71,067 (96)
Female	3,037 (4)
Age, y	
<50	3,352 (5)
50–64	40,513 (55)
65–84	27,725 (37)
≥85	2,514 (3)
Residence	
Urban	38,713 (52)
Rural/highly rural	35,118 (48)
Drive time to VA Medical Center	
>60 min	28,661 (39)
30–60 min	17,694 (24)
6–29 min	25,094 (34)
<6 min	2,387 (3)
Polyps or benign neoplasms	14,770 (20)
Mental health diagnoses	
No mental health diagnosis	23,958 (32)
Psychiatric only	19,383 (26)
Substance abuse only	11,341 (15)
Both psychiatric and substance abuse	19,422 (26)
Charlson comorbidity score (mean and range)	1.9 (0–19)
FOBT ordering facility is a VHA hospital	42,627 (58)
FOBT was ordered by patient's primary care provider	51,813 (70)
FOBT ordering provider type	
Physician	53,661 (72)
Nurse practitioner, physician assistant	16,203 (22)
Resident	2,686 (4)
Other	1,535 (2)

The modal surveillance interval for patients with 1–2 adenomas <1 cm was 5 years (84%). Most (70%) relied on primary care to notify gastroenterology of FOBT⁺ cases, and most (70%) did not require a separate appointment for colonoscopy prep instruction. The majority (62%) did not require a pre-op appointment for colonoscopy, and 54% reported using overbooking to minimize wasted colonoscopy appointments. Most (67%) used patient notification procedures that included some phone contact, but scheduling procedures were highly variable. The approach used to instruct patients about colonoscopy preparation was highly variable, with 44% using written methods only, 23% using verbal methods delivered by phone or an individual appointment, and 32% using group appointments or some other method involving both written and verbal instruction. Finally, most (69%) did not review prep procedures in their colonoscopy appointment reminders.

The cumulative proportion of patients with FOBT⁺ results receiving a colonoscopy at a VHA facility within 60 days was 30% (range, 10%–57% across facilities). Organizational structures significantly associated with 60-day follow-up rates in the multivariable model included: colonoscopy appointment availability is not a key barrier [OR, 1.43; confidence interval (CI), 1.09–1.90; *P* = 0.01]; and monthly or more frequent primary care feedback (OR, 1.79; CI, 1.02–3.16; *P* = 0.04; Table 4). Organizational processes significantly associated with 60-day follow-up rates in the multivariable model included: colonoscopy consult information does not ask about indication or contraindications for colonoscopy (OR, 1.48; CI, 1.07–2.05; *P* = 0.02), or asks about indication only (OR, 1.49; CI, 1.10–2.02; *P* = 0.01; a finding counter to our demand efficiency hypothesis), and gastroenterology notification directly of FOBT⁺ results by gastroenterology staff (OR, 1.85; CI, 1.17–2.91; *P* = 0.01). No patient-centered process measures were significantly associated with the 60-day outcomes in the adjusted model. After excluding potentially inappropriate FOBTs, and treating refusals and private sector colonoscopies completed after the FOBT⁺ as adequately followed up (last two columns of Table 4), the estimated follow-up rates increase markedly, and the OR estimates for colonoscopy appointment availability and gastroenterology notification remain significant. However, the OR estimates for primary care feedback, and colonoscopy consult information attenuate and are no longer statistically significant.

The cumulative proportion of patients with FOBT⁺ results receiving a colonoscopy within 6 months was 49% (range, 30%–70% across facilities). No organizational structures were significantly associated with the 6-month outcome in the multivariable model. Organizational processes significantly associated with 6-month follow-up rates in the multivariable model included using an adenoma surveillance interval of at least 5 years (5 years OR, 1.32; CI, 1.02–1.71; *P* = 0.04; 7–10 years OR, 1.57; CI, 1.11–2.20; *P* = 0.01); having gastroenterology notification directly from laboratory about FOBT⁺ cases (OR, 1.25; CI, 1.06–1.47; *P* = 0.008); and using group appointments or other combined verbal and written methods to provide patient colonoscopy prep instruction (OR, 1.48; CI, 1.22–1.79; *P* = 0.05; Table 5). After excluding potentially inappropriate FOBTs, and treating refusals and private sector colonoscopies completed after the FOBT⁺ as adequately followed up (last two columns of Table 5), the estimated follow-up rates increase to more than 67% in all subgroups, and only the estimate of group appointment for colonoscopy prep

Table 3. Distribution of facilities and patients across organizational structures and processes examined

Characteristic	Facilities (N = 98) ^a N (%)	Patients (N = 74,104) N (%)
Organizational structures		
Leadership support		
Primary care leadership support ^b		
Is a key barrier	0 (0)	0 (0)
Is not a key barrier	75 (100)	56,897 (100)
Missing	23	17,207
Gastroenterology leadership support ^c		
Is a key barrier	2 (2)	671 (1)
Is not a key barrier	78 (98)	61,171 (99)
Missing	18	12,262
Resources		
Colonoscopy appointment availability ^c		
Is a key barrier	38 (49)	37,658 (63)
Is not a key barrier	39 (51)	22,021 (37)
Missing	21	17,207
Tracking ^b		
>Weekly	15 (20)	13,340 (21)
At least weekly	27 (36)	26,513 (42)
No tracking	33 (44)	23,429 (37)
Missing	23	10,822
Feedback		
Primary care feedback ^b		
Aggregate	5 (6)	2,655 (4)
None	47 (62)	34,001 (59)
Individual, infrequent	8 (11)	6,520 (11)
Individual, frequent	16 (21)	14,394 (25)
Missing	22	16,534
Gastroenterology feedback ^c		
None	22 (27)	15,014 (24)
Written, infrequent	18 (22)	14,720 (23)
Verbal, infrequent	12 (15)	12,146 (19)
Verbal, frequent	18 (22)	13,432 (21)
Written, frequent	11 (14)	7,970 (13)
Missing	17	10,822
Incentives		
Primary care incentives ^b		
None	42 (56)	28,439 (50)
Recognition only	6 (8)	4,789 (8)
Monetary reward (alone or in combination with other strategies)	6 (8)	4,452 (8)
Reprimand (alone or in combination with recognition)	21 (28)	19,217 (34)
Missing	23	17,207
Gastroenterology incentives ^c		
None	52 (64)	37,204 (59)
Recognition only	15 (19)	12,893 (20)
Monetary reward (alone or in combination with other strategies)	7 (9)	6,257 (10)
Reprimand (alone or in combination with recognition)	7 (9)	6,599 (10)
Missing	17	10,822
Organizational processes		
Demand efficiency processes		
Contraindications on colorectal cancer screening reminder ^b		
None	39 (52)	29,996 (53)
1-2	21 (28)	14,327 (25)
3	7 (9)	4,669 (8)
4+	8 (11)	7,905 (14)
Missing	23	17,207
Information on colonoscopy consult ^b		
Contraindications	35 (47)	29,167 (51)
Indication	22 (29)	16,781 (29)
Neither	18 (24)	10,949 (19)
Missing	23	17,207
Surveillance for 1-2 adenomas <1 cm ^c		
<5 y	6 (8)	2,519 (4)
5 y	67 (84)	56,645 (90)
7-10 y	7 (9)	3,693 (6)
Missing	18	11,247

(Continued on the following page)

Table 3. Distribution of facilities and patients across organizational structures and processes examined (Cont'd)

Characteristic	Facilities (N = 98) ^a N (%)	Patients (N = 74,104) N (%)
Supply efficiency processes		
Gastroenterology notification ^c		
By primary care	55 (70)	42,829 (69)
By laboratory	19 (24)	14,005 (22)
By gastroenterology	5 (6)	5,512 (9)
Missing	19	11,758
Colonoscopy prep instruction ^c		
Separate appointment required	24 (30)	21,079 (33)
Separate appointment not required	57 (70)	42,203 (67)
Missing	17	10,822
Pre-op appointment ^c		
Required	31 (38)	28,060 (44)
Not required	50 (62)	35,222 (56)
Missing	17	10,822
Overbooking ^c		
Is used to meet colonoscopy demand	43 (54)	38,087 (60)
Is not used	24 (30)	17,427 (28)
No changes to meet colonoscopy demand	13 (16)	7,494 (12)
Missing	18	11,096
Patient-centered processes		
Patients notification ^b		
Written contact only	25 (33)	21,649 (38)
Some phone contact	50 (67)	35,248 (62)
Missing	23	17,207
Colonoscopy scheduling ^c		
Call from scheduler	25 (31)	19,560 (31)
Letter requesting patient call for appointment	11 (14)	7,887 (12)
Letter with assigned appointment	28 (35)	23,895 (38)
Other	17 (21)	11,940 (19)
Missing	17	10,822
Colonoscopy prep instruction ^c		
Verbal phone and individual appointment	19 (23)	15,965 (25)
Written only	36 (44)	23,442 (37)
Verbal group or other combined verbal/written method	16 (32)	23,875 (38)
Missing	17	10,822
Appointment reminders ^c		
Do not review prep/no reminder	25 (31)	24,385 (39)
Do review prep	56 (69)	38,897 (61)
Missing	17	10,822

^aDistribution from 81 facilities responding to the gastroenterology survey, or 76 responding to the primary care survey, depending on measure (98 facilities responded to one or both of the surveys).

^bPrimary care survey item.

^cGastroenterology survey item.

instructions remained significant (OR, 1.50; CI, 1.16–1.95; $P = 0.003$).

Discussion

Consistent with our hypothesis that organizational structures supporting quality improvement would be positively associated with follow-up rates, we found that adequacy of colonoscopy appointment availability, and providing primary care providers with individual, frequent feedback about the timeliness of FOBT⁺ referrals were positively associated with receiving follow-up colonoscopy within 60 days of an FOBT⁺. These findings are consistent with prior research documenting that limited colonoscopy capacity is the most common barrier to reducing FOBT⁺ follow-up delay (40), and that individual, frequent feedback can improve adherence to clinical practice guidelines (42, 43). However, the fact that no organizational structures were significantly associated with 6-month follow-up rates suggests that these factors have more influence on how

quickly, rather than whether, patients with FOBT⁺ results receive colonoscopy follow-up.

We found partial support for our hypotheses that higher follow-up rates would be associated with organizational processes enhancing demand efficiency, supply efficiency, and patient-centered processes. Specifically, our findings suggest that: using surveillance intervals for low-risk adenomas that are not more aggressive than recommended by guidelines (ref. 41; a demand efficiency measure); assigning responsibility for identifying FOBT⁺ cases to laboratory or gastroenterology staff (a supply efficiency measure); and using group and other combined verbal and written colonoscopy prep instruction processes (a patient-centered process) are positively associated with overall follow-up rates.

One organizational process measure (gastroenterology providers are notified by laboratory or gastroenterology staff about FOBT⁺ results) was significantly associated with both 60-day and 6-month follow-up rates. These results are consistent with findings from a prior randomized trial conducted in four VHA

Table 4. ORs, 95% CIs, and follow-up percentage estimates for organizational structures and processes derived from the original and sensitivity-adjusted^a multivariable regression models for 60-day follow-up rate outcome measure^{b,c}

Characteristic	Original multivariable estimates		Sensitivity-adjusted ^a multivariable estimates	
	OR (95% CI)	Follow-up % (95% CI)	OR (95% CI)	Follow-up % (95% CI)
Organizational structures				
Resources: colonoscopy appointment availability				
Is a key barrier	1.00	26 (23–30)	1.00	48 (43–52)
Is not a key barrier	1.43 (1.09–1.90)	34 (30–38)	1.48 (1.14–1.92)	58 (53–62)
Feedback: primary care feedback				
Aggregate	1.00	24 (16–34)	1.00	48 (37–60)
None	1.09 (0.65–1.82)	26 (22–29)	0.96 (0.59–1.58)	47 (43–51)
Individual, infrequent	1.52 (0.85–2.71)	32 (25–40)	1.32 (0.75–2.31)	55 (47–63)
Individual, frequent	1.79 (1.02–3.16)	36 (30–43)	1.71 (0.99–2.97)	61 (54–68)
Organizational processes				
Demand efficiency processes: information on colonoscopy consult				
Contraindications	1.00	25 (22–29)	1.00	48 (44–53)
Indication	1.49 (1.10–2.02)	33 (28–40)	1.30 (0.96–1.74)	55 (49–61)
Neither	1.48 (1.07–2.05)	33 (27–40)	1.19 (0.86–1.63)	53 (46–60)
Supply efficiency processes: gastroenterology notification				
By primary care	1.00	26 (24–30)	1.00	48 (45–52)
By laboratory	1.36 (0.97–1.90)	33 (26–40)	1.24 (0.89–1.73)	54 (46–61)
By gastroenterology	1.85 (1.17–2.91)	40 (30–50)	1.82 (1.17–2.83)	63 (53–72)

^aExcluding patients who may not have been appropriate for colorectal cancer screening (age <45 or >85, documentation of limited life expectancy in the medical record, or colonoscopy in the prior 10 years), and treating patients who refused colonoscopy or chose to pursue colonoscopy in the private sector as having adequate follow-up.

^bBold ORs are significant at $P < 0.05$.

^cORs for the individual-level factors controlled for in the 60-day model (age, race, residence, drive time to the nearest VHA specialty care facility, personal history of colorectal polyps or benign neoplasms, Charlson comorbidity score for the 1 year before the FOBT⁺ result, mental health diagnoses, whether the FOBT was ordered by their primary care provider, and what type of facility ordered their FOBT) are provided in Supplementary Table S2.

facilities, which found 30-day, 90-day, and 6-month follow-up rates improved significantly (by 9%–31%; $P < 0.03$) in facilities that implemented an electronic intervention to directly notify gastroenterology staff of FOBT⁺ results, but did not significantly change in the usual care comparison facilities (44).

Counter to our hypothesis that organizational processes designed to reduce unnecessary demand for colonoscopy would be positively associated with follow-up rates, we found facilities that asked about contraindications on colonoscopy consult templates had lower rather than higher 60-day follow-up rates. This finding might be explained by the fact that patients with documented limited life expectancy, recent colonoscopy, and refusal to complete follow-up colonoscopy were not initially excluded from our sample. Indeed, after excluding these cases from the analysis, the association of consult template characteristics with follow-up rates was no longer statistically significant. Thus, including information on contraindications on the colonoscopy consult template may identify individuals who should not have been screened, and some of these individuals appropriately do not have follow-up colonoscopy.

We hypothesized that colonoscopy prep instruction processes that involve some verbal instruction would be associated with higher follow-up rates than methods that involved only written instruction because verbal instruction processes would provide more opportunities to address patient questions. However, our findings suggest that some forms of verbal instruction (i.e., phone and individual appointments) were associated with lower 6-month follow-up rates than written only instruction methods. Because we did not collect information on the specific content of the prep instruction provided, we can only speculate about why group preparation instruction and other combined verbal and written methods were superior to verbal phone and individual appointment instruction. One possibility is that

group prep appointments and other combined methods may use a more structured approach than other verbal instruction methods, and so are more likely to encourage patients to identify and clarify aspects of the preparation they do not understand. Alternatively, the group/peer setting and other combined approaches may prompt greater patient engagement. The resulting enhanced clarification and/or engagement may increase the proportion of patients that attend their scheduled colonoscopy appointment and present with adequate bowel preparation, thereby reducing delays associated with needing to reschedule colonoscopy appointments. A final possibility is that instruction approaches that require patients to complete a group class or other formal instruction before scheduling a colonoscopy lead to self-selection of individuals that are more likely to adhere to their colonoscopy appointment. All of these explanations are consistent with findings from one prior study, which found that patients participating in a nurse-led group colonoscopy prep education program had higher colonoscopy completion rates and lower cancellation rates due to poor bowel preparation than patients who received an educational brochure only (45). Our finding that other measures of patient-centered processes (phone results notification, negotiated appointment scheduling, and appointment reminders that review prep instructions) were not associated with follow-up rates contrasts with previous studies attributing high endoscopy attendance to patient-centered processes such as education (46) and reminder systems (47, 48), may be unique to this patient population trained in the hierarchical traditions of the military, and may not generalize to other health care settings.

This study has a number of strengths, including the large sample size of patients and medical facilities, the rigorous methodology used to adjust our estimates for reasons a colonoscopy was not completed, and the fact that it identifies several

Table 5. ORs, follow-up percentage estimates, and 95% CIs for organizational processes significantly associated with 6-month follow-up rates in original and sensitivity-adjusted^a multivariable logistic regression models^{b,c}

Characteristic	Original multivariable estimates		Sensitivity-adjusted ^a multivariable estimates	
	OR (95% CI)	Follow-up % (95% CI)	OR (95% CI)	Follow-up % (95% CI)
Demand efficiency processes: surveillance for 1–2 adenomas <1 cm				
<5 y	1.00	42 (36–48)	1.00	70 (63–76)
5 y	1.32 (1.02–1.71)	49 (47–50)	1.14 (0.80–1.62)	73 (71–75)
7–10 y	1.57 (1.11–2.20)	53 (47–58)	1.33 (0.84–2.12)	76 (70–82)
Supply efficiency processes: gastroenterology notification				
By primary care	1.00	47 (45–49)	1.00	72 (69–74)
By laboratory	1.25 (1.06–1.47)	52 (49–56)	1.18 (0.94–1.48)	75 (71–78)
By gastroenterology	1.31 (0.99–1.73)	53 (47–60)	1.43 (0.98–2.10)	78 (72–84)
Patient-centered processes: colonoscopy prep instruction				
Verbal phone or individual appointment	1.00	43 (40–47)	1.00	68 (64–72)
Written only	1.18 (1.00–1.40)	48 (45–50)	1.22 (0.97–1.53)	72 (69–75)
Verbal group appointment or other combined verbal/written method	1.48 (1.22–1.79)	53 (50–56)	1.50 (1.16–1.95)	76 (73–79)

^aExcluding patients who may not have been appropriate for colorectal cancer screening (age <45 or >85, documentation of limited life expectancy in the medical record, or colonoscopy in the prior 10 years), and treating patients who refused colonoscopy or chose to pursue colonoscopy in the private sector as having adequate follow-up.

^bBold ORs are significant at $P < 0.05$.

^cORs for the individual-level factors controlled for in the 6-month model (age, race, residence, drive time to the nearest VHA specialty care facility, personal history of colorectal polyps or benign neoplasms, Charlson comorbidity score for the 1 year before the FOBT⁺ result, mental health diagnoses, whether the FOBT was ordered by their primary care provider, what type of provider ordered their FOBT, and what type of facility ordered their FOBT) are provided in Supplementary Table S2.

modifiable organizational predictors of FOBT⁺ follow-up rates. However, our findings should be qualified by several limitations. First, we may be underestimating actual follow-up rates because some patients with FOBT⁺ results may have pursued colonoscopy outside of the VHA. Indeed secondary analyses we conducted on this cohort suggest that up to 15% of patients with FOBT⁺ results who did not receive a colonoscopy in VHA within 6 months had documentation in their chart notes that they were pursuing colonoscopy in the private sector. However, sensitivity analyses treating patients with documentation of pursuing colonoscopy in the private sector as adequately followed up did not significantly alter the pattern of associations between organizational factors and follow-up rates reported here. A second possible limitation is that our measures of organizational structures and processes may include some measurement error. Structure and process reports from chiefs were measured at one point in time, in most cases with single-item measures, and may therefore be inaccurate (given that facilities may make periodic adjustments to structures and processes) or insufficiently sensitive (from oversimplification of the underlying processes). Furthermore, lack of variability in our sample forced us to collapse potentially distinct categories for several measures. Future studies should examine whether more detailed measures in more variable facility samples yield different results. In addition, our analysis excluded 12,822 FOBT⁺ patients from 25 facilities with incomplete facility survey data, and 10,806 FOBT⁺ from 43 facilities conducting fewer than 1,400 FOBTs in 2009, which may raise concerns about whether our findings can be generalized to FOBT⁺ patients from other VHA facilities in the sampling frame. However, our previous analysis of the survey data found no significant variation in facility FOBT⁺ follow-up rates or characteristics by survey response status (32), and facilities excluded on the basis of FOBT volume represented not only smaller facilities with FOBT-based screening programs, but also larger facilities with colonoscopy-based screening programs. Finally, the VHA is a unique context, characterized by a predom-

inantly male, low-income population with higher than average comorbidity burden, including high rates of mental health and substance abuse diagnoses. Therefore, our findings may not generalize to other health care contexts. Given that VHA is the largest integrated health care system in the United States, however, our findings have important implications for a substantial population of health providers and consumers in this country.

Despite these limitations, the insights gleaned from this study regarding the role organizational structures and processes can play in assuring patients with FOBT⁺ results receive timely colonoscopy will be helpful in guiding future efforts to improve FOBT⁺ follow-up rates. Specifically, our most robust findings suggest that gastroenterology clinics may be able to significantly increase the proportion of FOBT⁺ results that receive follow-up colonoscopy by assuming responsibility for identifying FOBT⁺ results, and using prep education processes that include both written and verbal information, but to increase the proportion of FOBT⁺ patients that receive follow-up colonoscopy within 60 days, it may be necessary to increase colonoscopy appointment availability. Given that the significant organizational-level predictors of follow-up rates we identified all had modest effects (i.e., resulting in at most 5%–14% differences in follow-up rates), multifaceted strategies designed not only to increase colonoscopy follow-up for FOBT⁺ results, but also to reduce FOBT use in patients who would not complete colonoscopy follow-up due to contraindications or personal preference, may be needed to close remaining gaps. A fruitful area for future research would be the evaluation of such multifaceted strategies.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

Disclaimer

The views expressed in this article are those of the authors and do not necessarily represent the position or policy of the Department of Veterans Affairs or the NIH.

Authors' Contributions

Conception and design: M.R. Partin, D.J. Burgess, J.F. Burgess Jr, D. Haggstrom, A.A. Powell, L.C. Walter, D.B. Nelson

Development of methodology: J.F. Burgess Jr, A. Gravely, S. Nugent, A. Shaukat, D.B. Nelson

Acquisition of data (provided animals, acquired and managed patients, provided facilities, etc.): M.R. Partin, S.E. Lillie, S. Nugent, A.A. Powell

Analysis and interpretation of data (e.g., statistical analysis, biostatistics, computational analysis): M.R. Partin, D.J. Burgess, A. Gravely, D. Haggstrom, A.A. Powell, A. Shaukat, L.C. Walter, D.B. Nelson

Writing, review, and/or revision of the manuscript: M.R. Partin, D.J. Burgess, J.F. Burgess Jr, A. Gravely, D. Haggstrom, S.E. Lillie, S. Nugent, A.A. Powell, A. Shaukat, L.C. Walter, D.B. Nelson

Administrative, technical, or material support (i.e., reporting or organizing data, constructing databases): A. Gravely, S. Nugent

Study supervision: M.R. Partin

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