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A root cause analysis of barriers to timely colonoscopy in California safety-net health systems

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Abstract

Objectives—Safety-net health care systems, serving vulnerable populations, see longer delays to timely colonoscopy after a positive fecal occult blood test (FOBT), which may contribute to existing disparities. We sought to identify root causes of colonoscopy delay after positive FOBT result in the primary care safety net.

Methods—We conducted a multisite root cause analysis of cases of delayed colonoscopy, identifying cases where there was a delay of greater than 6 months in completing or scheduling a follow-up colonoscopy after a positive FOBT. We identified cases across 5 California health systems serving low-income, vulnerable populations. We developed a semistructured interview guide based on precedent work. We conducted telephone individual interviews with primary care providers (PCPs) and patients. We then per- formed qualitative content analysis of the interviews, using an integrated inductive-deductive analytic approach, to identify themes related to recurrent root causes of colonoscopy delay.

Results—We identified 12 unique cases, comprising 5 patient and 11 PCP interviews. Eight patients completed colonoscopy; median time to colonoscopy was 11.0 months (interquartile range, 6.3 months). Three patients had advanced adenomatous findings. Primary care providers highlighted system-level root causes, including inability to track referrals between primary care and gastroenterology, lack of protocols to follow up with patients, lack of electronic medical record interoperability, and lack of time or staffing resources, compelling tremendous additional effort by staff. In contrast, patients' highlighted individual-level root causes included comorbidities, social needs, and misunderstanding the importance of the FOBT. There was a little overlap between PCP and patient-elicited root causes.

Conclusions—Current protocols do not accommodate communication between primary care and gastroenterology. Interventions to address specific barriers identified include improved interoperability between PCP and gastroenterology scheduling systems, protocols to follow-up on

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in- complete colonoscopies, accommodation for support and transport needs, and patient-friendly education. Interviewing both patients and PCPs leads to richer analysis of the root causes leading to delayed diagnosis of colorectal cancer.

INTRODUCTION

Colorectal cancer (CRC) is the third most prevalent and the second leading cause of cancer mortality in the United States.[1] Colorectal cancer incidence and mortality have declined over the last 20 years,[2] but this secular benefit has not benefited all populations,[3–8] with higher rates of CRC affecting patients in the safety net, including ethnic minorities, and uninsured, undocumented and low-income patients.

Colonoscopy delays are a significant problem among vulnerable care settings where resources are more limited.[9] A retrospective study in a safety-net system estimated a 58.1% likelihood of patients having a completed colonoscopy within 12 months of a positive fecal occult blood test (FOBT) result.[10] Another retrospective study found that only 44% of Veterans Affairs patients had a colonoscopy within 1 year after a positive FOBT result.[10] There is greater predicted advanced colon cancer diagnosis and increased mortality with each month of colonoscopy delay.[11] Among vulnerable populations, CRC is often diagnosed at a more advanced stage, leading to concern that colonoscopy delays are a contributor to current disparities in CRC mortality. Timely colonoscopy is therefore a safety and quality priority in the safety net.

Root cause analysis (RCA) is a validated means of analyzing patient safety events that may shed light on colonoscopy delays. The goal of an RCA is to apply a close lens to a small number of adverse events, to expose a richer number of root causes contributing to the event.[12] Root cause analyses are mandated for specific patient safety events by the Joint Commission, the major safety accreditation organization in the United States.[13] In the case of colonoscopy delays, an RCA approach that involves both primary care providers (PCPs) and patients is needed to identify additional, granular root causes to colonoscopy delay. Barriers and facilitators to colonoscopy completion have been explored through qualitative methods,[14–16] but reviews on the topic have addressed screening rather than diagnostic colonoscopy and have not used a patient safety framework to assess root causes of delay for an indicated colonoscopy.

In a retrospective chart review analysis of missed colonoscopy conducted by members of our group’s safety net system, challenges identified include lack of awareness of an abnormal result, lack of counseling to patient regarding their cancer risk, and lack of follow-up after a missed colonoscopy appointment, among other issues.[17] There is a lack of direct PCP and patient perspectives on the root causes of colonoscopy delay in the safety-net population. We sought to conduct an RCA involving a small number of colonoscopy delays, interviewing both PCPs and patients, to ascertain additional underlying root causes of colonoscopy delay to better identify potential solutions.

METHODS

We conducted an RCA of a convenience sample of cases, among which there was a clinically significant (greater than 6 month) delay in obtaining recommended colonoscopy for a positive FOBT. Cases were identified across 5 safety-net health care systems in California in the United States comprising 3 urban safety-net systems, 1 periurban safety-net system, and 1 rural/ periurban safety net system. These health care systems are member organizations of the Safety Promotion Action Research and Knowledge Network (SPARKNet), an Agency for Health Research and Quality–funded initiative to promote sharing of data to develop novel means of promoting safety (grant no. 5R01HS024426–03). These 5 systems were selected because they serve a high proportion of vulnerable populations, meaning predominantly low-income individuals who receive public health insurance through Medicare or Medi-Cal (Medicaid).

Although root cause analyses often only focus on 1 or 2 cases, we sought to capture as many cases that could be identified through the data sharing enabled by the 5 participating SPARKNet sites. Study team members developed inclusion/exclusion criteria, adapted from precedent work on delayed colonoscopy [17] in partnership with participating SPARKNet site leaders. Patients were eligible if they were adults older than 18 years, were English speaking, were cognitively able to consent to an interview, had a positive FOBT test, either had a colonoscopy appointment scheduled *or* completed a colonoscopy greater than 180 days past the positive FOBT result, and were empaneled to a PCP with continuity. The 180-day cutoff was chosen based on findings showing in- creased risk of CRC with delays greater than 6 months,[18] and empaneled patients were chosen so as to focus on root causes of delays among patients with health care access. Exclusion criteria included the following: patients institutionalized or residents of a nursing home, as they would not be representative of the general primary care safety net population; and patients who had been diagnosed with active CRC, as ethically we did not wish to cause emotional harm to patients undergoing cancer treatment. A member of the study team (RC) compiled a list of eligible patients from each study site and worked with SPARKNet leads at each site to contact PCPs. Primary care physicians were contacted first to ensure that patients' cases would be relevant for analysis and for permission to con- tact patients. If a PCP could not be contacted, we did not conduct outreach to patients. We attempted to reach all patients involved up to a maximum of 5 times. Recruitment occurred from April 2018 to October 2018, and interviews from May to September 2018, with data analysis from December 2018 to February 2019.

Senior members of the team (U.S., M.S., D.S.) developed the interview guide, adapted from prior instruments from a medical record review of incomplete CRC screening [17] and a qualitative RCA of medication-related adverse events.[19] Physician members of the study team (D.S., U.S.) conducted clinician interviews, and a non-physician member (H.L.) completed patient interviews. Interviews lasted for lasted for 30 to 60 minutes, were conducted via telephone, and structured based from an interview guide developed by the research team. Physician interviewees received $100 gift card or cash for participation; patients received $40 gift cards for participation. Interviews were recorded and transcribed, and qualitatively analyzed by 2 members of the study team (A.E.S., H.L.) using Dedoose, an online cloud-based qualitative coding software.[20] We used an integrative

inductive-deductive qualitative analysis approach.[21] We first deductively coded the data using predetermined conceptual codes adapted from Ishikawa's Fishbone Diagram's RCA categories,[22] including PCP, patient, environmental, and process-based root causes, to elicit primary contributing causes to the delay in colonoscopy. We then inductively coded the transcripts by having both coders review and code all interviews independently, iteratively adding new codes and categories as they emerged to uncover a wide variety of themes from the data. Discrepancies in coding were clarified through discussion between the coding team. Final themes were developed through reviewing the major codes with the rest of the study team to develop consensus on key study findings.

RESULTS

We identified 15 eligible patient cases across the participating networks. Of these 15, 2 were ineligible. For 1 case, neither the provider nor patient responded to recruitment calls. For the 12 remaining patient cases, we interviewed 11 PCPs and 5 patients; 7 of the 11 PCPs were female and 3 of the 5 patients were female. Mean patient age was 64 years (SD), and most were white. Seven patients were not interviewed; reasons for no interview included the following: could not be reached (4), cognitive impairment (2), and declined (1). Demographic information is listed in Table 1.

There was variation in how PCPs followed up to the positive FOBT result in the sample. Four PCPs discussed the result in a face-to-face encounter, 4 directly referred to colonoscopy without patient contact, 2 called the patient, and 2 had a team member con- tact the patient (Appendix Table 1).

Of the 12 total cases, 8 patients did complete a colonoscopy. Time from positive FOBT test to completed colonoscopy ranged from 7.1 to 38.1 months, with a median time of 11.0 months (interquartile range, 6.3 months). Of the 9 colonoscopies done, 4 patients had findings that were clinically significant for advanced adenomas; 1 patient had 11 benign adenomas, 1 had tubulovillous adenoma, 1 had tubular adenoma, and 1 had both tubular adenoma and hyperplastic polyps. Four patients in the sample did not have a colonoscopy completed at the time of interview. Of the patients who did not have a colonoscopy, 1 had a positive FOBT test result that was inappropriately ordered 5 years after a normal colonoscopy. One patient was turned away because a gastroenterology clinic refused to perform the procedure because of their active ongoing substance use. One patient repeatedly rescheduled the procedure because of childcare obligations, and 1 patient was lost to follow-up.

Thematic analysis of interview data revealed root causes for colonoscopy delay; these included system-level (processes and environmental factors) and individual (patient-specific factors, PCP-specific factors) factors. Details about major themes and exemplar quotes are available in Table 2. The root causes are compiled in a Fishbone Diagram in Figure 1. Primary care physician interviews more frequently described *system-level issues*, such as root causes about communication, staffing and human resources needs, and process issues around tracking referrals. Primary care physicians also mentioned patient comorbid conditions and concurrent medications. Patient interviews more frequently provided

individual-level barriers, such as lack of education from PCP, challenges with access to appointments, patient preferences and fears, social support/ assistance needs, and work obligations. Here we describe a subset of the identified root causes most relevant to preventive solutions in the safety-net.

Process-specific factors

Most process-specific root causes were identified by PCPs rather than patients. Primary care physicians expressed confusion about appropriate annual screening of patients, as some clinical sites automated the process to another team member so they were not aware of which patients received FOBT kits. After a positive FOBT result, PCPs had significant variation in how they followed up with a patient, for example, waiting for a face-to-face visit versus a telephone call, versus directly scheduling a colonoscopy.

Primary care physicians endorsed significant difficulty in tracking positive FOBT results and even greater difficulty in tracking referrals that had not resulted in a completed colonoscopy. Primary care physicians did not have a way to easily communicate with colonoscopy offices, leading to a fragmentation in communication both of scheduling appointments as well as colonoscopy results: “When the patient is in a different system, there’s no inter-system communication…if it is not affiliated to my hospital, then I would not know exactly what really happened unless I might get the record.” (PCP Interview).

Environment/System-specific factors

Most environment/system-specific root causes were reported by PCPs. Primary care physicians described limitations in Staffing shortages and turnovers also led to less human resources available to follow up on FOBT-positive patients: “…this was the right time frame here when we were short staffed. I lost a provider. Our director was hired and then we lost a provider within April, I believe…There were probably fewer appointments available.”

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Clinician-specific factors

Clinician-specific root causes were identified by PCPs as well as patients. Primary care physician interviews described lack of clarity around what patients should be excluded from colonoscopy because of comorbid conditions. Patient interviews shared the perception that PCPs did not provide sufficient explanation or education about the importance of the positive FOBT result or the need for colonoscopy, leading to less urgency to attend the colonoscopy appointment. Clinicians also described significant burden of between-visit workload to manage active FOBT-positive lists and no-shows.

An unanticipated finding was the remarkable resilience and capacity for primary care teams to obtain colonoscopies, despite these substantial barriers. Primary care physicians described substantial efforts to advocate for patients so that they could have a completed colonoscopy:

"I have a note on the lab that says, 'Positive, needs colo.' Then I wrote a note to our nurse… 'Please contact her and explain she should have a colonoscopy to investigate the positive FOBT test, further to make sure she has polyps there to be removed, if it's a positive FOBT. I am concerned she may re- fuse, so let me know if—when you talk to her, she does and I will call her as well.' Then I said, 'Please enter the e-referral once she agrees. Thanks.' That was on February 18. On February 22nd, she's had voice messages for her to call me back. Then on 25, a voice message to call back. On to 29, patient is unreachable, letter sent, and on 3/5 I entered the colo e-referral, anyway…"

Patient-specific factors

Both PCPs and patients identified root causes related to patient comorbidities. Medical comorbidities included frequent hospitalizations conflicting with colonoscopy date; psychiatric comorbidities included anxiety or personality disorders or cognitive barriers around complying with the colonoscopy prep and procedure itself. One patient was unable to receive a colonoscopy because of substance abuse: "I went in for surgery…I took my clothes, all that stuff, got in the bed. Then (the RN) came to the question about, "Do you do drugs?" I said yes, and she goes, "When was the last time you did it?" I said yesterday and the day before. She goes, "Have you done any today?" I said no her head nurse says, "Well, no. You have to be out of it for at least two weeks." I said, "I told my doctor about this," but she didn't even go to the doctor… I said, "Well, I'm sorry I took up a bed space," and…I got dressed."

Patient interviews identified a number of root causes related to preferences or emotions related to the procedure itself. Patients described fear of the colonoscopy due to its invasive nature, disagreement that a colonoscopy was the right procedure (one patient requested sigmoidoscopy instead), or simply did not want a colonoscopy: "I mean that's really invasive. For me, to even think about having it done is just something I do not want to do." Of note, almost no PCP interviews identified fear of the procedure as a root cause, whereas most individual-level patient barriers were identified by patients.

Patient interviews highlighted the significant logistical challenges around scheduling an appointment. Patients perceived a lack of available appointments, lack of access to bathroom or transportation to prepare and attend their colonoscopy visit, and work or child care obligations preventing them from attending the colonoscopy: "I had a [colonoscopy] scheduled but I had to cancel because I became a foster parent to a toddler and I have not had anybody to watch her while I go."

DISCUSSION

We identified a sample of clinically significant colonoscopy delays, with median time to colonoscopy of 11.0 months. A retrospective analysis of patients with a positive fecal immunohistochemical test result found an increased risk of advanced-stage disease if colonoscopy is obtained 10 to 12 months after the positive test result.18 For this reason, most networks recommend a goal of colonoscopy completion within 6 months after positive screen. In our sample, 4 of the 8 patients who completed a colonoscopy had clinically concerning adenomatous findings.

Our findings resonate with Singh et al,[23] who analyzed newly identified CRC cases in a large safety-net system. Their analysis found delays in obtaining colonoscopy in 33.7% of cases, most of which were due to delays in the follow-up appointment with gastroenterology. Our RCA, sampling a small number of cases but obtaining detailed insights from both PCPs and providers, allows us a more nuanced view of the complexities entailed in completing a colonoscopy in the safety net. Primary care physicians in general provided rich insights into process and system-level root causes, whereas patients gave richer insights into individual-level root causes including patient barriers and breakdowns in communication between patients and PCPs. By juxtaposing PCP and patient interviews, we see the root causes stemming from a health care system that cause significant burden to be placed on both parties to navigate the process to complete a needed colonoscopy. A closer lens on the breakdowns in the referral process may lend themselves to novel interventions. A full schematic of breakdowns in the referral process we identified in our interviews is depicted in Figure 2.

Primary care physician interviews highlighted information management challenges and resource limitations affecting follow-up. A frequent root cause of colonoscopy delay was the challenges in scheduling and fragmentation between the PCP and gastroenterology office. Primary care physicians were responsible for coordinating follow-up for rescheduling colonoscopy appointments, without a means of being notified that a patient had canceled or no-showed initially. Primary care physicians devoted additional unfunded time and navigated across fragmented information systems to advocate for completed colonoscopies.

Unclear clinical exclusion criteria were a common root cause in a number of cases. Patients from vulnerable populations experience more complex, multimorbid medical diagnoses affecting their capacity to follow up with gastroenterology,[24–26] as well as their eligibility for the colonoscopy procedure. In our sample, patients with medical comorbidities were either hospitalized or too sick to attend colonoscopy appointments. Behavioral comorbidities were also a notable root cause; at least one colonoscopy clinic designated active substance abuse as a contraindication to completing a colonoscopy, leading to a patient being turned away on the day of their procedure. Our interviews demonstrated the lack of accommodation for medical, behavioral, and cognitive disabilities in the colonoscopy referral process.

Patient interviews brought richer insights into communication breakdowns, scheduling challenges, and personal preferences and fears. Patients are burdened with engaging in a number of complex steps after a positive FOBT result: patients must understand the importance of a positive FOBT result, successfully hear from the gastroenterology clinic, obtain a colonoscopy appointment that works with their schedule, adhere to the bowel preparation, and successfully navigate to the procedure appointment with a support person. Patients described work/employment, childcare, or transportation needs that were incompatible with the colonoscopy appointment. Patients also reported substantial anxiety or fear related to the procedure itself.

There are a number of implications of our findings, which are specific to the barriers faced by patients and PCPs within safety net health care systems. On the individual patient level, safety net systems must implement protocols to reduce patient fears, maximize

patient understanding of the recommended colonoscopy, and proactively eliminate physical or transportation-related barriers. Patients with cognitive impairments or intellectual disability require additional education and assistance with the prep as well as coordinating appointments.

Improved educational materials to aid a PCP in explaining the importance of the colonoscopy—ideally, co-designed with patients—may help improve patient-PCP education and reduce fear and stigma. Patient education has been shown to improve fecal occult blood screening rates and deserves study for colonoscopy.[27] A screening questionnaire to elicit individual-level barriers to obtaining a colonoscopy could be provided at the time of the colonoscopy referral, including assessment of difficulties completing the preparation, accessing transportation, or support persons. If a patient does not have the physical capacity or housing capacity to comply with a bowel preparation, then respite facilities may be needed. The San Francisco Department of Public Health currently has a respite program for unhoused patients awaiting colonoscopy and other procedures.[28] If transportation or support persons are not available, innovative solutions such as a “transport van,” ride shares, or para-transit may be more cost-effective than multiple missed colonoscopy appointments and the downstream waste of resources incurred by no-shows.

Another implication of the root causes identified on the individual level is that PCPs need more support to counsel and refer their patients appropriately. Currently, PCPs lack well-defined medical exclusionary criteria to help decide when to defer a FOBT, beyond having a reasonable 10-year life expectancy,[29] meaning that younger adults with substantial chronic medical conditions would be eligible for screening but too sick to comply with follow-up. Primary care physicians also lack evidence-based guidelines for clear contraindications in the setting of substance use disorders, which would reduce miscommunication when there is active substance use. Additional mixed-quality individual-based interventions shown to increase colonoscopy completion after a positive FOBT include the following: clinician-based interventions, clinician reminders, and patient navigation.[27,30]

The implications of our findings of system-level root causes highlight the priority of identifying interventions to streamline the scheduling process between primary care and the colonoscopy office. Having gastroenterology, rather than primary care, directly follow up on positive FOBT result has been associated with reduced colonoscopy wait times.[31] Assigning direct gastroenterology follow-up in the safety net may not be as successful because of limitations in trust in new providers and challenges traveling to a different clinical site, but merits additional study. Regardless of who is accountable for following up on an incomplete colonoscopy referral, interoperable medical records or automated no-show notifications that allow gastroenterology and PCP offices to communicate about rescheduling are essential to prevent patients from being lost in a fragmented system.

LIMITATIONS

Our study has several limitations. First, this study focused on those who actually completed the FOBT screen to obtain a positive FOBT result. Patients who cannot complete the FOBT itself may have different needs in the primary care safety-net. Second, this analysis focused

on 12 cases to enable a “deep dive” of each case applying an RCA framework. Although this is a larger sample than most RCAs, our sample was small, and our findings emphasize prevalent root causes within these cases rather than qualitative findings that arrived at thematic saturation. We were not able to interview all patients involved in the included cases, most often because we were not able to reach them. Just as there are unmeasured barriers that impeded patients from participating in this study, these barriers may prevent them from completing a needed colonoscopy. Risks of bias include selection bias related to cases that may not have been identified within participating SPARKNet sites, selection bias related to patients we could not interview, and recall bias on behalf of participating interviewees. Our sample was limited to English-speaking patients and focused on California and may not be generalizable to other language groups and geographic regions. However, our study also has strengths: we obtained a geographic spread of sites serving Medicaid-eligible populations, and the individual- and system level barriers described here are likely shared at other sites serving vulnerable populations. Because most RCAs do not include patient perspectives, this study demonstrates the additional insights that patients can provide when there is an adverse safety event.

CONCLUSIONS

The process from identifying a positive FOBT result to obtaining a colonoscopy is a complex and multistep process, requiring substantial engagement from patients, family caregivers, and PCPs. Our analysis shows the systemic issue of health system fragmentation and inflexibility in the scheduling process, leading to burden placed on both PCPs and patients to navigate the steps between a positive FOBT result and a completed colonoscopy. Involving patients and front-line stakeholders provides richer insights into the root causes of delays, and involving patients and stakeholders will be a key strategy to develop novel solutions. Innovations in the referral process are necessary to eliminate some of the underlying preventable causes of colonoscopy delay and may be an underidentified contributor to current CRC care disparities.

Patient engagement, interoperable electronic medical records and scheduling systems, novel navigation and transport systems, and personalized educational materials may aid in reducing preventable delays in colonoscopy appointments and improving CRC care outcomes for vulnerable populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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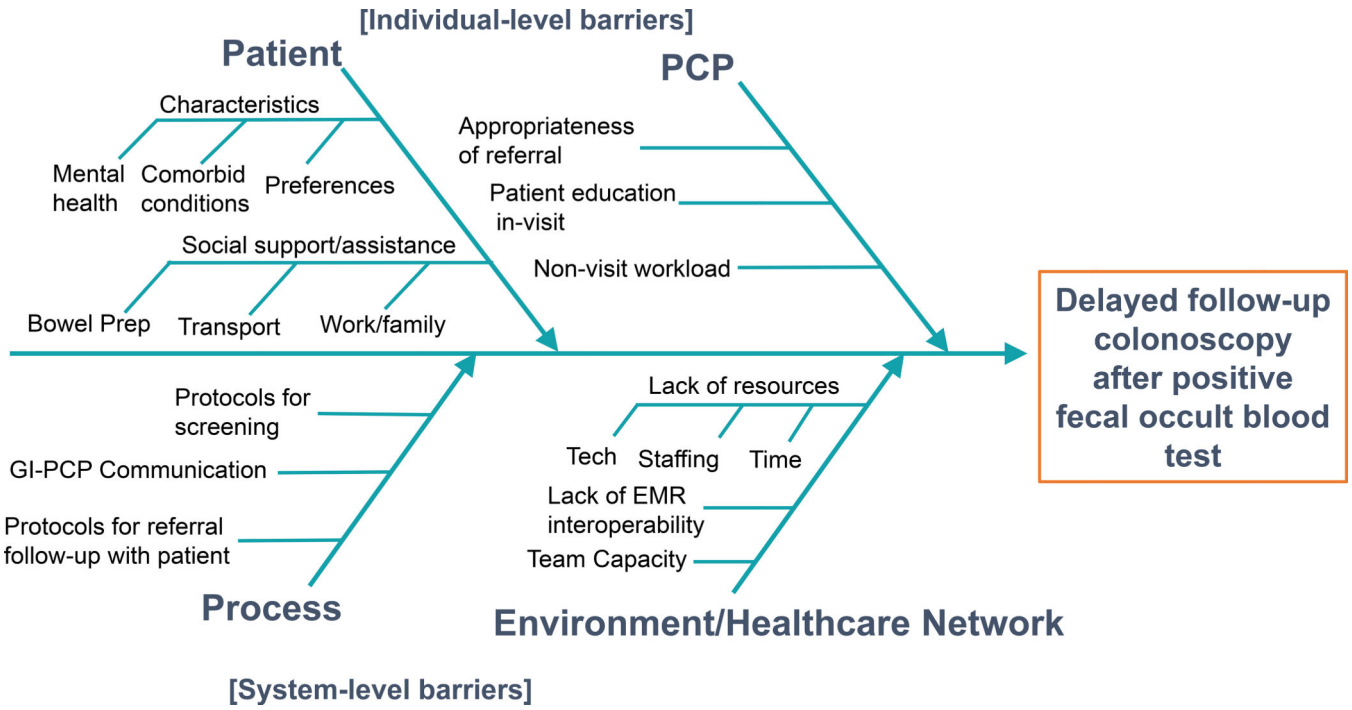

Figure 1.
Fishbone diagram of root causes of delayed colonoscopy in the safety net.

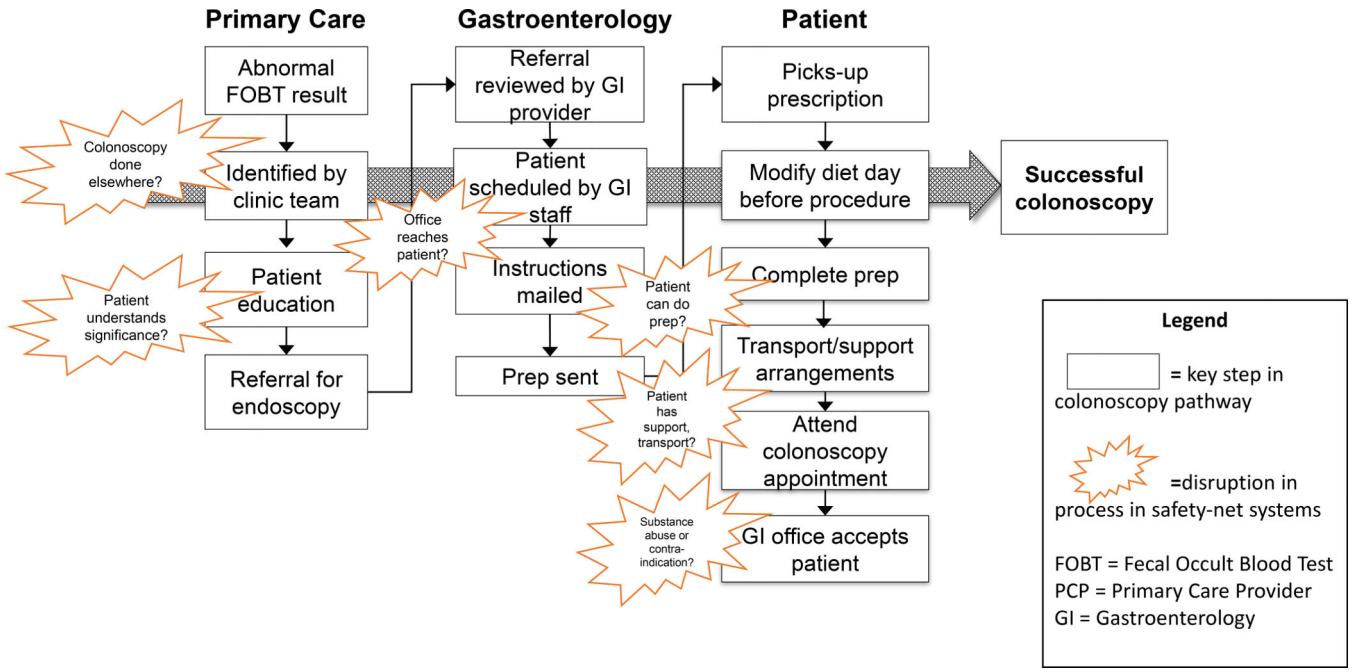

Figure 2.

Flow map of pathway to complete colonoscopy with disruptions highlighted as revealed in this RCA.

Table 1.
Demographic characteristics of patient cases

Demographic provided for all patient cases; not all patients were interviewed. One PCP was interviewed for two cases.

	Patient Cases (N=12)	**Primary Care Providers (N=11)**
Gender (% Female)	4 Female, 8 Male	3 Female, 3 Male, 5 Not disclosed
Age	50–59: 5 60–69: 4 70+: 3	Not disclosed
Race/Ethnicity (more than one may be selected)	White – 5 Black – 1 Asian – 1 American Indian/Alaskan Native—1 Native Hawaiian/Pacific Islander – 1 Other— 3 Hispanic/Latinx – 3	White – 2 Latinx – 2 Unavailable – 7
Employment	Full time: 1 Unemployed: 1 Disabled/on disability: 1 Retired: 2	
Educational attainment	<High School: 1 High School: 2 Some college: 1 Graduate School: 1	6 Family medicine, 5 Internal medicine (includes MD, PA and FNP)
Time to colonoscopy (median, IQR)	7.10 to 38.07 months (median 10.98, IQR 6.28)	
Colonoscopy results	Normal/negative: 2 Findings: “polyps, diverticulosis, tubulovillous adenomas; “11 benign polyps”; “Tubular adenoma, 1 with high grade dysplasia”; “tubular adenoma and hyperplastic polyps”	

TABLE 2.

Main Findings of Root Cause Analysis.

	Theme	Sub-themes	Example quotes	Proposed Solutions
System Level Root causes	Root causes related to specific policies and protocols	Protocol for providing FOBT to patient (inclusion/ exclusion criteria)	"I think I should not even have offered them (FIT test) because based on the current recommendation, (they) were not even needing it at that time." (PCP)	• Workflow for ineligible patients for receiving FOBT
		Scheduling delays for PCPs to see patients to discuss positive results	"…we used to make follow-up appointments…For example, if [the patient] saw me today, we would make a follow-up appointment for her in three months or four months from now for routine checkup. Since about the end of last year, we're changing to an open access system so …we have stopped making follow-up appointments." (PCP)	• Standardized protocol for discussing +FOBT (telephone vs. in-person, PCP. vs. nurse)
	Root causes related to human resources and staffing issues	Lack of time for PCP to proactively manage FOBT follow-up	"Honestly, for 25-plus years, I've been seeing patients 40 to 50 hours a week and have about two hours downtime and I only just started getting downtime in the last couple of years. So, I simply can't have a tickler file on people to get your labs done, get this done, and get that done. I'd say I barely have enough time to review what's in front of me and much less look for stuff that isn't in front of me." (PCP)	• Team based panel management
		Inadequate staffing	"The other thing that was happening during this period of time is … we were short staffed. I lost a provider. Our director was hired and then we lost a provider…There was probably fewer appointments available. I don't know why [the patient] wasn't coming in, if it was because of him or because there weren't enough appointments available." (PCP)	
	Root causes due to information management/ Inability of PCP to track or monitor referrals)	No local active list of patients with positive fecal test and no colonoscopy	"I can't track all my patients to see who's made it to their appointments or not" (PCP)	• Registry
		No ability to see EMR or schedule of colonoscopy office	"I think once they go to the private world—I really don't know what's going on there. I feel like once they go out of the system, it's out of my hands. I don't really know what's going on." (PCP)	• Interoperable EMRs • Automated colonoscopy no-show messages to PCP
Individual level RootCauses	Root causes related to PCP-related decisions, actions, or omissions	Appropriateness of referral	"Maybe, in the beginning, I should have been a little bit more proactive and told Dr. __ (GI) that patient does use methamphetamine and see if that changes anything". (PCP)	• Evidence based protocols for people living with substance abuse
		Non-visit workload burden (registry management)	"The problem is, at least what I see in our system, is that the doctor misses something, then it's missed forever…You get busy in the next day, and what happened the previous day is kind of the previous day." (PCP)	• Administrative time for panel management
		Patient education in-visit	"I don't think [my doctor] said that [getting the colonoscopy] was an urgent need. In other words, it was supposed to happen when it happened as soon as it made sense to do it, but I didn't have the sense that, "By golly! I've got to get this done right away." (Patient)	• Educational materials developed with patients to educate on rationale of colonoscopy • Colonoscopy referral screening tool to elicit barriers
	Root causes related to patient-related behaviors or structural challenges	Co-morbid medical, behavioral conditions, substance abuse	"I should say it was because I had the flu, but it's also because of the myasthenia gravis, because it has taken me a while to understand how it works, and so when I've got something wrong with me with something else like the flu, I'm almost afraid to do another procedure because I don't always know how my body is going to react to whatever is happening. I don't know energy-wise and muscle-wise what's going to happen to me" (Patient)	• Evidence-based exclusion criteria for advanced disease/ poor prognosis • Patient capacity to directly reschedule colonoscopy, or GI office follow up for

	Theme	Sub-themes	Example quotes	Proposed Solutions
				no shows due to illness
		Work or family obligations	"I had a [colonoscopy] scheduled but I had to cancel because I became a foster mom to a three-and-a-half-year-old and I haven't had anybody to watch him while I go." (Patient)	• Direct patient access to reschedule colonoscopy, or GI follow-up for no shows
		Social needs: access to bathroom, support person, or transportation	"The reason why is we were all aware that [the patient] couldn't the do the prep at home. He couldn't cooperate with the prep. Because of mental health issues, his morbid obesity, the risk of the procedure… We were trying to find a way to do it but it wasn't considered possible to do it." (PCP)	• Adapted bowel prep for patients with disability • Medical respite
		Fear/personal preference	"For one thing, I'm – how can I say this? I really don't like to have people touching me, and I mean that's really invasive. For me, to even think about having it done is just something I don't want to do." (Patient)	• Proactive elicitation of fears when scheduling colonoscopy