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Patient randomized trial of a targeted navigation program to improve rates of follow-up colonoscopy in community health centers

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Abstract

Background: Colorectal cancer (CRC) screening by annual fecal immunochemical test (FIT) is an accessible and cost-effective strategy to lower CRC incidence and mortality. However, this mode of screening depends on follow-up colonoscopy after a positive FIT result. Unfortunately, nearly one-half of FIT-positive patients fail to complete this essential screening component. Patient navigation may improve follow-up colonoscopy adherence. To deliver patient navigation cost-effectively, health centers could target navigation to patients who are unlikely to complete the procedure on their own.

Objectives: The Predicting and Addressing Colonoscopy Non-adherence in Community Settings (PRECISE) clinical trial will validate a risk model of follow-up colonoscopy adherence and test whether patient navigation raises rates of colonoscopy adherence overall and among patients in each probability stratum (low, moderate, and high probability of adherence without intervention).

Methods: PRECISE is a collaboration with a large community health center whose patient population is 37% Latino. Eligible patients will be aged 50–75, have an abnormal FIT result in the

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past month, and be due for a follow-up colonoscopy. Patients will be randomized to patient navigation or usual care. Primary outcomes will be colonoscopy completion within one year of a positive FIT result, cost, and cost-effectiveness. Secondary outcomes will include time to colonoscopy receipt, adequacy of bowel prep, and communication of results to primary care providers. Primary and secondary outcomes will be reported overall and by probability stratum.

Discussion: This innovative clinical trial will test the effectiveness and financial feasibility of using a precision health intervention to improve CRC screening completion in community health centers.

Keywords

Colorectal cancer screening; fecal immunochemical testing (FIT); prediction; patient navigation

1. INTRODUCTION

Colorectal cancer (CRC) claimed the lives of an estimated 50,000 adults in the US in 2018.[1] Improving screening through fecal immunochemical testing (FIT) could reduce CRC mortality by more than 50%, representing over 25,000 lives saved.[2] These mortality reductions, however, can only be achieved if patients with positive fecal test results receive follow-up colonoscopies.[3, 4] Unfortunately, failure to receive follow-up is common, especially among underserved populations: In studies that performed full medical record review, only 52 – 58% of patients in community health centers with an abnormal FIT result completed a follow-up colonoscopy.[5–7] In a recent San Diego-based study that obtained follow-up colonoscopy rates from eight community health centers, the 6-month colonoscopy completion rate was 44% overall, and ranged from 18% to 57%.[8] This is troubling because delays in follow-up colonoscopy can lead to increases in CRC incidence and mortality. Lee and colleagues reported a 31% higher risk of CRC and a two-fold higher risk for advanced stage disease among adults who delayed colonoscopy by 6 months or more (compared to obtaining a colonoscopy within 1–3 months).[9] Meester and colleagues used modeling to predict a 4% elevated CRC incidence and 16% elevated mortality among adults who delayed follow-up colonoscopy by 12 months versus 2-weeks.[10] In a Kaiser Permanente study, delays of 10 months or longer were associated with a 48% increased the risk of CRC and a two-fold increased risk for advanced-stage disease (compared to colonoscopy within 30 days).[11] Although much research has focused on the uptake of FIT screening, an important gap remains in knowledge of effective interventions for improving follow-up colonoscopy rates.

Fortunately, an emerging body of research suggests that patient navigation may be effective in increasing completion of CRC screening and follow-up. A patient navigator is a person who helps guide a patient through the healthcare system, by helping them communicate with their healthcare provider, set up healthcare appointments, and access needed community resources. Patient navigation has boosted rates of CRC screening and follow-up in several previous reports, with effect sizes ranging from 8–31%.[12–17] In the New Hampshire Colorectal Cancer Screening Program (NHCRCSP),[18] for example, patient navigation raised rates of colonoscopy uptake among low-income, uninsured patients, by 27 percentage points over a comparable clinic population (96% vs 69%, P<.001)[13]. However, patient navigation is

costly to implement, and providing this intervention to every patient is inefficient. To improve screening outcomes in a financially sustainable way, it may be necessary to identify which patients would most benefit from patient navigation and deliver navigation specifically to these patients.

Our team previously developed a risk-prediction model evaluating likelihood to obtain a follow-up colonoscopy after a positive FIT result using data from a large pragmatic study involving 26 community health center clinics (STOP CRC).[19] The current study will refine this model and apply it to a new population of patients who receive care at a large diverse federally qualified health center in Western Washington. Knowing which patients could benefit from patient navigation could allow health systems to optimize the delivery of these services, address health disparities, and reduce associated costs. The Predicting and Addressing Colonoscopy Non-adherence in Community Settings (PRECISE) trial will test the effectiveness and cost-effectiveness of providing patient navigation for follow-up colonoscopy to patients who vary in their probability of obtaining one on their own. In this paper we will describe the PRECISE study protocol.

2. MATERIALS AND METHODS

PRECISE is a large-scale patient-randomized controlled trial that will include 1,200 patients at 28 community health center clinics. The study will externally validate and, if needed, redevelop our previously developed risk prediction model,[19] then compare rates of follow-up colonoscopy completion in 1200 patients who are randomized to receive either a telephone-based program of patient navigation delivered by trained clinical staff or usual care. Secondarily, we will assess the effectiveness of the patient navigation program within groups defined by follow-up colonoscopy adherence probability (determined by the risk prediction model).

PRECISE has obtained approval from the Kaiser Permanente Northwest Institutional Review Board (IRB protocol number: 00000779), which has granted a waiver of informed consent, because the study involves minimal risks to patients. The study will be monitored by a data safety monitor, following an established data safety monitoring plan. The plan outlines the contents of reports to be discussed at regular meetings of the study team and monitor, and a process for reporting adverse events. Study protocol amendments will be documented on an on-going basis.

2.1 SETTING

This study will be conducted at Sea Mar Community Health Centers (Sea Mar), which operate 32 medical clinics. Sea Mar serves about 300,000 patients, about 29,000 of whom are age-eligible for CRC screening. Approximately 37% of Sea Mar patients are Latino. Sea Mar has a fully integrated electronic health record platform tailored for primary care (Allscripts, Chicago, Illinois).

CRC screening is available for all screening- and age-eligible Sea Mar patients, with the choice of screening test at the discretion of the patient and their primary care provider. Sea Mar promotes CRC screening in multiple ways. Providers distribute FIT kits to patients who

are due during routine clinic visits. In addition, Sea Mar operates a centralized mailed FIT outreach program that mails up to 1,000 kits each month. Mailed FITs are sent with wordless instructions, and a letter that describes the importance of CRC and the need for screening.[20] Sea Mar's Uniform Data System CRC screening rate for 2018 was 44.6%. Sea Mar uses a one-sample FIT test {OC-Auto® by PolyMedco (Cortland Manor, NY)), that is processed at their centralized on-site laboratory.

The average FIT-positivity rate at Sea Mar is 9%, yielding approximately 700 patients with a positive FIT test each year. Sea Mar has no on-site colonoscopy services; instead patients who need a colonoscopy are referred to one of numerous gastroenterology specialty care facilities (hospital or ambulatory surgical center) in the region.

2.2 RESEARCH AIMS

Our study has the following aims:

1. Externally validate our previously developed predictive risk model for follow-up colonoscopy-adherence on Sea Mar's population; adapt patient navigation program for local needs and resources; and train navigator staff.
2. Assess the effectiveness, cost, and cost-effectiveness of a centralized, phone-based patient navigation program for follow-up colonoscopy receipt for patients with a positive FIT result.
3. Assess effects of the patient navigation intervention on secondary outcomes (time to colonoscopy receipt, colonoscopy quality, and results communicated to health center); assess potential moderators of intervention effectiveness (e.g. colonoscopy completion probability level, intervention dose, and patients' sex, age, preferred language, Hispanic ethnicity, and insurance status); assess patient and provider satisfaction with navigation.

2.3 Aim 1: VALIDATE PREDICTIVE RISK MODEL, ADAPT PROGRAM, AND TRAIN PATIENT NAVIGATOR

The objectives of Aim 1 are to validate the risk prediction model, adapt the patient navigation program for local resources and preferences, and train the patient navigator staff.

Risk prediction model validation: The first phase of the PRECISE study will validate the risk prediction model that our team developed using data from the STOP CRC study involving eight federally qualified health centers in Oregon and California (1596 patients with a positive FIT; c-statistic > 0.66, bootstrap-corrected c-statistic > 0.62).[19] We will validate the model in a retrospective cohort of Sea Mar patients with a positive FIT result (N = 1401), identified over a two-year period. We will calculate each patient's predicted probability of obtaining a colonoscopy based on the Cox regression model's exact linear predictor using coefficients derived from the original model.[19] We will determine the external validation's separation (discrimination) of low-, moderate-, and high- probability patients by calculating the c-statistic and comparing it with the original cohort's bootstrap corrected c-statistic (0.63).[21, 22] A drop in the c-statistic of 0.05 or more from the original model will be considered inferior separation of patients and will require model refinement.

While we anticipate high capture of data elements for the risk model, if any of the required predictor characteristics are missing, we will impute their values using multiple imputation with chained equations.[23–25]

Adaptation of Patient Navigation Program: We will adapt the NHCRCSP patient navigation program for local needs and resources. The NHCRCSP patient navigation program[18] consists of six topic-areas that address establishing rapport, identifying and resolving barriers, bowel-preparation education, obtaining and completing bowel preparation, post-colonoscopy support, and understanding of results and rescreening interval. During patient contacts, navigators will assess the patient's understanding of each step in the colonoscopy procedure (e.g., obtaining laxative, finding someone to accompany them to the procedure), gather and document barriers, and obtain/confirm emergency contact numbers. The patient navigator will use video-phone calls as available and consistent with patients' preferences. The patient navigator may use text messages in place of phone calls for contacts made 1–2 days before the colonoscopy procedure and the day of the colonoscopy procedure, consistent with patients' preferences.

While some NHCRCSP materials can be used without modification, some will be tailored to reflect local resources and logistical processes within the Sea Mar environment. We will collaborate with Sea Mar staff to obtain local information about referring gastroenterology sites, colonoscopy preparation methods used, and resources for low-cost colonoscopy, including ways to enroll in insurance plans and community programs for donated colonoscopies. We will develop the following patient-facing materials to support the program: an introductory packet, containing a letter introducing the program and providing a telephone number of the patient navigator, a one-page navigation sheet detailing the topic areas and timing of navigation phone calls, and one-page fact sheet emphasizing the importance of CRC screening. In addition, we will develop resources sheets for the navigator, including (1) a one-page informational sheet describing instructions for the two most common types of colonoscopy preparation; and (2) an on-line spreadsheet detailing colonoscopy preparation and transportation policies for all referring gastroenterology providers. All materials will be reviewed by the project's advisory board and members of Sea Mar clinical staff. Consistent with the language preferences of Sea Mar staff, all patient-facing materials will be available in English, Spanish, and Russian.

Patient navigator training: The study navigator will be hired by the clinic. The navigator will have some clinical experience (e.g., nurse, medical assistant, care coordinator), will speak English and Spanish, will work on evenings and weekends, and will have access to medical records of patients with positive FIT results. Training in the NHCRCSP will be delivered by members of the project team, including the project Principal Investigator (bilingual English and Spanish), research associate, counselor (bilingual English and Spanish) and project gastroenterologist. Training will consist of an initial two-day didactic session focused on CRC screening and follow-up colonoscopy, followed by two one-day interactive sessions focused on motivational interviewing and how to use the cloud-based project database, followed by seven weeks of coaching and feedback to ensure that the patient navigator successfully completes the six-topic phone protocol and tracking

procedures. The training and coaching and feedback sessions will be delivered in English and Spanish to assure equivalency of intervention delivery across languages. Additionally, the navigator will meet with community-based organizations to learn how to connect patients with resources to address barriers including cost and transportation. During the training period, the navigator will also accompany a patient to his or her colonoscopy appointment to learn more about the overall process (i.e., registration, escort and transportation policies) and patient experience.

2.4 Aim 2: EVALUATE NAVIGATION INTERVENTION

Selection of eligible participants: Patients initially eligible for the study will be selected using electronic health record codes; they will be aged 50–75, have had a positive FIT result in the past month, and will not have electronic health record evidence of having a recent prior colonoscopy (within 3 years), metastatic cancer (ever) or being on hospice (ever). Prior to randomization, the medical records of initially eligible patients will be reviewed by the navigator and clinical champion, with guidance from the project gastroenterologist, to remove any patients who have had a recent colonoscopy (not detected by using medical record codes) or have other health conditions that contraindicate colonoscopy (e.g. shortened life expectancy, etc.). Patients with colorectal symptoms will also be excluded (i.e. inappropriate indication for FIT testing).

Randomization: Patients will be randomized using a stratified approach that considers county of residence (Skagit, Snohomish, King, Pierce, Thurston, Whatcom, Clark, and Grays Harbor). Patients will be randomly allocated to either receive the intervention or usual care. Randomization will be performed by the clinic data analyst, using program coding created by the project statistician. For practical reasons, neither the research team, the navigator nor the clinic staff will be blinded to randomization assignment. Allocation will be concealed for members of the research team performing outcome ascertainment. The randomization will result in 600 patients assigned to the patient navigation arm and 600 assigned to the usual care arm. Participants will be randomized into the study within 1 month of their FIT result. Following randomization, the project analyst will calculate and assign the patients' probability of receiving a follow-up colonoscopy, based on the risk prediction model.

We anticipate that a small number of patients will be ineligible for the study after randomization (i.e. randomized in error), either because of clinical factors (i.e. had a recent colonoscopy, or life-limiting co-morbidities) or patient factors (i.e. they transferred care or moved from the region, etc.) not discovered using medical record codes. We will track navigated patients who are randomized in error and review medical records to capture 'randomized in error' patients assigned to usual care.

Follow-up colonoscopy referral procedures: When patients receive a positive FIT result, the provider places a referral for a colonoscopy in the medical record and the team medical assistant contacts the patient (usually by phone) to notify the patient of their test result and provide instruction on how to schedule a colonoscopy with the referring provider. For the purposes of the study, the referral and notification procedures will continue as usual

care. The intervention will not be overlaid on the remaining components of usual care (telephone outreach by a referral coordinator). Instead, the medical records of patients randomized to the intervention will be flagged and removed from the referral coordinators' outreach lists so these patients will not receive standard care outreach.

Usual care: Usual care consists of a team of centralized referral coordinators who make monthly outreach attempts by phone to patients who have not completed a colonoscopy and whose referral is pending. Two follow-up phone call attempts are made at 30 and 45 days following the referral. If the patient is not reached, a follow-up letter is sent to the patient and gastroenterology office. The purpose of the letter is to inform the practice that the patient is unreachable and to inquire about the status of the referral (i.e. whether the patient has scheduled an appointment or completed a colonoscopy).

Intervention: Patients randomized to the patient navigation intervention will be mailed an introduction packet, then the navigator will deliver follow-up phone calls; up to 18 phone call attempts will be made to reach a patient before the patient is considered lost to follow-up. After the initial contact is made, the navigator will make up to an additional 18 call attempts to assess and resolve barriers with the patient. Once the patient schedules a colonoscopy, navigator phone calls will be timed to the colonoscopy procedure. One week before the colonoscopy, the navigator will make up to 6 call attempts to review the bowel preparation instructions and ensure that the patient has obtained the necessary preparation supplies. On the day before and day of the colonoscopy, the navigator will check-in with the patient by voicemail or text message. Two to four weeks after the colonoscopy, the navigator will make up to 6 call attempts to confirm that the patient has received and understands the results. We anticipate that most navigator contacts will occur in the first 3 months following randomization, contacts may occur up to 1- year following randomization.

The Navigator will maintain a log of navigator activities and program outcomes in a cloud-based database; the database will record: (1) patient contacts; (2) patient barriers and referrals to community resources, (3) canceled and rescheduled appointments, (4) completed colonoscopy procedures, and (5) reasons for discontinuation, exclusion or non-adherence to the program. Using the electronic health record, the navigator will send notes to the care team, to record any relevant patient status updates (e.g. patient deceased) obtained during navigation. The navigator will use the on-line resource spreadsheet, as needed, to advise patients on gastroenterology facility-specific resources or procedures.

The project team will undertake several procedures to monitor adherence to the intervention. The trainers will administer a training competency checklist to assure that the navigator achieves an established competency. The checklist was developed by the University of Washington for the NHCRCSP program and adapted for our project (See Supplement). We will assess intervention fidelity to ensure that the program is delivered as intended. We will measure fidelity as the proportion of patients for whom all relevant topic areas were discussed, and/ or the proportion of patients for whom the appropriate number and timing of attempts were made (in accordance with the study protocol). The project team will review intervention fidelity on a quarterly basis. The Data Safety Monitoring Plan will be followed to monitor the progress of the study; the plan includes processes for reporting recruitment

success, stopping rules, and adverse events. We will not obtain patient consents, as our study is deemed minimal risk.

Data collection: The electronic health record and a cloud-based database will be used to gather data for the study. Study retention will be promoted by (1) the navigator making up to 18 call attempts to reach the patient (call attempts will be made during the day, evenings, and weekends), (2) using all phone numbers available in the medical record to reach the patient; and (3) requesting from the patient contact information of someone who will know how to reach the patient.

Given the planned contact between patient navigators and patients randomized to receive navigation, it is possible that we will have better data capture among navigated, compared to usual care patients. To minimize possible bias, we will use chart audits to track primary and secondary outcomes in the medical record. Moreover, we will systematically request (for usual care and intervention patients) gastroenterology procedure and pathology reports from gastroenterology facilities to which patients have been referred and for whom there is no primary care record of a completed colonoscopy.

Assessment of effectiveness: We will evaluate intervention effectiveness by measuring the proportion of patients in each study arm who obtain a follow-up colonoscopy within one year of having a positive FIT result (Table 1). We hypothesize that a higher proportion of navigated patients, compared to non-navigated patients, will complete follow-up colonoscopy within one year. Secondarily, the effectiveness of patient navigation will be assessed across the probability categories of receiving a colonoscopy (low, moderate, high) assigned using the prediction model. We will assess colonoscopy receipt through chart audit, and records requests from gastroenterology facilities. Primary analyses will rely on intention-to-treat; that is, patients will retain their randomization assignment irrespective of whether they received patient navigation, with exclusion of patients who were randomized in error (i.e. were found to have had a recent colonoscopy or are clinically ineligible for a colonoscopy). Because we do not anticipate having auxiliary variables that correlate greater than .50 with the outcome that would allow us to use multiple imputation,[26, 27] we will handle missing outcome data for eligible patients who are lost to follow-up by assuming these patients did not complete a colonoscopy. In addition, we will conduct a sensitivity analysis by dropping patients with missing outcome data (i.e., listwise deletion).

Statistical analysis: We will use hierarchical generalized linear modeling[28] to account for clustering of patients within clinics. Because the primary outcome is binary (i.e., follow-up colonoscopy, yes/no), we will use a model with a logit link and binomial distribution (i.e., multilevel logistic regression). The independent variable will be arm (dummy-coded) with usual care as the reference group. ‘Clinic’ will be modeled as a random effect. Odds ratios >1 support the hypothesis that patient navigation has a higher follow-up proportion than usual care.

Sample size and power: Based on data from prior studies, we expect that 9% of patients (700 per year) will have a positive FIT, and 44% of patients under usual care will complete a follow-up colonoscopy within 1 year (based on chart abstracted data from 08/05/2017 to

08/04/2018 (N = 715 charts)). Accounting for patient ineligibility, we estimated power using a sample size of 1200 abnormal FIT results and a conservative intra-class correlation (ICC) of .03. Based on these estimates, in a logistic regression framework at a two-tailed alpha level of 0.05, we will have 80% power to detect a difference in follow-up rates of 12.9% (corresponding to an intervention completion rate of 56.9%, OR=1.68) when accounting for the ICC and a difference of 9.2% (corresponding to an intervention completion rate of 53.2%, OR=1.45), assuming no design effect from the ICC.[29, 30]

Assessment of cost and cost-effectiveness: We will assess the costs of implementing and maintaining the patient navigation program at the patient level using cost collection strategies adapted from other programs.[31–33] We will estimate how costs of patient navigation would differ depending on whether it is delivered as a service to all patients or restricted to subgroups whose baseline characteristics (described below) are associated with the greatest treatment effect of patient navigation. Next, using the framework of cost-effectiveness, we will estimate the incremental cost-effectiveness ratio as (1) cost per additional completed colonoscopy, (2) cost per additional adenoma detected, and (3) cost per additional cancer detected. To further evaluate the impact of specific program elements on cost, we will conduct sensitivity analyses on patient and system characteristics (e.g. changes in population sizes, baseline predicted likelihood of colonoscopy, etc.).

2.5 AIM 3: ASSESS SECONDARY OUTCOMES AND MODERATORS OF EFFECTIVENESS

We will gather data from the electronic health record on time to colonoscopy completion. We will use Cox proportional hazards regression models with shared frailty to evaluate differences between arms in time to colonoscopy completion.[34] We hypothesize that navigated patients will have a shorter time to colonoscopy than non-navigated patients. The Population-based Research to Optimize the Screening Process (PROSPR) consortium has recommended performing a colonoscopy within 90 days of a positive FIT test result[35] and delays of 6, 10, and 12 months or more have been shown to predict poorer CRC outcomes.[9–11] Significant hazard ratios >1 would indicate that the patient navigation arm experienced shorter times to colonoscopy completion than usual care. We anticipate finding up to 60 new cancers (1200 abnormal FIT results * 5% PPV for cancer).

Using the procedure and pathology reports, we will also track colonoscopy-related quality measures, including adequacy of colonoscopy preparation, and detection of adenomas and cancer. For binary secondary outcome and process measures (e.g. adequacy of bowel preparation communication of result to primary care provider), we will use the same modeling framework (e.g., multilevel logistic regression) as described for our primary outcome. Bowel preparation quality is rated according to a qualitative metric (poor, fair, good, excellent) or the Boston Bowel Preparation Score. A qualitative rating of poor or Boston Bowel Preparation Score of less than 6 overall or less than 2 for any segment will be considered inadequate. Bowel preparation also will be considered inadequate if alterations are made to rescreening interval because of bowel preparation quality.

Secondarily, we will assess whether the effectiveness of patient navigation differs by patient characteristics (e.g. patients' probability of colonoscopy completion, sex, age, preferred

language, Hispanic ethnicity, and insurance status) and intervention delivery (e.g. intervention dose). We will assess modification effects by adding these variables and their products with arm to the primary outcome model. The product represents the interaction of arm and patient characteristic / intervention delivery; a significant term provides evidence for effect modification. We will graph the simple effects (predicted probabilities) for any significant product terms to understand the nature of the effect modification.

We will track receipt of appropriate GI referral among patients allocated to navigation and usual care. In addition, we will track missed and canceled appointments in a subset of patients who are referred to GI practices with electronic portals that can be accessed by Sea Mar staff. Neither GI referrals nor missed and canceled appointments will be considered a secondary outcome.

Intervention dose: To evaluate the implementation of the intervention, we will track consistency of intervention dose: the number and content of successful outreach attempts delivered by patient navigators based on contacts. The standard protocol includes six pre-defined content areas. Dose will be calculated as the proportion of these six content areas addressed for each participant. We will also use medical record telephone encounters to calculate patient contact made by referral coordinators as part of usual care.

Qualitative data collection: We will conduct qualitative interviews with patients, patient navigators, clinic staff, and gastroenterology office providers and staff. Our qualitative team will conduct one-on-one phone interviews (n=~60) in English or Spanish with a sample of randomized patients at various Sea Mar clinics who received usual care or the patient navigation interventions. From each group, we will select a sample of FIT-positive patients across probability categories (high, moderate, and low probability of adherence) who underwent follow-up colonoscopy, as well as a sample of patients who did not complete follow-up colonoscopy. The interviews will assess persistent barriers that hinder participation in colonoscopy and identify program components that could enhance effectiveness. Interviews will explore reasons for getting or not getting a follow-up colonoscopy, as well as awareness of colonoscopy, previous colorectal cancer screening history, understanding of colonoscopy preparation social support, and general reaction to the program. We will also gather any unanticipated consequences of the program (both positive and negative).

We will conduct 25–30 one-on-one debrief interviews with patient navigators and identified clinic leadership/ staff and gastroenterology office staff/providers to understand adaptations to the program and factors that could influence sustainability. These interviews also will explore unanticipated consequences and persistent barriers to follow-up colonoscopy. Members of our advisory board will review de-identified data and assist in interpreting the findings of coded interviews. Findings from the interviews will inform future implementation of the patient navigation program and will be used to develop content for dissemination materials (e.g. implementation guide, training manuals).

3. DISCUSSION

Numerous national organizations, including the Institute for Healthcare Improvement, have called for an increase in personalized care delivered to those most likely to benefit.[30] Electronic health record data provide an unprecedented opportunity to identify patients at high risk of an event so that care can be tailored.[36] PRECISE will use electronic health record data to understand patients' likelihood to obtain a follow-up colonoscopy, with the ultimate goal of directing resources to patients who need it the most. PRECISE will evaluate the effects of this intervention on patient outcomes and will conduct an economic analysis to inform health system decision-making regarding adoption of a risk-based approach to tailoring patient navigation programs. If it is effective, PRECISE will facilitate the broad adoption of precision patient navigation programs and promote Institute of Medicine directives to deliver the right intervention to the right patient at the right time.

Risk-prediction models hold promise for identifying patients who are likely to forgo colonoscopy. While no previous model has assessed the risk of forgoing follow-up colonoscopy after a positive FIT result, two models have been developed to identify patients unlikely to obtain an initial screening colonoscopy based on academic primary care networks and integrated care systems. However, since rates of colonoscopy are higher in these settings than in community health centers, and because providers have access to more data elements for the models,[37, 38] these scores are not generalizable to community health centers. Moreover, it is unlikely that a scoring system for initial colonoscopy would generalize to follow-up colonoscopies. Our team has developed the first risk-prediction model specifically for follow-up colonoscopy receipt using data from a previous pragmatic clinical trial involving 26 health center clinics. Validating and using this tool to identify candidates for a patient navigator intervention will allow us to test the utility of risk prediction models for identifying and intervening on patients to increase colorectal cancer screening and early detection.

Our design will answer a unique pragmatic question: is patient navigation an effective approach to address low rates of follow-up colonoscopy? Secondarily, does the effectiveness of patient navigation differ by patients' probability of completing a colonoscopy? If successful, our program could allow health systems to tailor their patient navigation programs, overcome key barriers to sustaining patient navigation programs (including cost), and catalyze sustained impact on the field.

The study setting provides an opportunity to conduct a randomized trial within a large, diverse health center that primarily uses FIT for first-line colorectal cancer screening and will yield high data capture. Our study clinics serve socio-demographically diverse patients; we will analyze differences in intervention effect across relevant patient characteristics, including sex, age, preferred language, Hispanic ethnicity, and insurance status. Our program will be delivered pragmatically by clinic staff.

We are conducting this research in safety net clinics, so will likely encounter barriers inherent to research in real-world delivery systems. Drawing on our extensive experience conducting research in this setting, we will adjust to changing clinical processes and patient

needs as the study progresses. Our study will be four times larger than any previous evaluation of follow-up colonoscopy navigation.

In conclusion, patient navigation is widely endorsed as a critical approach to address low rate of follow-up colonoscopy among individuals who screen positive on FIT. Yet, few health systems can successfully implement and sustain such programs. Applying our risk prediction model and knowing which patients could benefit from patient navigation could allow insurers and health systems to optimize the delivery of patient navigation services, address health disparities, and reduce associated costs.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Primary and secondary outcomes and data sources for the PRECISE study.

Variable	Definition	Numerator	Denominator
Primary outcomes			
Colonoscopy completed	A colonoscopy is completed within 12 mo of the patient's FIT positive test date	No. of patients with completed colonoscopy within 12 mo of FIT positive test date	No. of eligible patients enrolled in study, with exclusions for patients randomized in error[a]
Cost and cost-effectiveness	Cost per program component, per-patient cost, and cost per additional completed colonoscopy	Difference in cost to deliver program	Difference in program effectiveness
Secondary outcomes			
Time to colonoscopy	Time from FIT positive test result to completed colonoscopy	Hazard of obtaining a colonoscopy by 365 days	No. of eligible patients enrolled in study, with exclusions for patients randomized in error[a]
Adequate bowel preparation quality	Bowel preparation is considered adequate by the endoscopist performing the colonoscopy	No. of patients with adequate bowel preparation, preparation is (excellent, good, or fair) and no alterations are made to rescreening interval because of bowel prep quality [**]	No. of patients with a performed colonoscopy during the study period (include patients for whom the procedure was discontinued because of poor bowel prep)
Results communicated to health center/ primary care provider	Records show that communication (e.g. procedure report) was received by the health center/ primary care provider regarding results of the colonoscopy examination	No. of patients whose health center / primary care provider received communication about their results	No. of patients with a completed colonoscopy during the study period
Colonoscopy outcomes	Adenomas, advanced adenomas, or cancer detected	No. of patients with adenomas, advanced adenomas, or cancer detected (based on pathology report)	No. of patients with a performed colonoscopy during study period

[a] we anticipate that a small number of randomized patients will be ineligible for colonoscopy for clinical reasons (i.e. had a recent colonoscopy, or life-limiting co-morbidities) or because they transferred care or moved from the region, etc.

[**] bowel prep quality is rated according to a qualitative metric (poor, fair, good, excellent) or the Boston Bowel Preparation Score. A qualitative rating of poor or Boston Bowel Preparation Score of less than 6 overall or less than 2 for any segment will be considered inadequate.