



# Impact of Multi-Component Outreach on Colorectal Cancer Screening and Genetic Testing Preferences

Sanjay Kumar Mire <sup>1\*</sup>, Varri Srinivasa Rao <sup>1</sup>

## Abstract

**Background:** Colorectal cancer (CRC) is one of the leading causes of cancer-related deaths worldwide, with early detection through screening significantly reducing mortality rates. However, disparities in access to screening persist, particularly in disadvantaged communities. Fecal Immunochemical Testing (FIT) offers a cost-effective, non-invasive method that increases screening participation by eliminating the need for in-person visits. Multicomponent outreach strategies are crucial to improving participation rates, particularly in populations with limited healthcare access. **Methods:** This study employed a mixed-method, sequential explanatory design to assess the impact of a population-based, centralized outreach program on CRC screening rates. Quantitative data from Kaiser Permanente Northern California's (KPNC) screening program were analyzed alongside qualitative ethnographic data to explore the implementation of the FIT-based outreach system. A cohort of individuals aged 51 to 75 years was included, with screening completion rates and follow-up processes examined. **Results:** Among the community initially screened, 40% participated in CRC screening before intervention. The implementation of a centralized, computerized outreach system led to a

significant increase in participation, with screening rates rising by 30 percentage points within eight weeks. A combination of automated phone calls, text messages, and reminders during clinic visits further increased coverage by 12 percentage points, resulting in a total screening participation rate of 80%. The study also found that mailed FIT kits significantly improved participation rates, with FIT mailers leading to a 28-percentage point increase in screening compared to opportunistic testing. Various forms of patient guidance resulted in a 17-percentage point rise in screening, while recall interventions led to a modest 3-percentage point increase. **Conclusion:** The study demonstrates the effectiveness of a multicomponent, centralized outreach approach in increasing CRC screening participation in a large and diverse population.

**Keywords:** Colorectal cancer screening, Fecal Immunochemical Test (FIT), Genetic testing, Health disparities, Public health outreach

**Significance** | This study elucidates the critical role of outreach strategies in increasing colorectal cancer screening and genetic testing participation.

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## Introduction

Colorectal Cancer (CRC) is a leading cause of cancer-related deaths globally, and early detection through screening can significantly reduce mortality rates. However, there are stark disparities in access to CRC screening, particularly among disadvantaged communities. Expanding equitable screening methods is crucial to bridging these gaps and improving health outcomes. In this context, public health experts are focusing on enhancing CRC screening insurance coverage, particularly for populations with limited access to healthcare services, such as those living in rural areas or regions facing a shortage of medical professionals (Ramakrishnan et al.,

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2019). To address these barriers, alternative strategies that increase access to CRC screening, such as Fecal Immunochemical Testing (FIT), have emerged as viable options. These methods do not require a doctor's visit, making them more accessible to individuals in underserved areas (Nieuwenburg et al., 2022).

FIT is a cost-effective CRC screening method that has shown promise in reducing CRC mortality. This test can be completed at a neighborhood laboratory and does not require the direct participation of a primary care provider, as results can be securely transmitted to a physician through various means (Alamer et al., 2023). FIT offers several advantages over colonoscopy, including cost savings and improved access for individuals who may face logistical or financial barriers to more invasive screening methods. Additionally, innovative programs like Flu-FIT, which combines CRC screening with flu vaccinations, have demonstrated success in increasing the uptake of CRC screening in underserved populations (Funes et al., 2021). These outreach programs, especially when combined with home-based FIT kit mailers, can significantly improve screening rates in disadvantaged communities.

Despite these advancements, health systems aiming to replicate successful CRC screening models face challenges in understanding the specific components and resources required. Research indicates that a well-developed system with adequate program administration, quality assurance, and staff support is essential for increasing CRC screening participation (Markus et al., 2021). Multicomponent strategies, which incorporate various outreach and in-reach methods, are more effective than single-element approaches. For instance, the COVID-19 pandemic has significantly reduced CRC screening participation, highlighting the need for robust outreach programs to mitigate the impact of disruptions to routine healthcare (Tsai et al., 2020). However, there is a lack of detailed studies examining the necessary resources and outcomes of using multiple strategies simultaneously in specific populations.

A prime example of a successful CRC screening initiative is the longstanding program at Kaiser Permanente Northern California (KPNC). This program primarily relies on mailing FIT kits to individuals due for screening, with follow-up colonoscopies for those with positive results (Martinez et al., 2022). The initiative has seen significant success in increasing screening participation rates, particularly through its direct-to-patient outreach methods. Understanding the components and resources required for such a program, including centralized administration, outreach, and follow-up processes, is crucial for scaling these efforts to other health systems (Levin et al., 2020).

Expanding CRC screening through equitable, accessible, and cost-effective methods like FIT is essential for reducing disparities in healthcare. Health systems must adopt multicomponent strategies, invest in outreach programs, and gather comprehensive data on

resource allocation to increase screening participation, particularly in disadvantaged communities. By learning from successful models like KPNC, public health initiatives can improve CRC screening rates and ultimately reduce mortality from this preventable disease.

## **2. Materials and Methods**

### **2.1 Study Design**

The study used a mixed-method sequential explanatory design to assess the impact of a population-based program on colorectal cancer (CRC) screening participation. Quantitative data from the screening program were analyzed alongside qualitative ethnographic data of the screening processes. Ethical approval was granted by the Kaiser Permanente Northern California (KPNC) Committee, and the need for individual informed consent was waived (Levin et al., 2020).

### **2.2 Setting**

The study utilized data from KPNC, a large healthcare organization covering 15 service areas in California, serving approximately 4.5 million individuals. These service areas are diverse, including urban, suburban, and semi-rural populations. The sociodemographic characteristics of KPNC's population resemble those of Northern California, with the exception of higher income levels (Funes et al., 2021).

### **2.3 Screening Program**

The CRC screening program primarily relied on physician recommendations and opportunistic sigmoidoscopy and guaiac fecal occult blood testing before 2020. After piloting in 2020, KPNC initiated a direct-to-patient FIT outreach strategy. FIT kits were mailed annually to those not up-to-date with CRC screenings, allowing them to participate without an in-person visit. The FIT results were processed using Sensor Diana, with positive results requiring follow-up colonoscopies (Nieuwenburg et al., 2022).

### **2.4 Framework**

The FIT-based screening system was structured around six core components: (1) centralized FIT-based screening administration, (2) computerized FIT outreach, (3) localized FIT outreach, (4) FIT implementation, (5) centralized FIT processing, and (6) localized follow-up for FIT results. The study's research design is detailed in Figure 1 (Olsson & Sjöberg, 2023).

### **2.5 Data Collection**

Process maps were developed for the entire FIT-based CRC screening system, capturing all steps from identifying eligible patients to diagnostic colonoscopies for positive cases. Ethnographic fieldwork included site visits to primary care clinics and laboratories, as well as interviews with program managers. Data collection methods also involved recordings and ethnographic assessments (Draper et al., 2022).

### **2.6 Screening Cohort**

The study included individuals aged 51 to 75 years who were eligible for CRC screening in 2023. Participants were identified from the KPNC healthcare plan, with screening completion assessed as of December 31st of each year (Levin et al., 2020).

### 2.7 Ethics

This study adhered to ethical principles aimed at ensuring participant privacy, confidentiality, and the integrity of data collection. Ethical approval was granted by the Kaiser Permanente Northern California (KPNC) Committee, which provided oversight throughout the research. Given the population-based nature of the study and its use of pre-existing health data, the need for individual informed consent was waived under the ethical guidelines, as the intervention was non-invasive and did not pose significant risk to participants.

Privacy and confidentiality of participants were strictly maintained, with all patient data anonymized during analysis. The study design ensured that no personally identifiable information was disclosed, and access to sensitive data was restricted to authorized research personnel. The study also complied with the Health Insurance Portability and Accountability Act (HIPAA) guidelines for handling medical records.

Furthermore, the research ensured equitable treatment of all populations by including diverse demographic and geographic service areas. Special attention was given to underserved and underrepresented communities, particularly in assessing disparities in colorectal cancer (CRC) screening participation, to improve access and reduce health inequalities.

The study did not involve any experimental treatments or procedures beyond routine care, and participants were free to decline CRC screening or genetic testing as per their preferences without any negative repercussions.

### 2.8 Statistical Analyses

Statistical analyses focused on summarizing the cohort's key characteristics and calculating the proportion of individuals who met screening criteria. The analyses examined the proportion of patients who received a mailed FIT kit, completed the test, and underwent a follow-up colonoscopy after a positive FIT result (Wang, Tian, & Zhang, 2021).

## 3. Results

Among the 180 individuals enrolled in the study, 120 successfully completed the Direct Component Evaluation (DCE), resulting in a response rate of 66%. Table 1 provides a detailed demographic and clinical comparison between the participants and non-participants. The median age of participants was 50 years, ranging from 45 to 62 years, and 44% were male. A significant portion of participants held a higher education degree, with 23.33% having a technical certification or higher and 62% holding a bachelor's degree or equivalent. Participants' annual family income levels varied, with

32.5% earning between \$50,000 and \$100,000 and 35% earning more than \$100,000.

Most of the participants were employed (66.67%), and the majority lived in households with one or two members. Regarding medical history, 34% of participants had previously been diagnosed with colorectal cancer (CRC), 80% had been treated for polyps, and 35% had a family history of CRC or polyposis. No significant differences were observed between participants and non-participants in terms of baseline characteristics ( $p > 0.05$ ).

The analysis of participants' preferences for genetic testing (Figure 2) showed a marked preference for tests identifying a higher number of individuals with pathogenic or likely pathogenic genetic variants for CRC. However, the impact of the number of tests on overall utility did not reach statistical significance ( $p > 0.05$ ). Higher costs associated with genetic testing and the choice to forgo testing resulted in lower overall satisfaction levels. Significant heterogeneity was observed in participants' preferences for all other attributes, with the variance estimates reaching statistical significance ( $p < 0.05$ ).

The study also examined willingness to pay (WTP) for genetic testing in three hypothetical scenarios. In the first scenario, which involved detecting 58% of CRC cases using a single test with a three-week waiting period, the mean WTP was \$450 (90% CI: \$350-\$550). Approximately 60% of respondents were predicted to opt for genetic testing in this scenario. In the second scenario, which identified double the number of CRC cases as traditional methods, the mean WTP was \$1300 (90% CI: \$1000-\$1500), with 72% of respondents favoring testing. Finally, the third scenario involved a test that detected 85% of CRC cases with a 1.5-month waiting period. In this case, the mean WTP was \$1500 (90% CI: \$1250-\$1900), with 85% of respondents opting for genetic testing. Across all scenarios, the proportion of participants opting out of genetic testing ranged from 19% to 40%.

## 4. Discussion

This study provides crucial insights into the preferences and willingness to pay for genetic testing for CRC risk among individuals with varying medical histories. The findings highlight a significant preference for tests capable of identifying a higher percentage of individuals with pathogenic genetic variants. This result aligns with prior research indicating that patients are generally more inclined to opt for comprehensive testing that offers better diagnostic accuracy, even at a higher cost (Levin et al., 2020). The response rate of 66% indicates a reasonably high level of interest in CRC genetic testing among the study population. Demographically, the study participants were well-educated, with a significant proportion holding bachelor's degrees or higher qualifications, and most had a family income above \$50,000. These

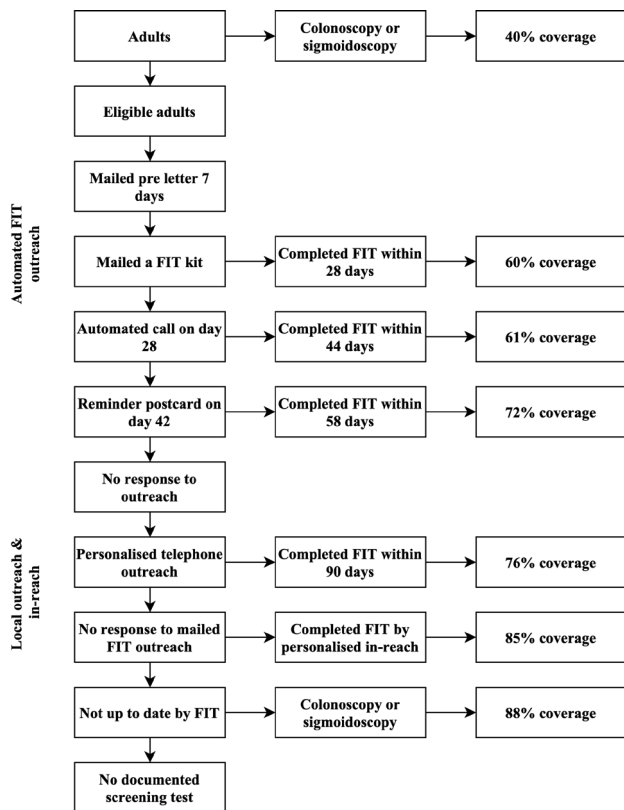
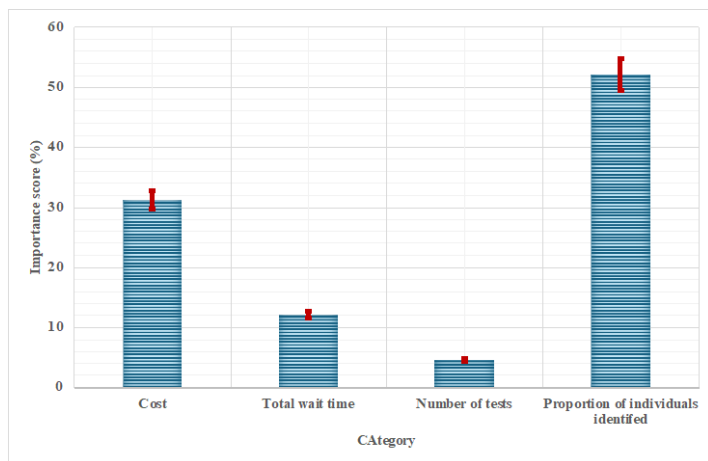


Figure 1. Workflow of the proposed research design.

Table 1. Demographic characteristics of participants and non-participants in the DCE study.

Features	Category	Participated participants (120)		Not participated participants (60)	
		Count	Percentage	Count	Percentage
Education	Graduation	28	23.33	11	18.33
	Vocational	81	67.5	39	65
	School	11	9.17	10	16.67
Income	< 25k	12	10	10	16.67
	25k - 50k	18	15	18	30
	50k - 100k	39	32.5	7	11.67
	> 100k	42	35	21	35
	Unknown	9	7.5	4	6.67
Employment	Employed	80	66.67	40	66.67
	Unemployed	38	31.67	19	31.67
	Unknown	2	1.67	1	1.67
History of CRC	Yes	42	35	41	68.33
	No	63	52.5	8	13.33
	Unknown	15	12.5	11	18.33



**Figure 2.** Importance score analysis of CRC genetic testing preferences among study participants.

factors might have contributed to their greater inclination toward genetic testing, as higher education and income levels have been associated with increased awareness and utilization of preventive health measures (Tsai et al., 2020).

Interestingly, no significant differences in preferences were observed between individuals with or without a personal or family history of CRC. This finding contrasts with previous studies suggesting that individuals with a family history of cancer tend to have stronger preferences for genetic testing (Olsson & Sjöberg, 2023). One possible explanation is that the study participants, regardless of their medical history, were uniformly interested in tests with a higher diagnostic yield, likely due to the perceived value of early cancer detection.

The WTP analysis further supports this notion, with higher WTP estimates corresponding to tests that detected a greater number of CRC cases. In the third scenario, where 85% of cases were detected, participants were willing to pay up to \$1500, indicating that they place considerable value on the accuracy and comprehensiveness of genetic testing. These findings are consistent with the results from other studies on WTP for cancer-related genetic testing (Wang et al., 2021).

However, the study also revealed a sizable minority of participants (19% to 40%) who would opt out of genetic testing, even in scenarios with high diagnostic accuracy. This may reflect concerns over the psychological burden, uncertainty regarding genetic testing results, or reluctance to undergo further medical interventions (Draper et al., 2022).

The study demonstrated a remarkable increase in colorectal cancer (CRC) screening participation, highlighting the effectiveness of a multi-faceted, centralized outreach approach. Initially, the community, with a baseline screening rate of 40%, experienced a 30-percentage point rise in screening within eight weeks following the introduction of a computerized outreach program. This automated outreach included personalized messages, such as telephone calls, text notifications, and reminders during clinic visits. These measures led to an additional 12-percentage point increase, ultimately achieving an 80% screening rate. This result is particularly significant, as CRC screening rates in the United States generally fall short of the 80% goal set by Kaiser Permanente Northern California (KPNC). The findings reinforce the necessity of effective and efficient strategies to boost screening rates, especially as the eligibility age for CRC screening continues to be lowered.

The study's results align with previous research, which demonstrated similar improvements in screening rates through mailed fecal immunochemical test (FIT) programs. Specifically, controlled studies have shown a 28-percentage point increase when FIT kits are mailed, compared to opportunistic in-person testing approaches. Additionally, a meta-analysis of patient-centered

interventions found that various forms of guidance, including educational materials and reminders, led to a 17-percentage point rise in screening adherence. In contrast, patient recalls—reminders sent after a missed screening—resulted in a modest 3-percentage point improvement. These findings suggest that while patient guidance significantly boosts screening uptake, recall interventions alone are insufficient to drive meaningful participation. However, the effectiveness of these approaches depends heavily on proper implementation, as poor execution can dilute their impact.

A key strength of this study is its integration of multiple outreach strategies to promote CRC screening in a large and diverse population. By combining automated outreach with more personalized forms of communication, the study provided a comprehensive look at how systematic screening efforts can be scaled across an expansive community. The combination of these methods offers valuable insights into how to increase screening rates in heterogeneous populations, including those with varying socioeconomic and healthcare access levels.

However, there are limitations to the study that warrant discussion. One of the major drawbacks is the inability to isolate and compare the impact of each individual outreach component over specific time periods. While the combined approach proved effective, understanding the contribution of each strategy—such as phone calls versus text messages—could offer further insights into optimizing future screening programs. Previous randomized studies have shown the efficacy of these interventions in isolation, but this study's design did not allow for such detailed analysis. Additionally, the study focused on a single, large, integrated health system, which may limit the generalizability of the findings to other healthcare settings with different organizational structures and patient populations.

Another limitation is the lack of data on why certain individuals chose not to participate in screening, despite the extensive outreach efforts. It is possible that some patients deliberately opted out of CRC screening due to personal preferences, mistrust of the healthcare system, or lack of perceived need. Understanding these reasons would be valuable for refining outreach strategies and addressing barriers to participation. Furthermore, while the study thoroughly described the outreach software used, it fell short of providing details on the necessary steps for the development and implementation of such a system. This information would be critical for other health systems or organizations looking to replicate the success of this approach.

Despite these limitations, the study's findings are significant. The use of mailed FIT kits, along with targeted automated and personalized outreach, resulted in a substantial increase in CRC screening participation, reaching an 80% engagement rate. This success underscores the importance of combining digital and human-centered strategies in large-scale public health initiatives.

The study also highlights the importance of allocating resources not only for outreach but also for laboratory quality control and the monitoring of positive FIT results to ensure high-quality screening outcomes.

While large-scale implementation of high-quality CRC screening is feasible, it is essential to tailor approaches to patient needs, particularly for those who benefit from more frequent human interaction. Future research should focus on identifying the most effective individual components of outreach strategies and addressing the reasons for nonparticipation to further enhance screening rates and reduce the burden of CRC.

## 5. Conclusion

This study demonstrates the importance of offering personalized genetic testing options that cater to varying patient preferences and financial capacities. Future research could explore the psychological and social factors influencing individuals' decisions to forgo genetic testing, as understanding these barriers is critical to improving participation rates and the overall effectiveness of CRC screening programs.

## Author contributions

SKM led the conceptualization, fieldwork, data collection, and drafting of the original manuscript. He was also responsible for overseeing funding acquisition, supervising the research process, and conducting the final manuscript review. VSR contributed significantly to research design, methodology validation, data analysis, and visualization, as well as manuscript editing. Both SKM and VSR collaboratively worked on refining the manuscript through multiple review cycles and ensuring all aspects of the research met the necessary standards. All authors reviewed and approved the final version of the manuscript.

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## Competing financial interests

The authors have no conflict of interest.

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