CLINICAL REVIEW

Interventions to Increase Colorectal Cancer Screening Uptake in Primary Care: A Systematic Review

Kamala Adhikari, PhD, Kimberly Manalili, MPH, Jessica Law, MSc, Madison Bischoff, MA, and Gary F. Teare, PhD

Objective: **We systematically reviewed and summarized previous studies that examined facilitators and barriers to implementing interventions to increase CRCS uptake in primary care practice.**

Methods: **We searched PubMed, Medline (EBSCO), and CINAHL databases, from the inception of these databases to April 2020. The search strategy combined a set of terms related to facilitators/barriers, intervention implementation, CRCS, and uptake/participation. A priori set inclusion and exclusion criteria were used during both title/abstract screening and full-text screening phases to identify the eligible studies. Quality of the included studies was appraised using quality assessment tools, and data were extracted using a predetermined data extraction tool. We classified facilitators and barriers according to the Consolidated Framework for Implementation Research domains and constructs and identified the common facilitators and barriers looking at how common they were across studies.**

Results: **A total of 12 studies were included in the review. Engagement of the clinic team, leadership team, and partners, clinics' motivation to improve CRCS rates, use of the EMR system, continuous monitoring and feedback system, and having a supportive environment for implementation were the most commonly reported implementation facilitators. Limited time for the clinic team to devote to a new project, challenges in getting accurate, timely data related to CRCS, limited capacity/support to use the EMR system, and disconnect between clinic team members were the most commonly reported implementation barriers.**

Conclusions: **The synthesized findings improve our understanding of facilitators of and barriers to the implementation of interventions to increase CRCS participation in primary care practice, and inform the customized implementation strategies. Many of the included studies had limited use of rigorous implementation science frameworks to guide their implementation and evaluation, which precludes a comprehensive understanding of the implementation factors specific to CRCS interventions in primary care. Future studies assessing the CRCS intervention implementation factors would benefit from the use of implementation science frameworks. (J Am Board Fam Med 2022;35:840–858.)**

Keywords: **Chronic Disease, Community Medicine, Faculty, Family Medicine, Health Promotion, Infant Health, Knowledge Translation, Population Health, Pregnancy, Prenatal Care, Primary Health Care, Postpartum, Social Determinants of Health**

Background

Colorectal cancer (CRC) is the second most common cause of cancer death worldwide.[1,2] CRC screening (CRCS) is highly effective at reducing the incidence and mortality of CRC.[1,3–5] Endoscopy-based (colonoscopy or sigmoidoscopy) and stool-based (Fecal Occult Blood Test (FOBT): Fecal Immunochemical Test (FIT) or Guaiac Fecal Occult Blood Test (gFOBT)) tests are the most commonly

This article was externally peer reviewed.
Submitted 4 October 2021; revised 6 December 2021; revised 20 December 2021; accepted 21 December 2021.

From Provincial Population and Public Health, Alberta Health Services, Calgary, Alberta, Canada (KA, JL, MB, GFT), Department of Community Health Sciences, University of Calgary (KA, KM, GFT).

Funding: This research was funded by Alberta Health through the Alberta Cancer Prevention Legacy Fund (ACPLF). Provision of funding by Alberta Health does not signify that this project represents the policies or views of Alberta Health. The funders had no role in the design of the study; in the collection, analyses, or interpretation of

used effective screening modalities for CRC.[1,6] CRCS program guideline recommendations such as age-group to screen and the choice of screening modalities vary by country.[1] Nevertheless, high adherence to CRCS is essential for achieving the benefits, and yet screening rates remain suboptimal.

Strong evidence suggests that multicomponent interventions targeted at multiple levels (such as provider reminders, improved access, and patient education) can effectively increase the CRCS participation rate.[7–10] However, the translation of interventions into routine primary care delivery, which often requires adaptation of existing care pathways and practices, can be difficult to achieve without a solid understanding of how to implement these interventions. Implementation can be influenced by a wide range of factors including those related to clinic context, intervention characteristics, providers' behavior, patient needs, and the implementation process.[11] A comprehensive understanding of these factors can provide a foundation for planning strategies for implementation.[11–13]

Several qualitative studies have reported on implementation factors pertinent to CRCS participation improvement interventions in primary care practice. However, to our understanding, there is no synthesis of these research findings; thus, a significant evidence gap exists in identifying effective implementation strategies. Our research objective was to systematically review and summarize previous studies that examined facilitators and barriers to implementing interventions to increase CRCS participation in primary care. Our review addressed the following research question: "What are the facilitators and barriers to implementing interventions to increase CRCS participation in primary care?"

Methods

Data Sources

We conducted a systematic review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement.[14] We searched PubMed, Medline (EBSCO), and CINAHL, from the inception of these databases to April 2020. Search strategy was developed with the assistance of content experts and a research librarian as well as a preliminary review of the literature to identify potential terms. The search strategy combined a set of terms related to barriers/facilitators, interventions, CRCS/FIT, and participation (see Table 1 in the online Appendix).

Exclusion and Inclusion Criteria

The inclusion criteria for this review were (1) the study implemented a multicomponent intervention (must include at least 1: provider reminders, patient education, in-clinic FIT kit distribution or FIT kit mailing, patient reminders and follow up); (2) the study assessed implementation barriers and facilitators; (3) the study was conducted in OECD (Organization for Economic Co-Operation and Development) countries; (4) the study used an observational or experimental or qualitative study design and provided original and empirical evidence; (5) the article written in the English language.

Study Identification

Two authors (JL and MB) performed title and abstract review, followed by full text review for inclusion using those criteria. KA independently reviewed 20% of a random sample of articles at both phases to ensure reliability. Discrepancies between authors were settled by consensus.

Quality Assessment

Quality of the included studies were appraised in duplicates by 2 authors (KA and KM) using quality assessment tools as appropriate to study designs: the Critical Appraisal Skills Program for qualitative studies,[15] the Mixed Methods Appraisal Tool for quantitative studies,[16] and the Quality Improvement Minimum Criteria Set for quality improvement studies.[17] Inconsistencies between authors were resolved by consensus.

Data Extraction

We constructed, pilot-tested, and refined a structured data extraction tool (see Table 2 in the online Appendix). JL and KA extracted data. Data extraction on 20% of the included articles was done by both data extractors to check consistency.

data; in the writing of the manuscript; or in the decision to publish the results.

Conflict of interest: The authors have no conflict of interest.

Corresponding author: Kamala Adhikari, PhD, University of Calgary, 2500 University Drive NW, Calgary, Alberta T2S 3C3, Canada (E-mail: kamala.adhikaridahal@ucalgary.ca; kamala.adhikaridahal@ahs.ca).

Data Analysis

All studies identified and excluded were summarized using a PRISMA flow diagram.[14] We summarized individual study characteristics and their key findings on barriers and facilitators using narrative synthesis.[18] We synthesized reported barriers and facilitators into distinct categories for the purpose of practical application and documented the frequency of these categories. Then, we classified the categories of facilitators and barriers according to the Consolidated Framework for Implementation Research (CFIR) domains and their subdomains.

The CFIR organizes implementation factors into 5 major domains (intervention characteristics; inner setting; outer setting; characteristics of the individuals involved; and implementation process) and their constructs. We selected the CFIR as our guiding framework as it includes comprehensive factors affecting implementation at multiple levels, can be applied to both qualitative and quantitative articles, and serves as a standardized structure for aggregating findings across studies in a systematic manner.

Results

Characteristics of the Studies

The initial search returned 10,511 deduplicated articles, of which 10,472 were excluded based on the title and abstract screening. We performed a full-text review on 39 articles. Of those, 12 studies were included in the review (Figure 1).

Almost all included studies were from the United States. Nine studies used a qualitative study design, 2 used quality improvement, and 1 used a quantitative study design to obtain data pertaining to barriers and/or facilitators. Five studies used the CFIR framework (including all or some domains)[11] and 1 study used the RE-AIM (reach, effectiveness, adoption, implementation, maintenance) framework[19] to guide the assessment of barriers and facilitators. Most studies collected data using an interview method with a semistructured guide (n = 10) with data from clinic staff, providers, and clinicians, and few studies collected from organizational key leaders (including CEO, Medical Director, Nursing Directors) and the project team (Table 1).

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) diagram. Abbreviation: OECD, Organization for Economic Co-Operation and Development.

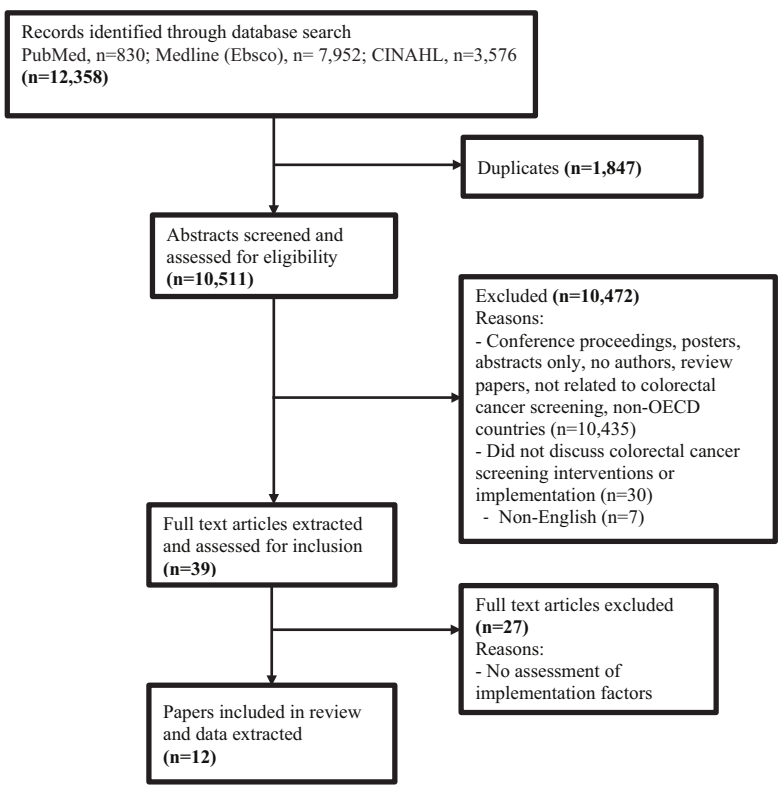

Table 1. Characteristics of Included Studies

Author	Objective	Type of EBIs or intervention program to improve CRCS	Study Setting	Key Study Methods
Green et al. 2017 USA	To assess the change in CRCS rate and intervention implementation facilitators and challenges	Mailed intervention, including mailing of FIT kit, patient education, and patient follow up. - First mailing: pamphlet on CRCS choices, and statements saying they are due for CRCS, and will soon receive a FIT kit. - Second mailing: FIT kit, pictographic instructions and a letter emphasizing the importance of completing screening. - Third mailing: Reminder letter if the FIT kit is not received and processed by the lab within 3 weeks.	Clinics	- No mention of methods-data collection tools/ techniques, samples in relation to barriers and facilitators assessment. - Used CFIR to report the implementation factors. - During implementation
Hannon et al. 2019 USA	To evaluation whether grantees implemented andmaintained EBIs over the funding cycle (measured with quantitative survey items) and barriers and facilitators to implementing andmaintaining EBIs (measured with open-text survey responses)	Implement one or more of these 5 interventions/EBI: - Provider-centered: provider reminder, provider assessment and feedback - patient-centered: small media (posters, postcards, brochures), client reminder - Addressing structural barriers (to address the financial barriers of low income and unscreened people).	CRCS program's grantee organizations (state department of health or tribal organization)	- Qualitative (online open text survey responses) - During implementation
Cole et al. 2015 USA	To identify facilitators of and barriers to implementation of a proactive, mail-based colorectal cancer screening program in Federally Qualified Health Centers setting that draws on the published evidence from the evaluation of the SOS program	- Patient education: mailing of patient information regarding CRCS - Mailed return kit and patient reminder: mailing of FOBT kits with stamps and reminders	Federally Qualified Health Centers comprising primary care clinics to provide primary care to low-income and uninsured patients	- Qualitative (Semi structured interviews guide developed based on CFIR) - During implementation
Bakhai et al. 2018 USA	To increase CRCS and identify the materials/ methods, physician and patient-related barriers to the acceptance of FIT and colonoscopy	1. Physician and staff reminder 2. In-clinic distribution of FIT 3. Patient education 4. FIT instruction 5. Patient reminder	Clinics	- Root cause discussion and analysis (using a fishbone diagram) - During implementation
Baldwin et al. 2020 USA	To explore implementation challenges and successes specific to two health insurance plans that serve enrollees in U.S. Medicaid and Medicare programs in implementing their mailed FIT programs in the first year	- Sent introductory letters and FITs via mail - Patient reminder (mailed postcard or live phone call)	Clinics	- Qualitative (telephone interviews using in-depth interview guide based on CFIR) - After implementation
Coronado, et al. 2017 USA	To report on implementation challenges faced by eight community health centers that participated in STOP CRC, a large comparative effectiveness cluster-randomized trial to evaluate a direct- mail program to increase the rate of CRCS	Mailed the introductory letter, the FIT kit, and the reminder postcard/letters.	Clinics	- Qualitative (telephone interviews using in-depth interview guide based on CFIR) - Before implementation or baseline and post implementation

Continued

Table 1. Continued

Author	Objective	Type of EBIs or intervention program to improve CRCS	Study Setting	Key Study Methods
Calanzani, et al. 2017, Scotland	To test the feasibility and acceptability of an opportunistic intervention in general practice patient consultations, examining whether a brief conversation was a viable way to engage with non-responders and increase bowel screening participation	Patient education: brief conversation between patient (non-responders) and providers about bowel screening. An opportunity to request a bowel screening kit, information leaflet, Freepost envelope were offered.	Clinics	- Qualitative (closed and open-ended questionnaire and semi-structured interviews - After implementation
Davis et al. 2019 USA	To explore how Accountable Care Organizations work with clinics (the key facilitators that enhanced the organization and clinics collaboration) while implementing multicomponent interventions to improve CRCS.	- Patient reminders - Patient education - Reducing structural barriers - Provider assessment and feedback - Patient and provider incentives - Provider reminder and recall	Accountable Care Organizational team	- Qualitative (key informant interviews using semi-structured interview guide) - During implementation
Cole et al. 2015 USA	- To describe self-reported EHR system capabilities necessary for completing/ delivering the CRC screening tasks and measuring colorectal cancer screening rates. - To describe the ease in using EHR systems and the perceived accuracy of EHR data for measuring CRCS.	CRCS reminders and provider reports	Clinics (50 community health center clinics)	- Quantitative (survey on EMR related barriers that can influence implementation) - Before implementation
Walsh et al. 2011 USA	To assess the extent to which components of the FLU-FOBT intervention program were adopted, implemented and maintained 1 year after completion of the RCT.	- Offering FOBT along with influenza vaccines - Patient education materials - Provided stamped mailing envelopes allowing patients to send completed sample to the lab	Clinics	- Qualitative (interview with clinic leaders using interview guide structured around the RE-AIM framework, after implementation
Weiner et al. 2017 USA	To describe facilitators of and barriers to implementing office systems in FQHCs (federally qualified health centers) clinics by using the practice facilitation and tool kit approach	- Implantation of policies and practices or procedures for CRCS including reminder systems to cue providers and patients to take actions for CRCS.	Clinics	- Qualitative (semi-structured interviews) - After implementation
Leeman et al. 2019 USA	To understand the process that Federally Qualified Health Center (FQHC) staff use to select and implement CRC screening interventions, and the factors influencing the intervention implementation	Patient level: education (one-on-one education, small media, group education) and patient remindersProvider level: provider assessment and feedbackOrganizational level: Patient navigators, reminder and recall systems Other interventions: FluFIT and mailed FIT	Clinics	- Qualitative (interviews using a semi-structured interview guide across CFIR framework domains). - During Implementation

Abbreviations: CRC, colorectal cancer; CRCS, colorectal cancer screening; FIT, fecal immunochemical test; CFIR, consolidated framework for implementation research; RE-AIM, reach, effectiveness, adoption, implementation, maintenance; EBI, evidence-based intervention; EHR, electronic health records; FBOT, Fecal Occult Blood Test; RCT, Randomized Controlled Trial; STOP CRC, Screening TO Prevent ColoRectal Cancer.

Quality of the Included Studies

All qualitative studies[20–28] were judged to have a clear research aim, appropriate qualitative methodology and research design, data collection that addressed the research issue, a clear statement of findings, and results that would provide local benefit. However, none of the studies mentioned whether the relationship between the researcher and participants was adequately considered. The included quantitative study[29] was judged as meeting 4 of the 5 quality criteria (relevant sampling strategy, representative sample, appropriate measurements, and appropriate statistical analysis), with the exception of risk for nonresponse bias. The quality improvement studies[30,31] were judged as meeting all criteria on the checklist (Table 2).

Facilitators

Detailed facilitators and barriers are described in Table 3 and in Table 3 in the online Appendix. The following 7 factors were most commonly reported across studies as facilitators for the successful implementation of interventions aiming to improve CRCS participation rate (Table 4).

Engagement was the most commonly reported facilitator, mapped to the CFIR constructs "readiness for implementation" and "implementation process" (engagement). Active engagement of clinic team members, clinic champions, leadership members,

Table 2. Quality Assessment of Included Studies

Qualitative studies (using the Critical Appraisal Skills Program checklist):

Study	Clear Statement of aims of the research	Qualitative Methods Appropriate	Research Design Appropriate	Recruitment Strategy Appropriate	Data Collection Addressed Research Issue	Relationship Adequately Considered	Ethical Issues Considered	Data Analysis Rigorous	Clear Statement of findings	Results Help Locally
Baldwin 2020	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Can't tell	Yes	Yes	Yes
Calazani 2017	Yes	Yes	Yes	Can't tell	Yes	No	Yes	Yes	Yes	Yes
Cole 2015	Yes	Yes	Yes	Yes	Yes	No	Can't tell	Yes	Yes	Yes
Coronado 2017	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Davis 2019	Yes	Yes	Yes	Can't tell	Yes	No	Can't tell	Yes	Yes	Yes
Hannon 2019	Yes	Yes	Yes	Can't tell	Yes	No	Can't tell	Yes	Yes	Yes
Leeman 2019	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Walsh 2012	Yes	Yes	Yes	Yes	Yes	No	Can't tell	Can't tell	Yes	Yes
Weiner 2017	Yes	Yes	Yes	Yes	Yes	No	Can't tell	Yes	Yes	Yes

Quality improvement studies (using the Quality Improvement Minimum Criteria Set):

Study	Organizational Motivation	Intervention Rationale	Intervention Description	Organizational Characteristics	Implementation	Study Design	Comparator	Data Source	Timing	Adherence/ Fidelity
Bhakhai 2018	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met
Green 2019	Met	Met	Met	Met	Met	Met	Met	Met	Met	Met

Study	Health Outcomes	Organizational Readiness	Penetration/Reach	Sustainability	Spread	Limitation
Bhakhai 2018	Met	Met	Met	Met	Met	Met
Green 2019	Met	Met	Met	Met	Met	Met

Table 3. Facilitators and Barriers of Implementation of Interventions to Improve Colorectal Cancer Screening (CRCS) Reported by Included Studies, Organized in Consolidated Framework for Implementation Research (CFIR) Domains

CFIR Domains	Study Reference	Facilitators	Barriers
1. Intervention characteristics			
Evidence	-	- Not identified	- Not identified
Relative advantage	Baldwin 2020, Leeman 2019, Cole 2015	**- The new program/intervention is beneficial or impactful: helps to increase CRC screening and patient engagements and provides a roadmap for improving CRC screening program.**	- Not identified
Adaptability	Green, 2017, Calanzani 2017, Baldwin 2020	- Flexibility that clinics could make choices about some components of interventions while maintaining fidelity.	- Not identified
Simplicity vs complexity	Green 2017	- Uncomplicated intervention; intervention could be put in place quickly.	- Not identified
Trialability	Cole 2015	- Program can easily be implemented/tested on a small scale first before the widespread implementation.	- Intervention significantly different than previous experience in the setting.
Design quality and packaging	Green 2017, Baldwin 2020	- **Use of already existing CRCS-related materials and infrastructure for intervention (e.g., FIT kits, pre-stamped envelope, bulk ordering, lab).** - Materials were tested, packaged, and made them available to the general public and clinical team. - Activities were able to be fit within clinicians' and staff's workflow (or work routines).	- Amount of time required and complexity of setting up mailed FIT program e.g., determining accurate eligibility lists and establishing workflows and vendor expectations).
Cost	Green 2017	- Prior research evidence on low cost for intervention (mailing FITkit).	- Not identified
2. Inner setting (clinic setting where the interventions were implemented)			
Networking and communication	Cole 2015, Bakhai 2018, Leeman 2019, Baldwin 2020, Weiner 2017, Green 2017	- Leveraging existing meeting structure/ communication strategies to introduce new programs. Staff meetings, where all staff members (practice manager and lead nurse) are involved to provide everyone with updated clinic information, policies, procedures, and also to gain insight on any suggestions or concerns. - **Communication by QI Committee about CRC screening improvement to staff via staff meetings, e-mail, newsletters and team huddles.**	- Communication challenges across organizations and within teams about mailed FIT program. Poor communication across disciplines. Organizational and professional teams have separate administrative and communication structures. - Communication of information about CRCS (status, improvement, efforts, process and plan) to providers and non-provider staff in separate meetings, limiting opportunities for interdisciplinary exchange.
Culture	Cole 2015, Green 2017	- Valuing prevention and population health. - **Individuals' and organizational commitment to improve CRCS rate**. - Viewing intervention as part of a broader preventive health agenda. - Vision to care for the underserved population. - Creation of quality improvement officer position that reports directly to CEO, which reflects importance of quality improvement works within the organization. - A shared mission of organizational and professional team of providing health care.	- Adoption and implementation of new interventions/programs at the discretion of administrative leadership without consultation of clinical or other staff about improvement priorities.
Implementation climate	Green 2017, Cole 2015 (quantitative study)	- Clinics' autonomy to trying new things. - Clinics' self-introduced adaptations. - Organizational encouragement for healthcare innovations. - Involvement of researchers with an experience of implementing the program.	- Not utilizing data feedback and strategies to improve and sustain intervention/project. - Staff not being able to generate specific information related CRCS using EMR functionality. - Staff not being able to send reminder to patients (using EMR functionality) due for CRCS.

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
Implementation climate: Tension for change	Hannon 2019, Cole 2015	- **Leadership with a strong motivation to improve CRCS.**	- **Conflicting opinions of clinical staff on approaches to improving CRCS.**
Implementation climate: Compatibility	Baldwin 2020, Davis 2019, Cole 2015	- Project's match with organization's mission and goal. - **Alignment of intervention with other similar initiatives/practices previously or currently experienced in the setting (cervical screening, alcohol brief intervention).** - Pieces of the intervention that fit within the current workflow. - New roles and workflows consistent with leadership vision for organization. - Organizational experience testing new program on a small scale before widespread implementation.	- Needed to create a new role (care manager) for intervention implementation, leading to increased cost. - **Incompatible intervention or not the best approach (specifically direct mail approach) for special patient population (homeless, low literacy): incongruous with how organization likes to work (face to face conversations and directly handing kits to patients); too impersonal and thus inferior to face-face encounters.**
Implementation climate: Relative priority	Leeman 2019, Cole 2015, Weiner 2017, Hannon 2019	- **Provider's premature death due to CRC increased the importance of project.** - **Leadership voiced strong support for CRCS as a priority and approach as a good fit for "where the organization is going".** - Project housed within group that measures how clinic/providers are doing on quality metrics, including CRCS. - Project/intervention selection based on what are going to be requirements in terms of resources, and then the overall value to patients from it. - **Organizations setting priorities that CRCS is in need of improvement and putting efforts to improve CRCS comparing to other areas.**	- Competing priorities for both providers and patients, that led to the limited frequency with which providers recommended screening and patients adhered to the recommendation. - Change fatigue. - Staff put preventive health issues lower on the priority list and sometimes forego offering them.
Implementation climate: Organizational incentives	Cole 2015	- New system for providing performance reports to clinical teams, which could create incentives. - Implementation support to providers to implement the project (by providing implementation facilitator).	- No financial incentives are tied to performance of providers or clinical teams.
Implementation climate: Goal and feedback	Cole 2015, Walsh 2012, Leeman 2019, Cole 2015	- **Agenda set for each patient before his/her visit where they (Medical Assistants) check a lot of preventive activities and see whether or not they are up to date for CRC screening in the year.** - **Monitoring of CRCS status every month and knowing the difference made or not made. Setting goal for few key indicators per years and providing monthly or quarterly performance feedback (clinic or provider specific).** - Creation of performance reports. - The goal, key indicators, and current status/ improvement presented via a graph, report, or scorecard, often during regularly scheduled meetings.	- No systematic way for sharing performance reports on quality measures (e.g., screening rate).
Implementation climate: Learning climate	Cole 2015, Bakhai 2018, Walsh 2012	- Teaching environment to support learning new skills and implementation of new practices. - Staff training regarding the project. - Availability of technical support regarding the use of EMR for project implementation and evaluation.	- Fast-paced clinic environment and financial pressures leading to most organizational resources devoted directly to clinical care. - Not much time or structure for clinical staff to participate in skill development. - Lack of peer mentoring or networking and support.

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
Readiness for implementation	Green 2017, Cole 2015 (quantitative study), Weiner 2017, Leeman 2019, Calanzani 2017, Hannon 2019, Cole 2015	- Robust data systems: EMR capturing accurate data related to CRCS history (identification of eligible patients, due or overdue for CRCS, high and average risks). Sharing EMR reports of eligible patients to attending providers. Building FIT workflow in EMR to document discussion with patients about FIT and to improve efficiency. - Written protocol regarding the implementation plans/processes.	- EMR: lack of EMR database; lack of EMR reminders/tools for physicians; lack of trackable documentation in EMR; lack of interpretable EMRs; lack of accurate EMR data for clinic patient member information; and time-consuming for modifying or establishing the EMR systems or functionalities/capabilities for changes. - **Lack of CRCS recommendation records in EMR.** - Recent rapid growth in organization and change in leadership structure. - Large health centers with numerous clinic sites and providers.
Readiness for implementation: leaders' and managers' engagement and commitment to implement)	Baldwin 2020, Leeman 2019, Cole 2015, Green 2017, Hannon 2019, Bakhai 2018, Davis 2019, Hannon 2019, Walsh 2012	- Program sponsored by clinical operation chief and supervised by clinic operation manager. - Project approval by grant funder. - Clinic leaders worked hard to find ways to finance the FOBT kit mailing and returning process. - Participation of leadership in pre-implementation interviews-demonstrating enthusiasm and willingness to involve and support. - Engaged provider groups and their teams/staff: they were informed of program and knew what is happening regarding the program. - Programmers work together in both delivery system and research. - Previous QI experience and **involved in projects related to FIT screening.** - Involving key staff and providers. - **Staff education and motivation regarding intervention/project.**	- Lack of involvement of high-level leadership such as CEO. - Lack of leadership and organization's financially accountability for intervention success. - High leadership/staff turnover or restructuring. - Limited coordination between participating clinic sites. - Undefined process for resourcing issues as they arise. - Differing roles and involvement-GPs less engaged than the nurses.
Readiness for implementation: Available resources (level of resources dedicated for implementation)	Green 2017, Hannon 2019, Cole 2015, Calanzani 2017, Cole 2015 (quantitative study), Leeman 2019, Weiner 2017, Bakhai 2018, Baldwin 2020, Coronado 2017, Walsh 2012	- Dedicated staffing in place to do the project. - **Assigned responsibility of medical assistants and front desk staff for maintaining the CRCS tracking log and patient reminders/ follow-up**. - Well-trained staff. Use of existing health information technology system. - New staff (e.g., patient navigators), change to their EMR systems, and educational material for providers, staff and patients. - Project funding to support clinic engagement and intervention implementation.	- Limited staff time. - Staff turnover- which caused clinics to redistribute staff rolesand train new staff in the clinic's office systems, and staffreluctance on the part of local gastroenterology practicesto perform free or low-cost diagnostic colonoscopies foruninsured or underinsured patients. Lack of staffing forpatient follow-up calls. - Lower performance of staff due to staff turnover orlongstanding operation issues. - Inadequate EMR staffingresources/technology support. - Limited time of GP.-Limited time for new innovation in an already pressuredenvironment. No dedicated time to do FIT related tasks.

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
			- Limited organizational resources for the scalability and sustainability of the program at the practice. - **Lack of clinical decision support tool for the physiciansto identify patients and order appropriate CRCS test.** - **Unavailability of FIT test/kit in the clinics**.
Readiness for implementation: Access to information and knowledge (knowledge about intervention implementation)	Walsh 2012, Coronado 2017, Leeman 2019, Cole 2015, Weiner 2017	- Participation of multiple clinical staff in pre-implementation interviews and interactions to understand the components of program and prepare for implementation. - **Creation of algorithm for CRCS and clinical workflow and making it available to clinical team.** - Clinic staff' access to wordless or pictorial information and instructions on CRC screening and beyond, developed by researchers. - **Clinic staff' learnings on how to assess CRCS eligibility, provide FOBT independently, and use patient education materials introduced by the study.** - Providing appropriate instructions for program in community clinics for test completion and return of kits to the laboratory using the new mailing envelope that was introduced by the study. - Availability and use of EMR reports for sending information (reminders) to clients and for providers. - Access to knowledge and information about interventions in an easy-to-understand format through patient information sheets, team huddles, and trainings.	- Not fully trained staff in place or not trained in new work. - Patient counseling script was too long. - Patient decision aids were too time-consuming. - Paper-based integrated summary was less useful as important information were lacking and inaccurate (such as patients due for CRCS and patients accessed interventions). - Lack of knowledge and skill of staff and training/support on EMR system. - Concerns about funding sustainability.
3. Outer setting			
Patient needs and resources: Extent to which patient needs are accurately known and prioritized by organization	Baldwin 2020, Leeman 2019, Calanzani 2017, Coronado 2017, Cole 2015	- Established "health access" program, which provides no cost or low-cost care to uninsured patients. - Engaged patients and getting feedback on processes and promotion of screening options. - **Creation of awareness about CRCS to patients and family.** - **Positive reactions from patients and expression of appreciation.** - **Patients' receptivity of CRCS: patients called in to share they had their FIT or colonoscopy completed and appreciation of screening opportunities and support provided.**	- No organized program for providing specialty and/ orhospital care to uninsured patients outside of the organization. - Patients' knowledge gaps, fear of adverse effects, and concernsrelated to transportation/ time away from work. - **Patient unable to understand FIT kit instructions.** - **Difficulty in interacting on the topic of bowel screeningwith certain groups (e.g., males and minority ethnicgroups).** - **Some patient populations do not want to talk about pooor keeping the poo in kit.** - Low patient awareness about CRC and **patients' confusionwith a mailed program.** - Patients' lack of insurance coverage to pay for follow-updiagnostic testing.

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
			- Patients' communication barriers such and not speakingEnglish, low health literacy, or difficulty hearing automatedcalls. - Limited access to transportation, negative attitudestowards stool testing and low priority given to screeningrelative to other medical needs.
Cosmopolitanism: degree to which organization is networked with other external organizations	Cole 2015, Davis 2019, Leeman 2019	- Organization participated in Regional Patient Centered Medical Home initiative. - Organizational alignment with other organizational initiatives on CRC screening and prevention. - Organization is engaged in various types of networks and participated in network-related meetings and activities-noted value of networking is opportunity for staff and providers to lean about what was working well for others.	
External policy and incentives: External mandates, regulations and incentives	Cole 2015, Hannon 2019, Coronado 2017	Externally funded research/project, where organizations are mandated to put greater emphasis on reporting and quality improvement.	- Ending of funding. - Shift in the partners' focus or priorities that led to thepartner no longer being interested in the program. - **No financial incentives to organization or staff for improving CRCS rates.** - **Impact on colonoscopy access for higher number of positive FITs.** - Cumbersome process of EMR vendor to activate EMR toolscreating time delays for execution of work. - Burdensome interface with outside labs processing FIT kitscreated delays/extra work. - A lot of fatigue as wanting to do something different andshowing that everything is important. - Influence of pay-for-performance incentives- staff andproviders being "overwhelmed" and experiencing "fatigue"related to all potential financial incentives. - Grant funding often linked to specific, preselectedinterventions, which led unintended consequences such aslack of motivation and feeling of fatigue and overwhelmedin providers/ staff.
4. Characteristics of individual involved			
Knowledge and beliefs about the intervention: attitude toward and value placed on the intervention	Hannon 2019, Green 2017, Cole 2015, Walsh 2012, Leeman 2019, Cole 2015 (quantitative study)	- Clinical champions and investigator with interest in the project. - Staff capacity to do the intervention related work. - Leadership and clinical staff voiced understanding of how the intervention works and understanding of principles of which it is based. - Providers value on preventive healthcare. - The perceived professional role in educating patients and raising awareness.	**- Some clinical staff (physicians and medical assistants) had incomplete knowledge about patient preferences in relation to CRC screening and effectiveness of different colorectal cancer screening tests.** **- Providers' gap in knowledge about recommended CRCS guidelines.**

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
		- Motivation to adopt something new. - Realization (of staff and providers) of importance of shifting from paper-based tracking to tracking in the EMR. - Staff/providers valuing the importance of EMRs in intervention implementation and monitoring the quality and success of screening programs. - Providers' interest and priorities for screening and interventions. - The willingness of staff to see the importance of intervention/project, to say that this is relatively easy test for the clients to perform. - **Staff/providers knowledge on intervention/ project and recognized its importance**.	- Providers desiring response rates for their patients/teams but information not available at the time of inquiry. - Provider/health center resistance to FIT screening in some locations. - Provider viewed project as adding pressurized work environment (project added greater workload as we are already struggling to provide our committed services). - **Providers believed that EMR-generated CRCS data are not accurate enough to guide the intervention implementation** (somewhat accurate requiring verification or not at all accurate and could not be used for reporting). - Reluctance of some clinic staff to adopt new roles and initial burden of participating in an RCT that required staff to shift up and back between intervention and control weeks during the RCT. - **Staff/providers' lack of confidence (i.e., self-efficacy) in their ability to translate their knowledge of CRCS and interventions into action.**
Other personal attributes	Baldwin 2020, Leeman 2019	- Positive reactions from providers and health centers. - Provider experienced minimum time and staff burden. - Nurses spending more time on this project and doing more education with the patients. - Ability to communicate with patients in a caring manner.	- Desire to implement other EBIs and not being able to implement all EBIs at one time.
5. Implementation process			
Planning: Degree to which implementation is planned in advance	Hannon 2019, Cole 2015, Green 2017	-Involving a multidisciplinary team and expertise in program planning and development. - Minimal number of meetings. - Detailed pre-implementation evaluation and implementation planning done by research team in collaboration with organizations.	- Challenges in getting approvals or arranging contracts with partners agencies. - Geographic distance between research team and organization making frequent in-person meeting difficult. - More time-consuming to set up/ start than anticipated. - **Some health centers/provider groups less interested as prefer to "do own thing" or had other CRCS strategies.** - **Not assessing local factors that influence CRC screening rates and therefore, are not purposefully targeting the factors that influence screening rates in their settings or populations.** - **Not assessing patient- and provider-level factors that contribute to low CRCS rates, leading to inappropriate intervention selection.**

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
			- No plan for the maintenance of the program/intervention implementation. As a result, improved screening participation outcome did not sustain.
Engaging: Individuals from organization with responsibility for implementation or opinion leaders	Baldwin 2020, Hannon 2019, Davis 2019, Weiner 2017, Cole 2015, Coronado 2017	- **Leadership participation in pre-implementation evaluation and financial sustainment (of FIT kit mailing)** - Support and strong champion to lead program at leadership level. - Engagement of providers, who lead CRCS program, clinical care, and education at the organization, as practice champions. - Engaging IT staff to confirm the accuracy of EMR databases. - Partnership approach that encourage health center participation by reducing staff burden and cost to implement CRCS on own (e.g., hiring implementation facilitator). - **Medical directors at health centers promoting FIT and idea of mailed FIT.** - Established workflows and strategies to address challenges as move into next year. - Established relationships and building partnerships: history of prior relationship between key leadership and primary care stakeholders, physical proximity of the key leadership's infrastructure, and joint leadership roles of the key stakeholders and regional clinics. - **Involving organizational leaders and formally appointed implementation leaders to support planning and execution of CRCS intervention**. - Identifying and preparing implementation champions and leaders.	- Multiple full-time responsibilities (teaching and clinical care) of practice champions. - Lack of communication between key departments about mailed programs so less able to address patient questions. - Lack of coordination between clinic staff and providers including "disconnect" between quality improvement coordinator and the clinicians who were directly responsible for recommending screening and distributing FOBT kits. - Lack of clarity of clinic staff roles.
Executing	Davis 2019, Green 2017, Baldwin 2020, Weiner 2017, Walsh 2012, Davis 2019, Coronado 2017	-Timelines for activities in place. - Materials/resources for activities in place, **including established workflows for FIT kit mailing and returning process/returning of mailed kits, EMR.** - **Assistance and use of a mailing vendor**. - Implementation coordination between team (recommending screening, ordering kit, offering kit, education, labs, scheduling colonoscopy). - Appoint patient navigator or use nurse navigator or practice facilitator to support the implementation or improve existing practice, track FIT orders, FIT completion and urgent colonoscopy referrals ("glue of the program"). - **Encouraging health centers to scrub or clean/update screening eligibility lists.** - **Providing information to providers on the FIT intervention program.** - Minimizing paperwork and integrating the intervention into existing information technology/EMR systems. - Clinic-based staff support, learning collaboration, and change via facilitation. - Use of tools including clinic self-assessment survey, the sample screening algorithm, the standing orders for CRCS, the tracking log, and the patient reminders. - Flexibility in implementing process and tools.	**- Complexity of working with vendors to get FIT kits ordered.** **- Delay in obtaining kits from vendor, some kits are out of date.** **- Delay in vendor mailing introductory letter and kits.** **- Lack of sufficient oversight with vendor so difficult to know exactly how many reminder calls were being completed or if they are following script.** **- Current lab vendor requires a two-sample test which may be barrier to FIT completion for patients.** **- Returned FIT kits not always processed.** **- Lack of workflow/process to ensure returned FIT kits were properly labeled before going to lab for processing.** - Delayed FIT kit mailing timeline, incorrect postage of kits. **- Wasted FIT samples because of no collection date labeled or mislabeling**.

Continued

Table 3. Continued

CFIR Domains	Study Reference	Facilitators	Barriers
		- **Start with small batch for testing and then the full-fledged mailed.**	- CIinics are not being able to easily create a list of patient panels by providers and generate the eligible patient panel reports. - **CRCS history inconsistently documented in health records.** - **Inability to accurately identify eligible patient for CRCS.**
Reflecting and evaluating	Green 2017, Davis 2019, Calanzani 2017, Baldwin 2020, Leeman 2019	- Producing and sharing performance data: producing accurate, transparent and actionable reports (with results and interpretation); identifying area of improvement; report sharing to inform team including administrative leadership; use to prioritize actions, helping clinics to figuring out the solutions, and monitor improvement. - Review of outcomes and implementation adjustments. - **Staff viewing more patients being returned the kit/screened than previously.** - Results intriguing enough to continue program. - **Requesting feedback from patients on their CRCS process.** - **Monitoring and reviewing data and using data to improve CRC screening efforts.**	- Lack of timely or accessible data to show the worth of efforts. - Assessment of kit return rate outcome hindered by delays and lag in claims data, hence, not being able to see the improvement. - Staff fatigue due to metric focus associated tasks. - **Collecting data for the purpose of organizational reporting, but not for evaluation purpose or using data to improve CRCS intervention implementation processes and outcomes.** - Not using existing data sources available-asking new data collection, leading to fatigue and too busy.

Bolded text signifies facilitators and barriers that are relatively more specific/targeted to CRCS intervention implementation whereas the nonbolded text are facilitators and barriers more general to implementation of change in primary care.
Table includes constructs for which relevant data existed in the reviewed literature; hence, other CFIR constructs such as innovation source and structural characteristics are not included in the table.
Abbreviations: CRC, colorectal cancer; CRCS, colorectal cancer screening; FIT, fecal immunochemical test; CFIR, consolidated framework for implementation research; EBI, evidence-based intervention; EMR, electronic medical records; QI, quality improvement; FBOT, Fecal Occult Blood Test.

and stakeholders was important before and during implementation. Engagement included inf-orming staff and leadership about the intervention, involving them in training and planning, and building relationships with primary care stakeholders. Priority or motivation to improve CRCS was also a key facilitator, mapped to the CFIR constructs "implementation culture and climate" and "individuals' knowledge and beliefs about the intervention." This included providers and leaders valuing preventive health care, prioritizing screening programs, and recognizing benefits of CRCS interventions and the existence of organizational goals and activities on CRCS or quality improvement. Similarly, use of robust EMR systems, mapping to "readiness for implementation" on the CFIR, was seen as important for CRCS practice improvement work, tracking the practice, and for performance monitoring and evaluation. An ideal EMR would have FIT workflow built in and capture accurate data including identification of eligible patients for CRCS.

In addition, resources staff's time, knowledge, skills, and training, and availability of well-packaged materials were related to the CFIR constructs "design quality and packaging," "implementation process (executing)," "knowledge and beliefs about the intervention," and "readiness for implementation." Implementation was facilitated by having dedicated and trained clinic staff to support the implementation, tested and well packaged educational materials, leveraging existing resources, and undisrupted clinic workflow. Continuous monitoring, feedback and reflection system of performance for improvement was mapped to the CFIR construct 'reflection and evaluation'. Strong quality improvement processes allowed for producing accurate, transparent and actionable reports; sharing

Table 4. Summary of Commonly Discussed Facilitators and Barriers and the Number of Studies They Were Identified In

Facilitators of implementation [related CFIR domains (and constructs)]	Number of studies	Barriers of implementation [related CFIR domains (and constructs)]	Number of studies
Engagement of clinic team, leadership team and partners [Implementation process (engaging) and internal setting (implementation readiness)]	9	Limited time of clinic team to commit new project [Internal setting (implementation readiness)]	8
Priority or motivation to improve CRCS rates and recognizing benefits of new interventions [Internal setting (culture and implementation climate) and characteristics of individuals involved (knowledge and beliefs about the intervention)]	7	Challenges or unavailability of getting accurate and timely data to implement interventions and evaluate the progress or intervention [Implementation process (reflection and evaluating)]	6
Use of EMR system [Internal setting (implementation readiness)]	7	EMR-related challenges due to limited skills and supports and time-consuming [Internal setting (implementation readiness)]	5
Resources- staff's time, knowledge, skills, and training, availability of well-packaged materials in place [Intervention characteristics (design quality and packaging), internal setting (implementation readiness), and implementation process (executing)]	6	Communication challenges with clinics/ organizations regarding FIT intervention program, disconnect between clinic team members, and lack of role clarity of clinic team [Internal setting (networking and communication) and implementation process (engaging)]	5
Continuous monitoring, feedback and reflection system of performance for improvement [Implementation process (reflection and evaluating)]	6	Patient-related barriers: includes cost, low health literacy, fear, not speaking English language, limited access (due to transportation), hesitancy of certain population to talk about or collect poo [Outer setting (patients' needs and resources]	5
Communication and coordination between clinic team [Internal setting (networking and communication)]	6	Process barriers due to lack of standard workflow, cumbersome workflow, or not following the process; delays from vendors [Implementation process (planning and executing)]	4
Clinics having autonomy to try new innovation and flexibility to adapt intervention/implementation process [Intervention characteristics (adaptability), internal setting (implementation climate), and implementation process (executing)]	5	Organizational structure changes, lack of leadership engagement, and leadership turnover [Internal setting (implementation readiness)]	4

Abbreviations: CRCS, colorectal cancer screening; CFIR, consolidated framework for implementation research; EMR, electronic medical records; FIT, Fecal Immunochemical Test.

reports to inform the team including administrative leadership; using reports to identify and prioritize actions, and monitoring progress. Communication and coordination between clinic team and clinic's autonomy to try new innovations and adapt the intervention, mapping to the CFIR constructs 'networking and communication' and 'implementation climate or process (execution),' respectively also supported the implementation.

Barriers

The following 7 factors were most commonly reported as barriers to implementing interventions to improve CRCS (Table 4).

Limited time of clinic team for a new project was the most commonly reported barrier, mapped to the CFIR constructs "readiness for implementation' and 'implementation process." Challenges were related to limited staff time to commit to a

new project, competing priorities, and a busy clinic environment due to existing activities or serving to acute health conditions. Challenges or unavailability of getting accurate and timely data, another commonly reported barrier, was mapped to the CFIR construct "implementation process (reflection and evaluation)." Challenges such as getting accurate and timely CRCS related data and inability to show the value of the implementation efforts impeded the implementation. EMR-related challenges, mapping to the CFIR construct "readiness for implementation," included limited staff capability for using the EMR, time-consuming process to modify EMR functionalities for the CRCS intervention and lack of EMR supports. These resulted in challenges with: using the EMR database and tools/reminders, documentation, and extracting accurate data.

Communication and coordination barriers, mapped to the CFIR constructs 'networking and communication' and 'implementation process (engaging)' included disconnection between clinic team members and lack of role clarity on intervention implementation. Patient-related barriers were mapped to the CFIR construct p"atients' need and resources." Studies reported a lack of insurance coverage for CRCS, low health literacy, limited access due to transportation problems, and hesitancy of certain minority ethnic groups to talk about or collect stool. In addition, the lack of leadership engagement and organizational changes and implementation process barriers, mapping to the CFIR constructs "readiness for implementation" and "implementation process (planning and executing)," respectively, negatively impacted the implementation. These included a lack of standard workflow, cumbersome workflow, delays from vendors in receiving FIT kits, a lack of involvement of high-level leadership, and organizational leadership structure changes.

Discussion

Interpretations

The multitude of identified facilitators and barriers across multiple levels show a complex picture of difficulties and opportunities faced while implementing evidence-based interventions in primary care. In general, the most commonly reported facilitators and barriers fell under: (1) clinic's implementation readiness and climate, and network and communication between the clinic team members (CFIR domain: clinic's internal setting); (2) project enga-gement, execution, and evaluation (CFIR domain: implementation process); (3) knowledge and beliefs about the intervention of individuals involved (CFIR domain: characteristics of individuals); and (4) patients' need and resources (CFIR domain: outer setting). Furthermore, while the majority of reported implementation facilitators and barriers are generic to improvement work in primary care, some were more specific to CRCS intervention implementation. The CRCS intervention specific facilitators included: providers', leaders', and organizations' motivation and commitment to improve CRCS rate; creation of awareness about CRCS to patients and family; and review of data to improve CRCS efforts. Some of the CRCS intervention specific barriers included: conflicting opinions of clinical staff on approaches to improving CRCS; FIT kit mail-out approach being too impersonal/inferior to face-to-face encounters; unavailability of FIT kits; and impact on colonoscopy access for higher number of positive FIT results (as a result of increased FIT participation). These findings suggest that planners of intervention programs could benefit from considering implementation factors important both in general for primary care and specific to the particular intervention.

However, it is important to acknowledge that these observed findings are also dependent on what was measured and reported in the studies. The studies that used implementation science frameworks captured the implementation factors more comprehensively than those that did not use a framework. They captured both general and CRCS intervention specific factors across different aspects of implementation. While no other systematic review has been conducted on facilitators and barriers to CRCS intervention uptake, our findings are consistent with the literature on intervention implementation in primary care. Multi-level factors such as organizational leadership and managerial engagement, individual and organizational capacity and practices (tools, staffing, time, health professionals' motivation, skills, and knowledge), monitoring and evaluation, and multidisciplinary team communication influence implementation in primary care.[32,33]

Key Gaps and Policy/Practice Implications

We were surprised at how relatively few articles were studying the implementation factors of widely recommended interventions to improve CRCS in

OECD countries. The studies had limited methodological rigor and lacked clarity on implementation details. The description of length/duration of implementation, adoption and adaptation of strategies, measurement constructs, implications or utility of identified barriers and facilitators was inadequate. Similarly, the relationship between the researcher and participants, which impacts response bias, was not mentioned in any of the qualitative studies. We suggest that future research be undertaken using implementation science frameworks to enhance clarity and transparency of reporting the implementation and methodology rigor.[11,13,19,34–45]

Behavioral interventions or strategies for health services are rarely "one-size-fits-all" due to the tremendous diversity of populations and real-world settings.[41,46–48] Assessment of barriers and facilitators is an essential step to help understand the implementation context. We recommend future studies to develop customized strategies through intervention mapping based on the barriers and facilitators identified[49] and evaluate these strategies. Overall, commitment to both implementing patient-centered CRCS improvement interventions in primary care settings and conducting implementation research to generate knowledge of real-world applicability are critical to improve CRCS participation.

Strengths and Limitations of the Review

We used a systematic approach, rigorous, yet feasible methods in a resource constrained health services research environment. Efforts were made to maintain consistency across reviewers (eg, training, regular meetings). However, we were unable to include 2 independent reviewers fully in each step. We mapped the reported findings with CFIR constructs to provide a comprehensive, systematic picture of facilitators and barriers to guide the identification of strategies that could be tailored, implemented and tested in the future. However, the barriers and facilitators reported here are the experiences of diverse primary care contexts. We did not analyze the barriers and facilitators by the types of participants, settings, and specific intervention due to the data limitations. The implementation challenges regarding organizational structure, implementation climate and readiness, and implementation process may differ across them. In addition, this analysis relied on peer-reviewed published articles and is subject to publication bias.

Conclusions

The summary of synthesized findings improves our understanding of facilitators of and barriers to the implementation of interventions to increase CRCS uptake/FIT participation in primary care practice. The understanding can help researchers, decision makers, primary care practitioners, and program developers in the careful design of interventions and development of strategies to optimize implementation. Future studies assessing CRCS intervention implementation factors would benefit from the use of implementation science frameworks to further understand the context of implementation and enhance understanding of how to implement these programs more effectively.

To see this article online, please go to: http://jabfm.org/content/35/4/840.full.

References

1. International Agency for Research on Cancer (IARC). Colorectal cancer screening. IARC Handb Cancer Prev 2019;17:1–300. http://publications.iarc.fr/573.
2. Ferlay JE, Lam F, Colombet M, et al. Global cancer observatory: cancer today [Internet] International Agency for Research on Cancer; 2020 (accessed January 21, 2021) Available from: https://gcoiarcfr/today/home.
3. Heitman SJ, Hilsden RJ, Au F, Dowden S, Manns BJ. Colorectal cancer screening for average-risk North Americans: an economic evaluation. PLoS Med 2010;7:e1000370.
4. Fitzpatrick-Lewis D, Ali MU, Warren R, Kenny M, Sherifali D, Raina P. Screening for colorectal cancer: a systematic review and meta-analysis. Clin Colorectal Cancer 2016;15:298–313.
5. Patient completion of screening tests [Internet] Health Quality Council of Alberta; 2019 (accessed January 21, 2021). Available from: https://focus.hqca.ca/primaryhealthcare/screening/.
6. Coldman A, Flanagan W, Nadeau C, et al. Projected effect of fecal immunochemical test threshold for colorectal cancer screening on outcomes and costs for Canada using the OncoSim microsimulation model, Journal of Cancer Policy. Journal of Cancer Policy 2017;13:38–46.
7. Rodríguez-Gómez M, Ruiz-Pérez I, Martín-Calderón S, et al . Effectiveness of patient-targeted interventions to increase cancer screening participation in rural areas: A systematic review. Int J Nurs Stud 2020;101:103401.
8. Sabatino SA, Lawrence B, Elder R, et al. Effectiveness of interventions to increase screening for breast, cervical, and colorectal cancers: nine updated systematic reviews for the guide to community preventive services. Am J Prev Med 2012;43:97–118.

9. Increasing colorectal cancer screening: multicomponent interventions. Finding and rationale statement [Internet] Community Preventive Task Force; 2016 (accessed January 30, 2021). Available from: https://www.thecommunityguide.org/findings/cancer-screening-multicomponent-interventions-colorectal-cancer.
10. Increasing colorectal cancer screening: multicomponent interventions [Internet] The Community Guide; 2017 (accessed January 15, 2021). Available from: https://www.thecommunityguide.org/findings/cancer-screening-multicomponent-interventions-colorectal-cancer.
11. Damschroder LJ, Aron DC, Keith RE, Kirsh SR, Alexander JA, Lowery JC. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci 2009;4:50.
12. Cane J, O'Connor D, Michie S. Validation of the theoretical domains framework for use in behaviour change and implementation research. Implement Sci 2012;7:37.
13. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. Implement Sci 2011;6:42.
14. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. Ann Intern Med 2009;151:W65–94.
15. Critical Appraisal Skills Programme (CASP) checklist [Internet]. CASP-UKnet; 2018 (accessed June 11, 2021). Available from: https://casp-uknet/casp-tools-checklists/.
16. Hong QPP, Fàbregues S, Bartlett G, et al. Mixed Methods Appraisal Tool (MMAT8) [Internet]. Canadian Intellectual Property Office, Industry Canada; 2018 (accessed June 11, 2021). Available from: http://mixedmethodsappraisaltoolpublic.pbworks.com/w/file/fetch/127916259/MMAT_2018_criteria-manual_2018-08-01_ENG.pdf.
17. Hempel S, Shekelle PG, Liu JL, et al. Development of the Quality Improvement Minimum Quality Criteria Set (QI-MQCS): a tool for critical appraisal of quality improvement intervention publications. BMJ Qual Saf 2015;24:796–804.
18. Popay J, Roberts H, Sowden A, et al. Guidance on the conduct of narrative synthesis in systematic reviews. A product from the ESRC methods programme version 1, b92 [Internet]. Lancaster University; 2006 (accessed January 30, 2021). Available from: https://www.lancaster.ac.uk/media/lancaster-university/content-assets/documents/fhm/dhr/chir/NSsynthesisguidanceVersion1-April2006.pdf.
19. Glasgow RE, Vogt TM, Boles SM. Evaluating the public health impact of health promotion interventions: the RE-AIM framework. Am J Public Health 1999;89:1322–7.
20. Calanzani N, Cavers D, Vojt G, et al. Is an opportunistic primary care-based intervention for non-responders to bowel screening feasible and acceptable? A mixed-methods feasibility study in Scotland. BMJ Open 2017;7:e016307.
21. Cole AM, Esplin A, Baldwin LM. Adaptation of an evidence-based colorectal cancer screening program using the consolidated framework for implementation research. Prev Chronic Dis 2015;12:E213.
22. Coronado GD, Schneider JL, Petrik A, et al. Implementation successes and challenges in participating in a pragmatic study to improve colon cancer screening: perspectives of health center leaders. Transl Behav Med 2017;7:557–66.
23. Davis MM, Gunn R, Pham R, et al. Key collaborative factors when Medicaid accountable care organizations work with primary care clinics to improve colorectal cancer screening: relationships, data, and quality improvement infrastructure. Prev Chronic Dis 2019;16:E107.
24. Hannon PA, Maxwell AE, Escoffery C, et al. Adoption and implementation of evidence-based colorectal cancer screening interventions among cancer control program grantees, 2009-2015. Prev Chronic Dis 2019;16:E139.
25. Leeman J, Askelson N, Ko LK, et al. Understanding the processes that federally qualified health centers use to select and implement colorectal cancer screening interventions: a qualitative study. Transl Behav Med 2020;10:394–403.
26. Walsh JM, Gildengorin G, Green LW, Jenkins J, Potter MB. The FLU-FOBT Program in community clinics: durable benefits of a randomized controlled trial. Health Educ Res 2012;27:886–94.
27. Weiner BJ, Rohweder CL, Scott JE, et al. Using practice facilitation to increase rates of colorectal cancer screening in community health centers, North Carolina, 2012–2013:. Prev Chronic Dis 2017;14:E66.
28. Baldwin LM, Schneider JL, Schwartz M, et al. First-year implementation of mailed FIT colorectal cancer screening programs in two Medicaid/Medicare health insurance plans: qualitative learnings from health plan quality improvement staff and leaders. BMC Health Serv Res 2020;20:132.
29. Cole AM, Tu SP, Fernandez ME, et al . Reported use of electronic health records to implement evidence-based approaches to colorectal cancer screening in community health centers. J Health Care Poor Underserved 2015;26:1235–45.
30. Bakhai S, Ahluwalia G, Nallapeta N, et al . Faecal immunochemical testing implementation to increase colorectal cancer screening in primary care. BMJ Open Qual 2018;7:e000400.
31. Green BB, Fuller S, Anderson ML, et al. A quality improvement initiative to increase colorectal cancer (CRC) screening: collaboration between a

primary care clinic and research team. J Fam Med 2017;4:1115.

32. Rubio-Valera M, Pons-Vigués M, Martínez-Andrés M, et al. Barriers and facilitators for the implementation of primary prevention and health promotion activities in primary care: a synthesis through meta-ethnography. PloS One 2014;9:e89554.
33. Seckler E, Regauer V, Rotter T, et al. Barriers to and facilitators of the implementation of multi-disciplinary care pathways in primary care: a systematic review. BMC Fam Pract 2020;21:113.
34. Moore GF, Audrey S, Barker M, et al. Process evaluation of complex interventions: Medical Research Council guidance. BMJ 2015;350:h1258.
35. Moore G, Audrey S, Barker M, et al. Process evaluation in complex public health intervention studies: the need for guidance. J Epidemiol Community Health 2014;68:101–2.
36. Proctor EK, Powell BJ, McMillen JC. Implementation strategies: recommendations for specifying and reporting. Implement Sci 2013;8:139.
37. Powell BJ, Waltz TJ, Chinman MJ, et al. A refined compilation of implementation strategies: results from the Expert Recommendations for Implemen-ting Change (ERIC) project. Implement Sci 2015;10:21.
38. Proctor E, Silmere H, Raghavan R, et al. Outcomes for implementation research: conceptual distinctions, measurement challenges, and research agenda. Adm Policy Ment Health 2011;38:65–76.
39. Gaglio B, Shoup JA, Glasgow RE. The RE-AIM framework: a systematic review of use over time. Am J Public Health 2013;103:e38–46.
40. Subramanian S, Hoover S, Tangka FKL, et al. A conceptual framework and metrics for evaluating multicomponent interventions to increase colorectal cancer screening within an organized screening program. Cancer 2018;124:4154–62.
41. Leeman J, Calancie L, Kegler MC, et al. Developing theory to guide building practitioners' capacity to implement evidence-based interventions. Health Educ Behav 2017;44:59–69.
42. Perry CK, Damschroder LJ, Hemler JR, et al. Specifying and comparing implementation strategies across seven large implementation interventions: a practical application of theory. Implement Sci 2019;14:32.
43. Campbell M, Fitzpatrick R, Haines A, et al. Framework for design and evaluation of complex interventions to improve health. BMJ 2000;321:694–6.
44. Harvey G, Kitson A. PARIHS revisited: from heuristic to integrated framework for the successful implementation of knowledge into practice. Implement Sci 2016;11:33
45. Esmail R, Hanson HM, Holroyd-Leduc J, et al. A scoping review of full-spectrum knowledge translation theories, models, and frameworks. Implement Sci 2020;15:11.
46. Curran GM, Bauer M, Mittman B, et al. Effectiveness-implementation hybrid designs: combining elements of clinical effectiveness and implementation research to enhance public health impact. Med Care 2012;50: 217–26.
47. Mathieson A, Grande G, Luker K. Strategies, facilitators, and barriers to implementation of evidence-based practice in community nursing: a systematic mixed-studies review and qualitative synthesis. Prim Health Care Res Dev 2019;20:e6.
48. Leeman J, Birken SA, Powell BJ, et al. Beyond "implementation strategies": classifying the full range of strategies used in implementation science and practice. Implement Sci 2017;12:125.
49. Powell BJ, Beidas RS, Lewis CC, et al. Methods to improve the selection and tailoring of implementation strategies. J Behav Health Serv Res 2017;44:177–94.