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Review

From participation to diagnostic assessment: a systematic scoping review of the role of the primary healthcare sector in the National Bowel Cancer Screening Program

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Abstract. Primary health care (PHC) plays a vital support role in organised colorectal cancer (CRC) screening programs by encouraging patient participation and ensuring timely referral for diagnostic assessment follow up. A systematic scoping review of the current evidence was conducted to inform strategies that better engage the PHC sector in organised CRC screening programs. Articles published from 2005 to November 2019 were searched across five databases. Evidence was synthesised and interventions that specifically require PHC involvement were mapped to stages of the CRC screening pathway. Fifty-seven unique studies were identified in which patient, provider and system-level interventions align with defined stages of the CRC screening pathway: namely, identifying/reminding patients who have not responded to CRC screening (non-adherence) ($n = 46$) and follow up of a positive screen referral ($n = 11$). Self-management support initiatives (patient level) and improvement initiatives (system level) demonstrate consistent benefits along the CRC screening pathway. Interventions evaluated as part of a quality-improvement process tended to report effectiveness; however, the variation in reporting makes it difficult to determine which elements contributed to the overall study outcomes. To maximise the benefits of population-based screening programs, better integration into existing primary care services can be achieved through targeting preventive and quality care interventions along the entire screening pathway.

Additional keywords: preventive medicine, quality of health care, secondary prevention.

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Introduction

Screening of average-risk adults (from age 50 to 74 years) for colorectal cancer (CRC) contributes to reduced mortality (Australian Institute of Health and Welfare 2019). Acknowledging that the National Bowel Cancer Screening Program (NBCSP) is not fully implemented, participation has yet to reach the desired rate to achieve maximum benefit, particularly with some population groups being under-screened or never screened (Australian Institute of Health and Welfare 2019). A range of external constraints restricted the implementation process (Flitcroft *et al.* 2010), with limited involvement of primary health care (PHC) in the program design despite the eligible patient cohort (50–74 years) visiting a GP at least six times each year (Australian Institute of Health and Welfare 2018). To enhance the vital role that PHC plays in realising the benefits of screening (Cole *et al.* 2002; Zajac *et al.* 2010), more practical guidance is needed to support the fundamental role of the PHC sector in preventive and quality care (NBCSP 2016) along the CRC screening pathway.

The CRC screening pathway is characterised by multiple interfaces of care across different providers and settings, creating complexities in implementation (Zapka *et al.* 2010). In Australia, this is compounded by Federal and State Government boundaries implicit in a patient's participation in the NBCSP. The role of PHC in CRC screening is similar irrespective of whether CRC screening is undertaken as routine quality care or part of an organised population-based screening program, with identification of eligible patients and endorsement and completion of screening consistent with evidence-based clinical guidelines (Emery *et al.* 2014). Numerous systematic reviews provide information to assist the PHC sector to improve screening

What is known about the topic?

- Despite a body of evidence identifying effective primary care interventions and the known influence of GP screening recommendation, primary healthcare engagement in bowel cancer screening programs is limited.

What does this paper add?

- Our review aligns effective primary care interventions with the bowel cancer screening pathway to identify opportunities and research gaps, to readily incorporate bowel cancer screening into routine practice.

participation, but many only review interventions targeting one stage of the screening pathway; for example, recruitment, whereas identifying interventions that have relevance along the entire screening pathway is expected to enhance the effectiveness of the population-based screening program.

This systematic scoping review examines provider- and practice-based interventions that support the role of the PHC sector that align with stages of the NBCSP and require the explicit involvement of GPs and their practice staff; namely, identifying and reminding patients who have not responded to CRC screening (non-adherence) and follow up of an iFOBT (immunochemical faecal occult blood test) and referral to diagnostic services, if required. A systematic scoping review was considered the most appropriate form of review to address the research question: What are the patient, professional and system-level interventions implemented in PHC settings (Interventions) that improve CRC screening completion (Outcomes) of non-adherent, eligible patients (Population), compared with baseline or a control group (Comparison). The review purpose was to identify future practice and research priorities to improve the effectiveness of CRC screening through strategies that allow better integration of the NBCSP with PHC in Australia.

Methods

Five databases (MEDLINE, PsycINFO, Embase, CINAHL and PubMed) were selected for the scoping review (Arksey and O'Malley 2005; Levac *et al.* 2010), as these were expected to contain relevant studies. The latest search was undertaken in November 2019 for articles from 2005, to coincide with the NBCSP implementation, to the date the search was re-run (19 November 2019). The keywords and medical subject headings specified in Appendix 1 were used. Additional studies were identified through reference tracking of systematic reviews, clinical guidelines and other key papers identified through the database searches.

For ~10% articles, two investigators (C. A. Holden, J. Caruso) reviewed the same subset of titles and abstracts, achieving 92% agreement. Both reviewers read full-texts to determine their eligibility when the inclusion and exclusion criteria were applied. Disagreements between reviewers were resolved by consensus-based discussion.

PHC involvement in CRC screening programs

The NBCSP Quality Framework (NBCSP 2016) was used to identify stages that specifically require involvement of the PHC sector; namely, optimised recruitment participation (i.e. recruitment of non-adherent, eligible patients) and follow-up assessment (following a positive iFOBT). Interventions that were directed at these stages of opportunistic or organised CRC screening programs were included as eligible studies (Fig. 1).

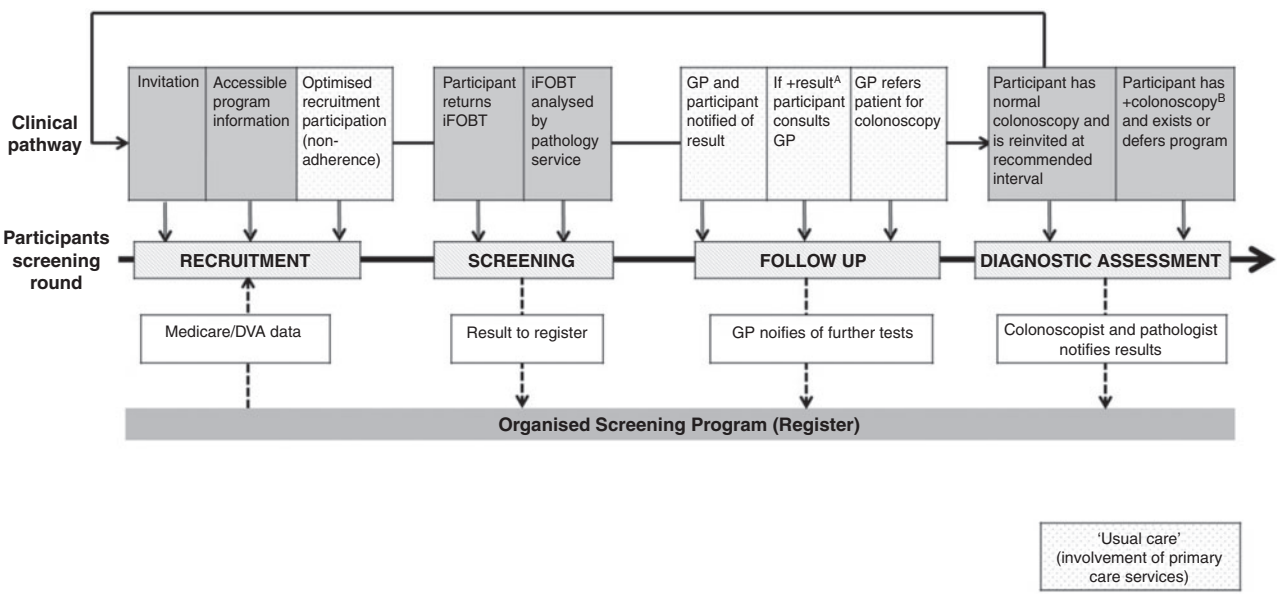

Fig. 1. Primary care involvement across the National Bowel Cancer Screening Program (NBCSP 2016). Schematic diagram modified from the National Bowel Cancer Screening Program Quality Framework, version 2 (NBCSP 2016). [A]A positive (+) result means that blood was detected in the completed immunochemical Faecal Occult Blood Test (iFOBT). [B]A positive colonoscopy is identified by reporting one of the following: tubular adenoma, tubulovillous adenoma, villous adenoma, sessile serrated adenoma, traditional serrated adenoma, adenoma not otherwise classified, or carcinoma.

Studies with no family physician/GP involvement were excluded.

Inclusion criteria

To be eligible, the study design was limited to randomised, quasi-randomised or controlled trials published in English. Observational studies were excluded during full-text review as the search identified sufficient controlled trials (saturation point). Systematic reviews, meta-analyses and clinical guidelines were excluded, but contributed additional studies to review from their reference lists.

Studies from countries where a population-based CRC screening program is established were included if the intervention was implemented in family practice/primary care (Schreuders *et al.* 2015). Interventions were included if they were: (1) aimed at increasing CRC screening participation of non-adherent patients (improved adherence and diagnostic follow up); (2) implemented in primary/general practice settings; (3) focussed on asymptomatic patients eligible for population-based screening (who had not previously participated or were from underserved population groups); and (4) were not an established component of an existing organised screening program (e.g. personal invitation, advanced notification letters, iFOBT kit mail-out etc.). The primary outcome of interest was CRC screening completion, which needed to be reported quantitatively and derived from medical records or administrative data for the study to be included. We reported pilot studies or studies reporting different analyses of the same intervention as a single study.

Exclusion criteria

Articles were excluded if they: (1) failed to meet the inclusion criteria; (2) were randomised trials comparing different screening methods; or (3) assessed interventions that involved surveillance colonoscopy or follow up after cancer treatment.

Data extraction

Data extracted for mapping and analysis included author, year, study country, study design, alignment with NBCSP stage, sample size, primary outcome measure and the population group if specifically defined. We categorised the intervention level and intervention type using a previously defined taxonomy of patient, practitioner and system-level interventions (de Silva and Bamber 2014) to allow reporting consistency. Whether the intervention was part of a quality-improvement (QI) process was also recorded. Characteristics and findings of included articles are summarised in Table 1.

Studies were not appraised for quality, as the primary purpose was to extract and map the available data in line with systematic scoping review methods (Arksey and O'Malley 2005; Levac *et al.* 2010). However, we attempted to assess effectiveness in changing the primary outcome using criteria to classify study outcomes and applied to score intervention effectiveness previously used by Leykum *et al.* (2007). The criteria and accompanying rating scale addressed study heterogeneity and differences in the unit of analysis and unit of randomisation between studies (e.g. comparison with baseline values or control groups). The criteria and rating scale described by Leykum *et al.* (2007) was used to classify study outcomes and applied to score effectiveness of interventions described. In summary, scores of 0 (no effect), 0.5 (mixed results) and 1 (effective intervention) were applied to the reported statistical significance of study outcomes. Where possible, results adjusted for potential confounders were used to determine effectiveness.

Results

Of 2674 articles, 57 unique studies were included in the review (Fig. 2).

Characteristics of included studies

The 57 eligible studies were conducted in the USA ($n = 42$), Canada ($n = 5$), Europe ($n = 5$), UK ($n = 3$), Korea ($n = 1$) and Australia ($n = 1$). Aligning to NBCSP stages, most studies reported interventions targeting non-adherence to optimised recruitment participation ($n = 46$), with 11 studies targeting follow-up stages, namely positive screen follow up ($n = 8$) and colonoscopy referral ($n = 3$). Four of these studies explored GP–Program interaction, in which an organised screening program supported family practice/primary care in monitoring/care processes. Approximately half ($n = 28$) of eligible studies focussed on interventions that improved screening participation of specific population subgroups that tend to be under-screened or never screened. An overview of study characteristics is summarised in Table 1.

Number and type of interventions

A quality framework of patient, professional and system-level interventions (de Silva and Bamber 2014) was applied to categorise interventions. The 57 studies yielded 24 different interventions around screening participation; 11 directed at the patient level, six at the professional level and seven at the system/organisational level. Eighteen studies included multiple interventions at several levels.

Interventions targeting different elements of the NBCSP

Optimised recruitment participation (Non-adherence)

Most identified studies ($n = 46$) focussed on interventions that optimised screening participation (non-adherence), with most exploring patient-level interventions; that is, those interventions targeting the patient that were generated from the practice. Most patient-level interventions focussed on self-management support systems, with education activities (Walsh *et al.* 2005; Sequist *et al.* 2009; Aragones *et al.* 2010; Dietrich *et al.* 2013; Green *et al.* 2013; Jerant *et al.* 2014), lay-person support structures (mostly lay-person patient navigators) (Fiscella *et al.* 2011; Lasser *et al.* 2011; Jandorf *et al.* 2013; Leone *et al.* 2013; Shankleman *et al.* 2014; Reuland *et al.* 2017) and health coaching/counselling (Myers *et al.* 2007; Fiscella *et al.* 2011; Menon *et al.* 2011; Davis *et al.* 2013; Basch *et al.* 2015; Temucin and Nahcivan 2018) reported as mostly effective in improving adherence in organised CRC screening programs. Reminders for screening (Walsh *et al.* 2005; Myers *et al.* 2007; Fiscella *et al.* 2011; Dietrich *et al.* 2013; Green *et al.* 2013; Leone *et al.* 2013; Baker *et al.* 2014; Cohen-Cline *et al.* 2014; Hendren *et al.* 2014; Phillips *et al.* 2015; Benton *et al.* 2017;

Table 1. Characteristics and findings of included articles ($n = 57$)

RCT, randomised control trial; CRC, colorectal cancer; FOBT, faecal occult blood test

Author (year)	Country	Study design (follow up)	Primary outcome measure	Intervention type	Population group	Sample size
Optimised recruitment participation (non-adherence)						
Aragones *et al.* (2010)	New York, USA	RCT (3 months)	CRC screening completion	Patient level Education activities Using technology (e.g. smartphone apps or behaviour change computer modules) Professional level Point-of-care prompts	Latino immigrant, Spanish-speaking patients	65 patients, 65 practitioners, 18 clinics
Atlas *et al.* (2014)	Massachusetts, USA	Cluster randomised trial (12 months)	Cancer screening completion (colorectal, breast and cervical)	Professional level New staff roles (patient navigators) System level IT systems for sharing information within and across organisations	Women	103 870 patients (38 073 CRC patients), 169 practitioners;18 clinics (for breast, cervical and colorectal cancer)
Aubin-Auger *et al.* (2016)	Val d'Oise, France	Cluster RCT (7 months)	CRC screening completion	Professional level Training in communication skills, cultural competency, patient involvement, support to self-manage, etc.		45 practitioners, 35 clinics
Baker *et al.* (2014)	Illinois, USA	RCT (6 months)	CRC screening completion	Patient level Reminders for screening Outreach programs for vulnerable / marginal groups and young people	Vulnerable populations such as Latinos, uninsured patients	450 patients
Basch *et al.* (2015)	New York, USA	RCT (12 months)	CRC screening completion	Patient level Health promotion Health coaching/counselling Professional level Training in specific tools or conditions Outreach visits (e.g. interprofessional learning, academic detailing, peer review etc.)	Non-US-born urban minority	564 patients, 459 practitioners
Benton *et al.* (2017)	England, UK	Non-randomised controlled trial (14 months)	CRC screening completion	Patient level Reminders for screening		12 878 patients, 25 clinics
Cohen-Cline *et al.* (2014)	Washington, USA	Randomised trial (6 months)	CRC screening completion	Patient level Reminders for screening		13 279 patients
Davis *et al.* (2013)	Louisiana, USA	Quasi-experimental design (12–18 months)	CRC screening completion	Patient level Health coaching/counselling	Low-income, uninsured patients in rural settings	961 patients, 8 clinics
Dietrich *et al.* (2013)	New York, USA	RCT (18 months)	CRC screening completion	Patient level Education activities Reminders for screening	Women	2240 patients
Dodd *et al.* (2019)	NSW, Australia	Cluster RCT (9 months)	CRC screening completion	Patient level Reminders for screening Education activities Professional level Point-of-care prompts: face-to-face GP endorsement		114 patients, 4 clinics

Fiscella *et al.* (2011)	New York, USA	Randomised trial (within practice) (12 months)	CRC screening completion	Patient level Reminders for screening Layperson support services (patient navigator) Health coaching/counselling Professional level Point-of-care prompts Training in specific tools or conditions	Underserved patients: African Americans, Latinos, Medicaid patients, patients without insurance	469 patients (breast and colorectal screening), 323 patients overdue for CRC screening
Fitzgibbon *et al.* (2007)	Illinois, USA	RCT (24 months)	CRC screening completion and patients (%) who received provider recommendations for screening	Patient level Changing the way in which information is provided (e.g. leaflets, online, health literacy initiatives) Professional level Outreach visits (e.g. interprofessional learning, academic detailing, peer review etc.)	Non-compliant male veterans	986 patients, 44 practitioners
Green *et al.* (2013)	Washington, USA	RCT (12 and 24 months)	CRC screening completion	Patient level Reminders for screening Education activities Professional level New staff roles (patient navigators) System level Electronic referral systems		4675 patients, 21 clinics
Guiriguet *et al.* (2016)	Spain	Cluster RCT (12 months)	CRC screening completion	Professional level Point-of-care prompts		41 042 patients, 130 practitioners
Hendren *et al.* (2014)	New York, USA	RCT (12 months)	CRC screening completion	Patient level Reminders for screening Changing the way in which information is provided (e.g. leaflets, online, health literacy initiatives) Professional level Point-of-care prompts	Low-income and minority patients	366 patients (breast and colorectal cancer) (240 CRC patients)
Hirst *et al.* (2017)	England, UK	RCT (18 weeks)	CRC screening completion	Patient level Reminders for screening		8269 patients, 141 clinics
Huei-Yu Wang *et al.* (2018)	Metropolitan Washington DC and Philadelphia/ New York City, USA	Cluster RCT	CRC screening completion	Professional level Training in communication skills, cultural competency, patient involvement, support to self-manage, etc.	Chinese Americans	479 patients; 25 practitioners
Jandorf *et al.* (2013)	New York, USA	Randomised trial	CRC screening completion	Patient level Layperson-led support services (patient navigators) Professional level New staff roles (patient navigators)	African American patients	350 patients
Jerant *et al.* (2014)	California, New York, Colorado and Texas, USA	RCT (12 months)	CRC screening completion	Patient level Using technology (e.g. smartphone apps or behaviour change computer modules) Education activities	Multi-ethnic: Hispanic, Hispanic/English, Hispanic/Spanish	1164 patients, 5 clinics

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Table 1. (Continued)

Author (year)	Country	Study design (follow up)	Primary outcome measure	Intervention type	Population group	Sample size
Jimbo *et al.* (2019)	South-east Michigan, USA	RCT (6 months)	CRC screening completion	Patient level Using technology (e.g. smartphone apps or behaviour change computer modules (decision aids))		540 patients, 15 clinics
Kiran *et al.* (2018)	Toronto, Canada	RCT (6 months)	Cancer screening completion (colorectal, breast and cervical)	Patient level Reminders for screening		5270 patients, 6 clinics
Lasser *et al.* (2011)	Massachusetts, USA	RCT (12 months)	CRC screening completion	Patient level Layperson-led support services (patient navigators)	Haitian Creole-speaking or Portuguese-speaking patients	465 patients, 6 clinics
Leone *et al.* (2013)	North Carolina, USA	Controlled trial (6 months)	CRC screening completion	Patient level Reminders for screening Layperson-led support services (patient navigators)	Medicaid patients who were not up to date with screening	163 patients, 12 clinics
Ling *et al.* (2009)	Pennsylvania, USA	RCT (12 months)	CRC screening completion	System level Quality-improvement facilitation and projects		599 patients, 10 clinics
Maddocks *et al.* (2011)	Ontario, Canada	RCT (12 months)	Cancer screening completion (colorectal, breast and cervical) and kidney disease screening	Patient level Identifying and targeting people at high risk/case finding Professional level Audit and feedback Training in specific tools or conditions		23 688 patients, 22 practitioners, 9 clinics (breast cancer, cervical cancer, colorectal cancer, kidney disease)
Mader *et al.* (2016)	New York, USA	Pre- and post-intervention study (6 months)	Cancer screening completion (colorectal, breast and cervical)	System level Quality-improvement facilitation and projects	Racial/ethnic minorities, those with low socioeconomic status, the uninsured, those from geographically isolated/rural locations and Medicaid-eligible populations	210 staff (practitioners, nurses, physician assistants, administrative staff), 23 clinics
Menon *et al.* (2011)	Three USA sites: Midwestern x2, South-eastern x1	Randomised trial (12 months)	CRC screening completion	Patient level Health coaching/counselling		515 patients
Miller *et al.* (2011)	North Carolina, USA	Randomised trial (6 months)	CRC screening completion	Patient level Changing the way in which information is provided (e.g. leaflets, online, health literacy initiatives)	Socioeconomically disadvantaged: mixed literacy	264 patients
Myers *et al.* (2007)	Philadelphia, USA	RCT (24 months)	CRC screening completion	Patient level Reminders for screening Health coaching/counselling		1546 patients
Ornstein *et al.* (2010)	USA	Cluster randomised trial (24 months)	CRC screening completion	System level Continuous quality-improvement projects, including audit and feedback		68 150 patients, 32 clinics

Phillips *et al.* (2015)	USA	RCT (9 months)	CRC screening completion	Patient level Reminders for screening		600 patients, 6 practitioners, 1 clinic
Pignone *et al.* (2011)	Georgia and Florida, USA	Controlled trial (12 months)	CRC screening completion	Patient level Changing the way in which information is provided (e.g. leaflets, online, health literacy initiatives) Involving patients in decisions (via decision aids and training professionals in shared decision-making) Professional level Outreach visits (e.g. interprofessional learning, academic detailing, peer review, etc.)		443 patients
Potter *et al.* (2011)	California, USA	Pre- and post-intervention study (6 months)	CRC screening completion	Patient level Identifying and targeting people at high risk / case finding Outreach programs for vulnerable/ marginal groups and young people	Low-income Chinese American community	1372 patients, 6 clinics
Price-Haywood *et al.* (2014)	Louisiana, USA	Cluster RCT (24 months)	CRC screening completion	Patient level Involving patients in decisions (via decision aids and training professionals in shared decision-making) Professional level Audit and feedback Training in communication skills, cultural competency, patient involvement, support to self-manage etc.	Patients at risk for low health literacy: minorities, middle-aged or older, publicly ensured and uninsured	168 patients (94 patients for CRC screening), 18 practitioners
Reuland *et al.* (2017)	North Carolina and New Mexico, USA	RCT (6 months)	CRC screening completion	Patient level Layperson-led support services (patient navigators) Involving patients in decisions (via decision aids and training professionals in shared decision-making)	Vulnerable populations: diverse low-income communities including substantial numbers of Latino patients	265 patients, 2 clinics
Ritvo *et al.* (2015)	Ontario, Canada	RCT (12 months)	CRC screening completion	Professional level New staff roles (patient navigators)		5240 patients, 21 clinics
Sequist *et al.* (2009)	Massachusetts, USA	RCT (15 months)	CRC screening completion	Patient level Education activities Professional level Point-of-care prompts		21 860 patients, 110 practitioners, 11 clinics
Shankleman *et al.* (2014)	England, UK	Randomised trial (3 months)	CRC screening completion	Patient level Health promotion Layperson-led support services Outreach programs for vulnerable/ marginal groups and young people	Low socioeconomic status and high ethnic diversity	9113 patients, 42 clinics
Sun *et al.* (2018)	San Francisco, USA	RCT (26 months)	CRC screening completion	Patient level Reminders for screening Health promotion Professional level Training in specific tools or conditions	Chinese Americans	3120 patients, 42 practitioners

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Table 1. (Continued)

Author (year)	Country	Study design (follow up)	Primary outcome measure	Intervention type	Population group	Sample size
Temucin and Nahcivan (2018)	Istanbul, Turkey	Pre- and post-intervention study (6 months)	CRC screening completion	Patient level Health coaching/counselling (nurse-led)		110 patients, 1 clinic
Vernon *et al.* (2011)	Texas, USA	RCT (6 months)	CRC screening completion	Patient level Using technology (e.g. smartphone apps or behaviour change computer modules)		1224 patients
Walsh *et al.* (2005)	California, USA	Cluster randomised trial (12 months)	CRC screening completion	Patient level Reminders for screening Education activities Professional level Outreach visits (e.g. interprofessional learning, academic detailing, peer review, etc.)		7993 patients (enrolled for 2 years), 2665 patients (enrolled for 5 years), 94 practitioners
Wu *et al.* (2016)	Massachusetts, USA	Controlled before and after study (5 months)	CRC screening compliance and completion	System level IT systems for sharing information within and across organisations		5320 patients, 70 practitioners, 6 clinics
Positive follow up						
Cha *et al.* (2011)	Korea	Controlled trial (12 months)	Colonoscopy completion in patients with an abnormal screening test	Patient level Proactive monitoring and follow up		8318 patients (90 patients with an abnormal screening test)
Freund *et al.* (2014)	Illinois, Washington, Florida, Ohio, Oregon, Colorado, Texas, Massachusetts and New York, USA	Multi-centre ($n = 9$) trial (individualised study design) (12 months)	Time to cancer diagnosis after abnormal screening result	Patient level Layperson-led support services (patient navigators)	Low income, uninsured or publicly ensured, and from racial and ethnic minority populations	10 521 patients (with abnormal screening test results for breast, cervical, colorectal or prostate) (497 patients with colorectal cancer), 9 clinics
Green *et al.* (2014)	Washington, USA	Randomised trial (6 months)	Colonoscopy completion in patients with an abnormal screening result	Professional level New staff roles (patient navigators)		147 patients, 21 clinics
Humphrey *et al.* (2011)	Oregon, USA	Cluster randomised trial (1 month, 3 months, 6 months)	Colonoscopy consultation +/− colonoscopy completion in patients with an abnormal screening result	System level Electronic referral systems	Veterans	8 clinics
Paskett *et al.* (2012)	Ohio, USA	Group randomised trial (nested cohort design) (12 months)	Time to diagnostic resolution (from abnormal breast, cervical or colorectal cancer screening tests or symptoms)	Patient level Layperson-led support services (patient navigators)	Includes underserved populations (minority, poor and elderly)	862 patients, 18 clinics

Raich *et al.* (2012)	Colorado, USA	Randomised trial (6 months)	Time to diagnostic resolution (from abnormal breast, colorectal or prostate cancer screening tests)	Patient level Layperson-led support services (patient navigators)	Underserved populations (consequence of setting)	235 patients with colorectal cancer
Wei *et al.* (2005)	New Hampshire, Massachusetts and Connecticut, USA	Pre- and post-intervention (12 months)	Includes CRC screening completion (FOBT +/− colonoscopy)	System level Quality-improvement facilitation and projects		127 practitioners
Colonoscopy referral						
Lebwohl *et al.* (2011)	New York, USA	Pre- and post-intervention (12 months)	Screening colonoscopy completion	Patient level Layperson-led support services (patient navigators) System level Improvements to referral letters	Ethnically and socioeconomically diverse population	749 patients
Powell *et al.* (2011)	USA	Controlled pre- and post-intervention (2 months and 12 months)	Colonoscopy completion in patients with an abnormal screening result	System level Improvement collaboratives	Veterans	24 clinics (21 intervention, 3 control)
Singh *et al.* (2009)	Texas, USA	Pre- and post-intervention (up to 4 years)	Timely and appropriate colonoscopy completion in patients with an abnormal screening result	System level Continuous quality-improvement projects, including audit and feedback	Veterans	533 patients
GP–Program interaction[A]						
Jonah *et al.* (2017)	Ontario, Canada	Cohort study (5 months)	Cancer screening completion (colorectal, breast and cervical)	Professional level Audit and feedback System level Reminder systems (external organisations/systems reminding practices about specific monitoring or processes of care)		For CRC only: 1 206 660 patients, 7856 practitioners
Le Breton *et al.* (2016)	France	Cluster RCT (17 months)	CRC screening completion	System level Reminder systems (external organisations/systems reminding practices about specific monitoring or processes of care)		20 778 patients, 144 practitioners
Rat *et al.* (2017)	Loire-Atlantique and Vendée, France	Cluster randomised trial (12 months)	CRC screening completion	System level Reminder systems (external organisations/systems reminding practices about specific monitoring or processes of care)		31 229 patients, 1446 practitioners, 801 clinics
Stock *et al.* (2017)	Ontario, Canada	Cohort study (6 months)	Time to follow-up colonoscopy in patients with an abnormal screening result	Professional level Audit and feedback System level Reminder systems (external organisations/systems reminding practices about specific monitoring or processes of care)		9661 patients

[A]GP–Program interaction: systems initiated by an organised screening program to support GPs in monitoring/processes of care.

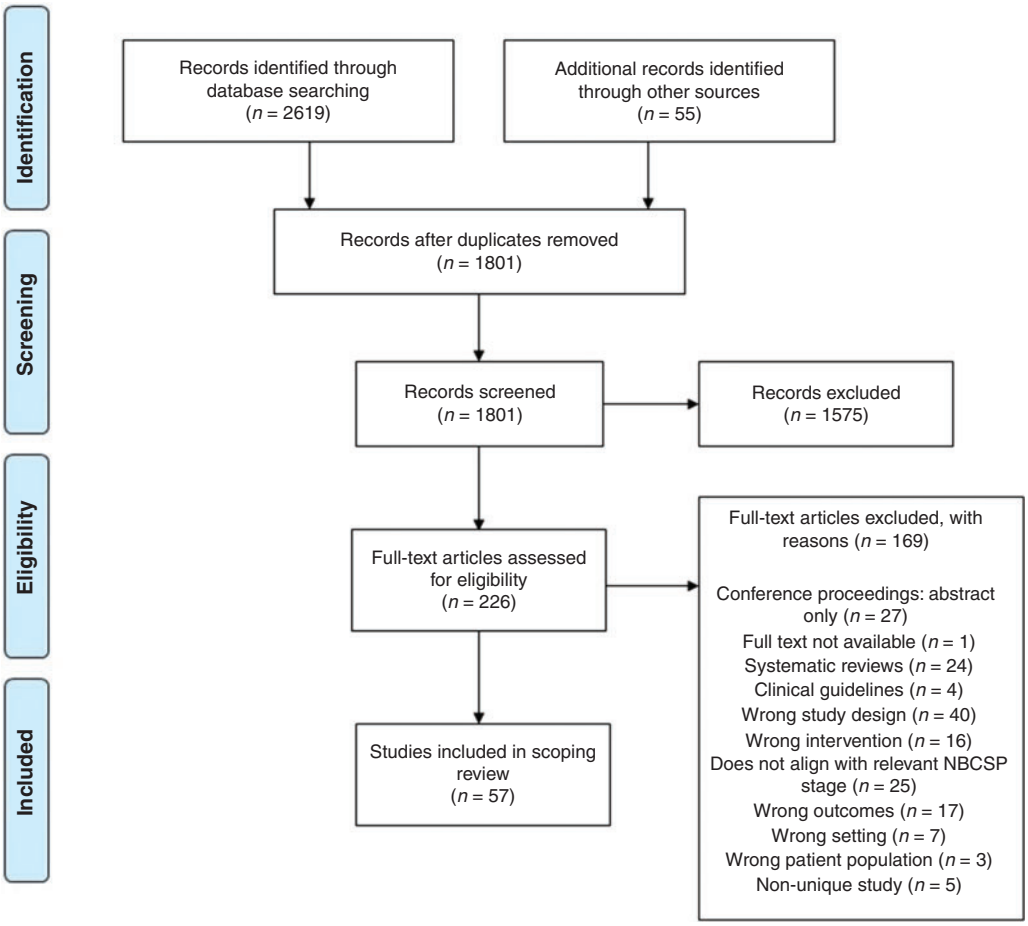

Fig. 2. PRISMA flow diagram of study selection. NBCSP, National Bowel Cancer Screening Program.

Hirst *et al.* 2017; Kiran *et al.* 2018; Sun *et al.* 2018; Dodd *et al.* 2019; using different formats, e.g. text messaging (Hirst *et al.* 2017), GP-endorsed mail-outs (Benton *et al.* 2017; Kiran *et al.* 2018) and automated telephone calls (Phillips *et al.* 2015), or a combination) were also mostly effective in improving adherence in organised CRC screening programs for both eligible patients not up-to-date with screening and under-screened population subgroups. Involving patients in decisions (e.g. via decision aids) reported mixed results (Pignone *et al.* 2011; Price-Haywood *et al.* 2014; Reuland *et al.* 2017; Jimbo *et al.* 2019). Interventions that aimed to improve access to care, such as outreach programs for vulnerable/marginal groups and young people (Potter *et al.* 2011; Baker *et al.* 2014; Shankleman *et al.* 2014) tended to be mostly effective in improving adherence to CRC screening.

Nineteen eligible studies included professional-level interventions to improve adherence to CRC screening programs, although most ($n = 15$) simultaneously included patient- or system-level interventions as a multi-component study. In a comparable way to studies that test the effectiveness of patient reminders for screening, point-of-care prompts to the physician (at the time of the patient consultation) also tended to demonstrate improvements in adherence to CRC screening in primary care (Sequist *et al.* 2009; Aragones *et al.* 2010; Fiscella *et al.* 2011; Hendren *et al.* 2014; Guiriguet *et al.* 2016; Dodd *et al.* 2019). Training initiatives targeting professionals reported mixed results (such as training in specific tools or conditions; Fiscella *et al.* 2011; Maddocks *et al.* 2011; Basch *et al.* 2015; Sun *et al.* 2018) and training in communication skills, cultural competency, patient involvement, support to self-manage etc. (Price-Haywood *et al.* 2014; Aubin-Auger *et al.* 2016; Huei-Yu Wang *et al.* 2018), although interprofessional training delivered by peers and through academic detailing, tended to report more effective outcomes.

Only nine eligible studies included system-level interventions to improve adherence to CRC screening programs. There were too few eligible studies to determine intervention effectiveness; however, improvement initiatives (Ling *et al.* 2009; Ornstein *et al.* 2010; Mader *et al.* 2016) tended to report improved adherence. Similarly, while there were too few system-level studies to determine the specific effectiveness of computer systems for sharing information within and across organisations, most studies that focussed on system-level interventions included computer systems that supported the intervention delivery, suggesting that health informatic approaches improved quality of care.

Table 2. Intervention effectiveness relating to the quality-improvement (QI) process (Leykum *et al.* 2007)

Intervention type	Intervention effectiveness[A]			Total no. studies
	0	0.5	1	
QI process not applied to implement one or more interventions	12	9	17	38
Study reports that a QI process is in place but not clear how intervention is part of that process	1	2	9	12
Intervention is explicitly part of a QI process	0	3	4	7
Total	13	14	30	57

[A]A rating scale of 0 (no effect), 0.5 (mixed results) and 1 (effective intervention) was applied for an assessment of effectiveness in changing the primary outcomes based on criteria described by Leykum *et al.* (2007).

Follow up

Despite the role of primary care services in ensuring that patients who receive a positive screen result are referred appropriately for further assessment, only one-quarter of eligible studies ($n = 11$) explored primary care interventions that improve diagnostic patient follow up and approximately half of these included a system-level intervention ($n = 6$).

Positive screen follow up. Only eight eligible studies focussed on improving patient follow up with a positive initial screen. Most were single-level interventions; that is, across only patient ($n = 4$), professional ($n = 1$) or system ($n = 2$) levels.

Most studies explored the effectiveness of patient navigators to improve positive screen follow up across both patient level (lay-person support services; Paskett *et al.* 2012; Raich *et al.* 2012; Freund *et al.* 2014) and professional level (as new staff roles within the family practice/primary care setting; Green *et al.* 2014). Other interventions that explored positive screen follow up included system-level interventions that focussed on electronic referral systems (Humphrey *et al.* 2011), QI and facilitation projects (Wei *et al.* 2005) and external reminder systems (Stock *et al.* 2017). Although there were too few eligible studies to determine effectiveness of some interventions, patient navigators and QI initiatives tended to report improved outcomes.

Colonoscopy referral. Only three eligible studies focussed on interventions to improve colonoscopy referral. All reported system-level change interventions including improvement initiatives (such as continuous QI projects, including audit and feedback (Singh *et al.* 2009), and improvement collaboratives (Powell *et al.* 2011)) and service provision (such as improvements to referral letters (Lebwohl *et al.* 2011)), acknowledging that there were insufficient studies to determine effectiveness in the context of colonoscopy referral. Patient-level interventions (layperson-led support services, patient navigators; Lebwohl *et al.* 2011) targeting colonoscopy referral were implemented with other system-level activity as a multi-level intervention.

GP–Program interaction

Despite many organised population-based CRC screening programs worldwide, all requiring primary care involvement (to different extents), there were relatively few eligible studies that specifically tested interventions that target GP–Program interaction activity to improve CRC screening completion. Two studies from Canada (Jonah *et al.* 2017; Stock *et al.* 2017) and two from France (Le Breton *et al.* 2016; Rat *et al.* 2017) had mixed results. All used system-level activities (i.e. reminder systems (external organisations reminding practices about specific monitoring/care processes) at different points of the screening pathway, with the Canadian studies (Jonah *et al.* 2017; Stock *et al.* 2017) also incorporating physician audit and feedback.

QI initiatives

The scoping review identified that studies including a continuous QI element reported greater effectiveness (Table 2).

Nineteen studies reported that interventions aimed at improving CRC screening participation were implemented as a QI process, but details of the QI model were not reported in one study (Cha *et al.* 2011). With one exception (Leone *et al.* 2013), all studies ($n = 18$) reported effectiveness or trends towards improvements in outcome measures when the intervention was implemented as a defined QI initiative or within an existing QI process. Most studies addressed optimised recruitment participation ($n = 14$); however, interventions addressing follow-up stages were also identified.

Where QI process detail was described ($n = 18$), in eight it was part of a QI framework, but it was difficult to determine which elements contributed to the overall study outcomes. The same applied to an additional four studies where the intervention was implemented within an existing named QI program. Only seven studies explicitly indicated that the CRC screening participation intervention was a defined improvement initiative and detailed the elements of the model applied.

Discussion

This systematic scoping review highlights the PHC practice and research opportunities to improve CRC screening participation, particularly for non-adherent, eligible patients in the context of a population-based bowel cancer screening program. This review made a distinction between optimised recruitment participation (non-adherence) and follow up, where an organised screening program may moderate the PHC role; better integration of CRC screening into existing primary care services (prevention and quality care interventions) along the entire screening pathway may maximise the benefits of population-based screening programs.

In the large number of systematic reviews (including meta-analyses) and empirical studies that focus on PHC interventions that enhance CRC screening participation, most studies focus on identifying and reminding patients who have not responded to CRC screening (non-adherence). Few studies consider the PHC role in the full CRC screening pathway, despite the important role the primary care service has in follow up and referral for

diagnostic services, if required. Emery *et al.* (2014) provides the most comprehensive analysis of the primary care role to support cancer screening and management, including follow-up diagnostic assessment, albeit across several cancer types. The alignment of interventions with NBCSP stages that require specific PHC involvement is a unique perspective of our review. This approach identifies practice opportunities and research gaps in ensuring patients complete the screening pathway, particularly if in the NBCSP.

Acknowledging that observational studies were excluded, a significant gap identified is the dearth of high-quality Australian studies investigating interventions that specifically address opportunities for PHC to address patient screening non-adherence and follow up. Most Australian research has focussed on interventions relevant to an organised screening program, without reference to the essential role of primary care services, with interventions that the NBCSP has already implemented (e.g. advanced notification) and/or compared screening test efficacy (which were excluded from our search criteria). Without robust Australian studies, the generalisability of the review findings to the Australian setting might be limited. However, this finding also identifies opportunities and a strong need for more Australian research in this area, specifically to study interventions that can be implemented in primary care services to complement the NBCSP rather than developing parallel systems to improve bowel cancer screening participation.

Interventions are categorised according to different quality care levels for easier incorporation into existing QI processes, which have been shown to be more effective in achieving change in routine clinical practice (Grol and Grimshaw 2003). However, most studies report interventions as discrete activities and on only one element of the screening pathway (e.g. recruitment), which may not readily integrate with existing QI practice in primary care services. Furthermore, most reviews investigate interventions aimed at earlier participation stages with fewer exploring diagnostic follow up of positive screening tests (Selby *et al.* 2017). Without explicit PHC engagement in screening programs, alternative and individualised practice-based processes are adopted that attempt to work alongside, but potentially diminish the effectiveness of organised screening programs. This review moves beyond studies that explore the practitioner influence on screening participation and instead focuses on how PHC can facilitate (non-adherent) eligible patients to participate in CRC screening.

Some interventions demonstrate benefits across both the screening (non-adherence) and diagnostic follow-up pathway. These include improvement initiatives (such as QI initiatives, including facilitation/audit and feedback (system level)) and self-management support initiatives (such as patient navigators (patient and professional level)). Consistent with other reviews (Klabunde *et al.* 2007; Zapka *et al.* 2010; Emery *et al.* 2014), reminders for screening and point-of-care prompts are important interventions for optimising recruitment participation; however, their effectiveness for subsequent screening stages is not known. The effectiveness of alternative reminder systems, such as external organisations (e.g. the National Cancer Screening Register, NCSR, or equivalent) may offer substitute reminders across the screening pathway, but their effectiveness in the context of the NBCSP needs testing. This review confirms that interventions targeting multiple levels of quality care represent more effective strategies to improve CRC screening participation (Senore *et al.* 2015). Opportunity exists to align CRC screening participation efforts with routine primary care QI processes. The revision of the Practice Incentive Payment (PIP) (which encourages general practices, through additional government payments, to continue providing quality care (Australian Government Department of Human Services 2019)) to include CRC screening (a national cancer priority) within a quality care model might further support a primary care role in the NBCSP. Identifying practice priorities that streamline the patient experience across the screening pathway and avoid duplication of organised screening programs, is expected to improve the NBCSP effectiveness and overall patient care.

A limitation of this review is the focus on an organised population-based screening program, rather than CRC screening more broadly for the eligible population. However, the findings are relevant to whether screening is undertaken in private practice or through an organised screening program, given the role of primary care services in non-adherence and preventive care follow up. Furthermore, limiting the search to publications post 2005 and excluding observational studies, might have resulted in potentially relevant studies being excluded. Publication bias, where studies with null results are less likely to be submitted or accepted for publication, may overestimate intervention effectiveness. However, as almost half (47%) of the included studies reported null or mixed outcomes, the effect of publication bias is likely to be very low. Studies that were not specific to CRC tended to report combined effectiveness of a single intervention across all screening programs, making it difficult to determine the effectiveness of included interventions. The effectiveness categorisation that we used was our attempt to overcome these limitations to determine the intervention effectiveness when specifically applied to CRC screening.

Most studies identified in this review evaluated single screening elements, despite evidence that interventions incorporating multi-component or QI practices tend to be more effective strategies, particularly if they do not require clinical staff involvement (Klabunde *et al.* 2007; Zapka *et al.* 2010; Senore *et al.* 2015). Future research needs to focus on QI practices targeting CRC screening that effectively bridge the gap between organised population-based screening programs and ‘usual care’ delivered in primary care services. In this context, the review highlights the untapped opportunities and benefits that the NCSR may offer to seamlessly engage and support the PHC sector to undertake CRC screening through digital solutions and overcome external constraints that have restricted the NBCSP implementation process to date (Flitcroft *et al.* 2010).

In summary, our review points to a potential opportunity to enhance the PHC role to maximise the benefits of population-based bowel cancer screening programs through existing primary care preventive and QI initiatives. As noted by Dodd *et al.* (2019), the possibility exists for PHC in Australia to adopt an important ‘adjunct’ role to support the NBCSP along the entire screening pathway, particularly for those asymptomatic, eligible patients who are more difficult to reach. The NBCSP

cost-effectiveness warrants the investment in evidence-based strategies to improve screening adherence, particularly those that target improved CRC screening and follow up in primary care services (Worthington *et al.* 2020). As others have noted (Zapka *et al.* 2010), the NBCSP needs to invest in provider- and system-level strategies that 'bridge the care transitions across primary and hospital-based services', from screening to diagnosis and possible treatment.

Conflicts of interest

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Appendix 1. Systematic search strategy: Ovid Medline (29 January 2018)

Topic	Search number	Search term	Result
Bowel cancer	1	Colorectal Neoplasms/	73 265
	2	Colonic Neoplasms/	65 719
	3	Occult Blood/	4971
	4	Sigmoid Neoplasms/	4351
	5	Sigmoidoscopy/	4586
	6	Rectal Neoplasms/	38 558
	7	Colonoscopy/	23 020
	8	'Bowel cancer'.mp.	1681
	9	'Colorectal cancer'.mp.	69 821
General practice	10	General Practitioners/	5947
	11	General Practice/	11 277
	12	Family Practice/	63 712
	13	Primary Health Care/	66 511
	14	Physicians, Family/	15 735
Screening	15	Mass Screening/	92 717
	16	Preventive Health Services/	12 314
	17	'Early Detection of Cancer'/	17 392
	18	Secondary Prevention/	17 714
Applying OR/AND operators and search limits	19	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9	193 179
	20	10 or 11 or 12 or 13 or 14	146 701
	21	15 or 16 or 17 or 18	135 292
	22	19 and 20 and 21	562
	23	22	562
	24	limit 23 to (English language and humans and year = '2005 -Current')	368