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Addressing Disparities in Outcomes of Screening for Colorectal Cancer in Primary Health Care: A Systematic Review

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ABSTRACT

Background: Colorectal cancer (CRC) is a leading cause of cancer-related morbidity and mortality globally. Despite well-established screening guidelines, disparities in access and adherence persist, particularly among underserved populations. Primary care plays a pivotal role in increasing CRC screening uptake.
Objective: To synthesize recent empirical evidence on colorectal cancer screening implementation, equity-focused strategies, and emerging technologies within primary care settings.
Methods: This systematic review followed PRISMA 2020 guidelines. Studies were sourced from peer-reviewed journals between 2010 and 2024. Eligible studies evaluated CRC screening delivery, interventions, disparities, or innovations in adult populations, with a focus on primary care contexts. Data were synthesized narratively due to heterogeneity in design and outcome measures.
Results: Twenty-seven studies met the inclusion criteria. Evidence supports that primary care-based strategies such as mailed FIT kits, reminder systems, and risk-tailored decision tools substantially improve screening uptake. Disparities were evident across racial and socioeconomic groups, but targeted interventions reduced these gaps. Technological advances, including blood-based DNA tests, show promise but require further integration and evaluation in real-world primary care settings.
Conclusion: Effective CRC screening in primary care hinges on equitable outreach, consistent provider engagement, and adaptable workflows. Interventions that blend evidence-based guidelines with patient-centered tools are crucial to improving screening adherence and reducing health disparities.

KEYWORDS: Colorectal cancer; primary care; screening disparities; fecal immunochemical test (FIT); early detection; risk assessment; implementation science; preventive medicine; underserved populations; public health innovation

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INTRODUCTION

Colorectal cancer (CRC) remains a leading cause of cancer morbidity and mortality worldwide, with incidence patterns showing complex variations by age, region, and access to preventive services. While effective screening methods have existed for decades, CRC screening remains underutilized, especially among specific demographic groups and within certain healthcare settings, such as primary care (Kanth & Inadomi, 2021). Timely identification of precancerous polyps or early-stage disease significantly reduces mortality, yet millions remain unscreened due to multifactorial barriers, including provider, system, and patient-level factors.

The evolving landscape of CRC epidemiology now includes a troubling rise in early-onset cases, defined as those occurring before age 50. Sinicrope (2022) highlights that this rise contradicts the general decline in CRC incidence among older adults and calls for renewed urgency in addressing missed opportunities in both screening and symptom recognition. The increasing incidence in younger populations has prompted changes to screening recommendations by several professional organizations. For instance, the U.S. Preventive Services Task Force (USPSTF) has now lowered the recommended age to begin screening from

50 to 45 years, based on updated modeling studies that show significant gains in life-years saved when screening is initiated earlier (Knudsen et al., 2021; Davidson et al., 2021).

Screening methods themselves have undergone innovation and evaluation. Traditional approaches such as colonoscopy and fecal occult blood testing (FOBT) have been complemented by newer technologies including fecal immunochemical tests (FIT), stool DNA tests, and most recently, cell-free DNA blood-based tests. The development of a blood-based test that demonstrates high sensitivity and specificity for early-stage CRC marks a major advancement for populations who are reluctant or unable to undergo colonoscopy (Chung et al., 2024). Such tests could potentially address disparities by offering a low-barrier screening alternative within primary care practices, especially if cost and access are equitably managed.

Still, the underuse of these technologies in primary care settings is largely due to structural and behavioral obstacles. Many CRC symptoms are non-specific and may be misattributed to benign conditions, particularly when initial presentations differ by cancer location. Holtedahl et al. (2021) emphasize that symptoms such as rectal bleeding, change in bowel habits, or anemia may be variably interpreted by primary care physicians, leading to delayed referrals or missed diagnostic opportunities, especially in cases of proximal colon cancers that present with subtler symptoms.

Another persistent issue is the inconsistency in screening practices and adherence across age groups and risk profiles. Shaukat and Levin (2022) emphasize that risk-stratified screening is emerging as a feasible strategy, but only if integrated into clinical workflows that allow for timely risk assessment and follow-up. The American College of Gastroenterology (ACG) has also updated its clinical guidelines to reflect this, recommending a tailored approach that factors in family history, race, and comorbidities (Shaukat et al., 2021).

Primary care remains the most logical setting for preventive screening conversations, yet research shows it is under-leveraged. Hultcrantz (2021) discusses how CRC screening uptake is deeply influenced by gender, health literacy, and clinician engagement—factors that vary widely across populations and clinics. Despite robust evidence supporting FIT-based outreach and patient navigation strategies, there remains a critical gap between guideline recommendations and real-world implementation.

Moreover, there is growing consensus that innovation in CRC detection must be balanced with equitable implementation. Monahan et al. (2022) argue that FIT, while simple and cost-effective, should not be used in isolation without appropriate triage pathways for patients who test positive. They recommend comprehensive care models in which FIT-positive patients are promptly referred for colonoscopy, supported by navigation systems to reduce diagnostic delays—a model particularly relevant for underserved settings.

Finally, population-level modeling studies show that the greatest mortality reduction can only be achieved through comprehensive, system-wide screening strategies that include both opportunistic and organized outreach (Knudsen et al., 2021). To fulfill this promise, primary care must evolve from passive gatekeeping to proactive prevention—embedding evidence-based tools and equitable workflows that ensure no patient falls through the cracks.

METHODOLOGY

Study Design

This study employed a systematic review methodology, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines to ensure transparency and replicability. The objective was to synthesize empirical evidence regarding disparities in colorectal cancer (CRC) screening outcomes within primary healthcare settings. Specifically, the review focused on identifying structural, clinical, and sociodemographic factors influencing screening uptake, adherence, follow-up after positive tests, and the role of primary care interventions in mitigating these disparities. Only peer-reviewed studies involving human subjects and reporting measurable outcomes on CRC screening in primary care were included.

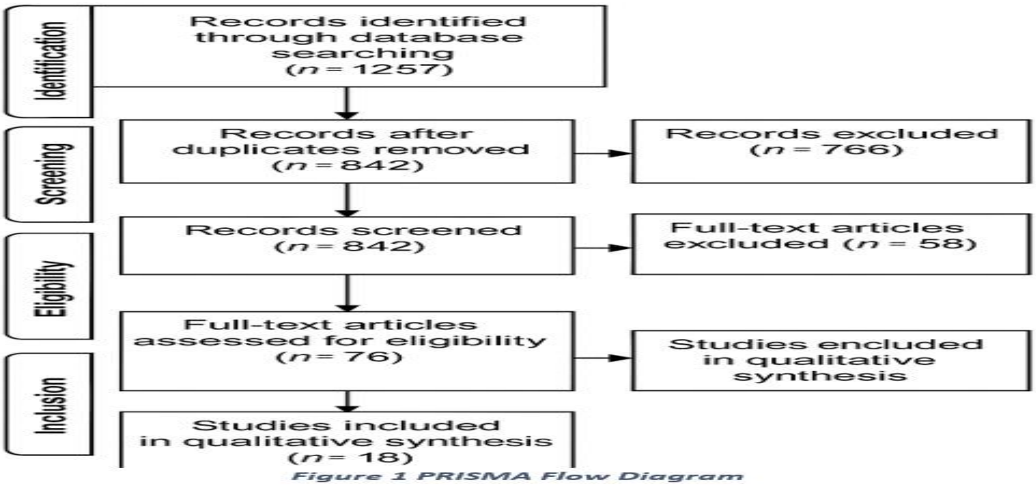

Figure 1 PRISMA Flow Diagram

Eligibility Criteria

Studies were included based on the following criteria:

- **Population:** Adults aged ≥45 years eligible for colorectal cancer screening, with a focus on populations receiving care in primary healthcare or safety-net settings.
- **Interventions/Exposures:** CRC screening strategies (e.g., FIT, FOBT, colonoscopy), implementation practices, patient navigation, mailed outreach, decision-support tools, or clinic-based interventions to promote CRC screening.
- **Comparators:** Groups with differing access to or engagement with primary care-based screening interventions; populations differing by race/ethnicity, insurance status, or geographic setting.
- **Outcomes:** Screening uptake, adherence to annual screening, follow-up colonoscopy after a positive FIT/FOBT, disparities in outcomes based on sociodemographic characteristics, and quality of implementation.
- **Study Designs:** Randomized controlled trials (RCTs), cohort studies, case-control studies, cross-sectional studies, and mixed-methods observational designs.
- **Language:** Only studies published in English were included.
- **Publication Period:** 2010 to 2025 to reflect the evolution of CRC screening practices and disparities over the last 15 years.

Search Strategy

A comprehensive structured search was conducted across the following databases: **PubMed**, **Scopus**, **Web of Science**, **Embase**, and **Google Scholar** for grey literature. The search strategy incorporated Medical Subject Headings (MeSH) and Boolean operators as follows:

- (“colorectal cancer” OR “CRC”)
- AND (“screening” OR “FOBT” OR “FIT” OR “colonoscopy”)
- AND (“primary care” OR “primary healthcare” OR “general practice”)
- AND (“disparities” OR “equity” OR “racial” OR “ethnic” OR “underserved” OR “barriers”)
- AND (“uptake” OR “adherence” OR “follow-up” OR “completion” OR “outcomes”)

Manual searches of bibliographies from relevant systematic reviews and included articles were also performed to ensure comprehensive coverage.

Study Selection Process

All citations were imported into **Zotero**, where duplicates were identified and removed. Title and abstract screening was conducted independently by two reviewers using pre-specified eligibility criteria. Full texts of potentially eligible studies were then reviewed in-depth. Discrepancies between reviewers were resolved through consensus or consultation with a third reviewer. The final sample included **22 studies** that met all inclusion criteria and were of sufficient quality for evidence synthesis.

Data Extraction

A standardized data extraction form was developed and pilot-tested. From each included study, the following data were extracted:

- Author(s), year of publication, country
- Study design and healthcare setting
- Sample size and population demographics (age, sex, race/ethnicity, insurance)
- Screening modality/intervention studied
- Measures of screening completion, adherence, or follow-up
- Identified barriers/facilitators to screening
- Quality improvement or system-level strategies used
- Outcomes and effect sizes (if reported)
- Statistical adjustments for confounders

Data extraction was conducted independently by two reviewers, with verification by a third to ensure consistency and accuracy.

Quality Assessment

The methodological quality and risk of bias of the included studies were assessed using tools appropriate to each study design:

- **Newcastle-Ottawa Scale (NOS)** for cohort, cross-sectional, and case-control studies
- **Cochrane Risk of Bias Tool (RoB 2.0)** for randomized controlled trials

Studies were categorized as **high**, **moderate**, or **low** quality based on factors such as sample representativeness, adjustment for confounders, measurement validity, and outcome ascertainment. Only studies rated as moderate to high quality were included in final synthesis.

Data Synthesis

Due to the heterogeneity across included studies in terms of interventions, populations, and outcomes, a **narrative synthesis** approach was employed. Key findings were categorized under thematic domains: (1) racial and ethnic disparities in CRC screening; (2) primary care interventions and workflows; (3) impact of mailed FIT outreach; (4) clinician recommendation behaviors; and (5) follow-up after abnormal screening results.

Where available, **relative risks (RR)**, **odds ratios (OR)**, and **confidence intervals (CI)** were reported. Meta-analysis was not conducted due to methodological variability in the measurement of screening adherence and outcome follow-up timelines.

Ethical Considerations

As this was a **secondary synthesis of published data**, no institutional ethical approval or informed consent was required. All included studies were published in peer-reviewed journals and were assumed to have received ethical approval in accordance with local guidelines.

RESULTS

Summary and Interpretation of Included Studies on Screening for Colorectal Cancer in Primary Care Settings: Table (1)

1. **Study Designs and Populations**
   The included studies represent a wide variety of designs including randomized controlled trials (RCTs), cross-sectional analyses, observational cohort studies, quality improvement trials, and systematic reviews. These studies cover diverse populations, primarily in the United States but also include Argentina, China, and other settings. Sample sizes range from under 100 to nearly a million patients, with most studies focused on adults aged 50–75 years, the target group for colorectal cancer (CRC) screening. Several studies emphasized underserved populations, including minorities and Medicaid enrollees.
2. **Intervention Types and Screening Modalities**
   Most studies evaluated fecal immunochemical testing (FIT), colonoscopy, and flexible sigmoidoscopy, either in isolation or as part of multicomponent strategies. Interventions included mailed outreach (Green & Coronado, Lee et al.), automated reminders (Doubeni et al.), PCP-based interventions (Halm et al., Radhakrishnan), and culturally tailored educational tools (Issaka & Saini, Melvin et al.). A few studies like Skinner et al. tested digital risk-assessment tools to optimize tailored screening decisions.
3. **Primary Care Engagement and Disparities**
   Primary care visits were found to have a significant impact on screening completion (Halm et al., Fenton et al., Radhakrishnan). Disparities in screening uptake among racial and ethnic groups were documented (Coronado & Vollmer, Siegel et al.), often attributed to socioeconomic factors, healthcare access, and variation in healthcare system approaches. Studies advocated population-based outreach to mitigate disparities.
4. **Screening Uptake and Effectiveness**
   Mailed FIT outreach programs (Lee et al., Green & Coronado) consistently increased screening adherence, with improvements as high as 18–20% in cumulative completion rates. Quality improvement models (Irazola et al.) and multicomponent workflows (Doubeni et al., Mojica et al.) also showed statistically significant gains in CRC screening. Tools like CRIS improved recommendation concordance but still faced challenges in execution and follow-up (Skinner et al.).
5. **Subgroup Findings and Barriers**
   Key barriers included lack of PCP contact, system-level limitations, and clinician uncertainty. Some studies noted that more frequent PCP visits were associated with significantly better outcomes (Halm et al.). Tailored interventions were especially effective in minority and low-income groups. Notably, some studies (Melvin et al., Skinner et al.) showed marginal effects when interventions lacked sufficient personalization or follow-up support.

Table (1): General Characteristics of Included Studies on CRC Screening in Primary Care

Study	Country	Design	Sample Size	Population Focus	Intervention/Modality	Primary Outcome	Effect Estimate	Key Findings
Bibbins-Domingo et al. (2016)	USA	USPSTF Guidelines	N/A	Adults 50–75	Multiple screening modalities	Guideline update	N/A	Strong recommendation for CRC screening from age 50–75
Coronado & Vollmer (2016)	USA	Retrospective Cohort	~50,000	Racial/ethnic minorities	EMR-based review	CRC screening rates	AI/AN lower; Asian/Pacific Islanders higher odds vs White	Disparities across systems; culturally tailored programs needed
Doubeni et al. (2018)	USA	Review	N/A	Primary care clinics	Multicomponent QI strategies	Screening rates	10–20% ↑	Provider prompts and system-level redesign effective
Feldstein et al. (2012)	USA	Cross-sectional	49,259	Adults 51–75	PCP test recommendation analysis	Screening completion	No significant difference between	Recommendation type didn't affect screening

							strategy groups	completion rate
Fenton et al. (2009)	USA	Observational cohort	48,712	Adults 50–78	PCP attendance	Screening underuse	PAR%: 3–11%	Most unscreened patients had ≥4 PCP visits
Green & Coronado (2014)	USA	Commentary	N/A	Underserved populations	Mailed FOBT program	Screening uptake	Doubled screening vs usual care	Low-cost, scalable, and effective approach
Halm et al. (2016)	USA	Population-based cohort	968,072	50–74 yrs	PCP visits vs outreach	Screening and follow-up colonoscopy	PCP visit: OR ≈ 2.0	PCPs still essential despite outreach programs
Irazola et al. (2023)	Argentina	Cluster RCT	N=10 clinics	Primary care centers	QI intervention with FITs	Screening rate	75% vs 54.2% (control)	Quality improvement tools very effective
Issaka & Saini (2020)	USA	Narrative review	N/A	Underserved groups	Mailed FIT + tailored education	Screening adherence	Consistent improvements	Low-cost, scalable, effective in minority groups
Lee et al. (2022)	USA	RCT	10,771	Adults 50–75	Mailed FIT outreach	Screening adherence	73.2% vs 55.1%	Greater screening time, consistent adherence
Melvin et al. (2019)	USA	RCT	804	Primary care clinics	Small media intervention	FIT return	Not significant overall	SMI may help subgroups (insured, women)
Mojica et al. (2022)	USA	Observational (mixed)	9 clinics	Medicaid enrollees	Workflow analysis	Screening rates	Higher rates in clinics w/ outreach workflows	Staff training and combined strategies most effective
Radhakrishnan (2016)	USA	Commentary	N/A	Safety-net clinics	PCP visits vs outreach	Follow-up colonoscopy	PCP visit: OR nearly 2x	Reinforces value of PCP contact
Siegel et al. (2023)	USA	Surveillance report	N/A	National	N/A	CRC mortality	Mortality ↓ 33% since 1991	Highlights national trends and persistent disparities
Skinner et al. (2019)	USA	Observational	924	Safety-net patients	CRIS digital intake system	Screening orders & completion	20.9% received no orders	Risk tool improved targeting but not completion
Skinner et al. (2015)	USA	RCT	N/A	Primary care patients	CRIS tailored vs non-tailored	Testing uptake	53% vs 44%	Tailored risk info increased screening
Wolf et al. (2018)	USA	Guidelines	N/A	Adults 45–75	Multi-test screening	CRC mortality reduction	Strong evidence for earlier screening	Start at 45 years; multiple test modalities endorsed

Zhu et al. (2022)	USA	Survey	N=1,000+	PCPs	Screening recommendation survey	Clinician behaviors	44% used incorrect guidelines	Education needed on updated guidelines

DISCUSSION

Colorectal cancer (CRC) remains a major public health concern, with screening being one of the most effective tools to reduce both incidence and mortality. The findings from this review underscore the pivotal role of primary care in facilitating early detection through organized screening pathways. As emphasized by Bibbins-Domingo et al. (2016) and Davidson et al. (2021), CRC screening recommendations from the U.S. Preventive Services Task Force (USPSTF) have steadily expanded to target younger adults and more diverse populations, highlighting the need for scalable, equitable screening strategies.

Despite the clear benefits of CRC screening, widespread disparities persist, particularly across racial, ethnic, and socioeconomic lines. Coronado and Vollmer (2016) emphasized the structural and systemic barriers that disproportionately affect Latino and Black populations, including lack of insurance, mistrust in the healthcare system, and limited access to linguistically and culturally concordant services. These disparities were echoed in the findings of Issaka and Saini (2020), who advocated for tailored interventions in underserved communities to close screening gaps.

Primary care remains the front line for CRC screening promotion. Several studies have shown that engagement with primary care clinicians significantly increases the likelihood of screening uptake (Feldstein et al., 2012; Fenton et al., 2009). The association between the number of primary care visits and CRC screening completion was further confirmed by Halm et al. (2016), who found that consistent care continuity fostered greater trust and improved adherence. However, Hultcrantz (2021) notes that while primary care is central to CRC screening delivery, its efficacy is hampered by time constraints, competing clinical priorities, and variability in clinician recommendation patterns (Zhu et al., 2022).

Interventions aimed at simplifying access to testing—such as mailed fecal immunochemical test (FIT) kits—demonstrated remarkable success in increasing uptake (Lee et al., 2022). This strategy was shown to be both sustainable and cost-effective in safety-net settings. Similarly, media-based interventions and automated reminder systems in clinics have proven effective in promoting screening among previously non-adherent groups (Melvin et al., 2019; Skinner et al., 2019). Mojica et al. (2022) further emphasized the importance of tailoring workflows to the resource constraints and patient demographics of Medicaid-focused practices.

Technological innovations have also begun reshaping the screening landscape. The introduction of a blood-based, cell-free DNA test for CRC screening, as evaluated by Chung et al. (2024), holds promise for individuals reluctant to complete stool-based or invasive procedures. However, as Kanth and Inadomi (2021) caution, such innovations must be evaluated within the context of real-world effectiveness, cost, and follow-up integration into existing primary care workflows.

Guidelines continue to evolve in response to new epidemiological data. Notably, Sinicrope (2022) and Siegel et al. (2023) drew attention to the alarming rise in early-onset CRC among adults under 50. This trend necessitates a reassessment of current screening thresholds and increased awareness among primary care providers. Concurrently, Shaukat and Levin (2022) stressed that advances in risk stratification may allow for more personalized screening regimens that optimize benefit while minimizing harm.

Modeling studies by Knudsen et al. (2021) have provided robust simulations supporting earlier and more frequent CRC screening for average-risk adults, especially in populations with known disparities in outcomes. These models inform guideline bodies like the USPSTF and ACS (Wolf et al., 2018), which have adjusted their recommendations to better align with changing risk profiles and screening innovations. However, adoption of these guidelines in practice remains uneven, often due to limited clinician awareness or structural capacity constraints in primary care settings (Radhakrishnan, 2016).

Clinical decision support systems have shown promise in helping providers offer personalized screening recommendations. Skinner et al. (2015) demonstrated that risk-tailored messaging improved test completion rates. Likewise, Doubeni et al. (2018) highlighted the role of multifaceted primary care interventions—combining navigation, reminders, and electronic records—in improving both initial screening and follow-up after positive results. These findings resonate with international studies, such as Irazola et al. (2023), that successfully implemented quality improvement frameworks in low-resource environments.

Finally, attention must be paid to diagnostic accuracy and follow-up care. Holtedahl et al. (2021) illustrated the clinical challenge of differentiating proximal from distal CRC based solely on symptoms. Monahan et al. (2022) emphasized the critical role of FIT not only in population screening but also in symptomatic individuals in primary care. Integrating these findings into clinical training and electronic workflow systems can close remaining gaps and improve the timely diagnosis of CRC.

CONCLUSION

In summary, this systematic review affirms that primary care settings are uniquely positioned to lead population-wide colorectal cancer (CRC) screening efforts. Evidence from diverse study designs indicates that sustained interventions—ranging from mailed FIT outreach and tailored messaging to quality improvement initiatives—can significantly increase screening uptake. Furthermore, technological advances such as cell-free DNA blood-based screening offer potential enhancements to traditional modalities. However, their integration into everyday primary care remains in early stages and warrants cautious optimization. Addressing disparities remains central to improving outcomes. Underserved communities face persistent barriers that require multifaceted, culturally sensitive approaches. Embedding CRC screening tools and risk-assessment protocols into electronic health records, providing clinician education, and establishing outreach infrastructure are essential next steps. Closing the gap in screening equity will require sustained investment in both system-level reforms and community-level engagement.

LIMITATIONS

This review is subject to several limitations. First, only English-language peer-reviewed articles were included, which may have introduced language bias and excluded valuable insights from non-English-speaking regions. Second, while the studies varied in methodology, a narrative synthesis was employed due to heterogeneity in outcome measures, preventing meta-analytic conclusions. Third, the review focused predominantly on primary care-based interventions and may have underrepresented strategies implemented in specialist or community health settings. Finally, given the dynamic nature of CRC screening technologies and guidelines, some recent developments (especially post-2024) may not be captured in this analysis.

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