Chapter

Public Health: Prevention

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Abstract

Nowadays, colorectal cancer prevention strategies play an essential role in reducing the incidence and mortality of the cases. A well-designed and establishment of the clinical pathway of screening programme needed in all country. Types of screening tools used may vary between the country with the use of FOBT and colonoscopy. The standard guideline related to screening programme such as for high-risk group should be emphasized more as compared to the low-risk group. The uptake of screening for CRC should be highlighted more as the program have showed a significantly reduction of the cases and mortality. The barrier of CRC screening uptake mainly due to poor awareness, discomfort, low physician recommendation, low socioeconomic and improper screening programme. Therefore others prevention strategies beside screening program such as health education and interactive intervention strategies need to be empower.

Keywords: screening, prevention, FOBT, colonoscopy, fecal test

1. Introduction

Colorectal cancer (CRC) incidence and mortality rates vary across worldwide, with distinct gradients across human development levels were seen, pointing towards an increasing burden in countries in transition. In general, CRC incidence and mortality rates are still rising rapidly in many low-income and middle-income countries, particularly in Eastern Europe, Asia, and South America. While stabilizing or decreasing trends are seen in highly developed countries such as Japan, the United States and Australia, where rates remain among the highest in the world [1].

CRC mortality can be reduced if cases are detected and treated early. When identified early, CRC is more likely to respond to effective treatment and can result in a greater probability of surviving, less morbidity, and less expensive treatment. On the other hand, CRC screening aims to identify individuals with abnormalities suggestive of cancer or pre-cancer who have not developed any symptoms and to refer them for diagnosis and treatment. Nonetheless, a screening program is a far more complex public health intervention compared to early diagnosis [2].

2. Colorectal cancer screening programs

CRC screening programs are currently underway in most European countries, Canada, specific regions in North and South America, Asia, and Oceania. The most comprehensive screening strategies were based on fecal occult blood testing, and more recently, the fecal immunochemical test (FIT) [3]. While other options for CRC screening are fecal immunochemical test annually, guaiac-based fecal occult

blood test annually, multi-target stool DNA test every three years, colonoscopy every ten years, computed tomography colonography every five years, and flexible sigmoidoscopy every five years [4].

CRC screening programs are designed for populations according to risk stratification. In general population-based screening, these programs are offered to the

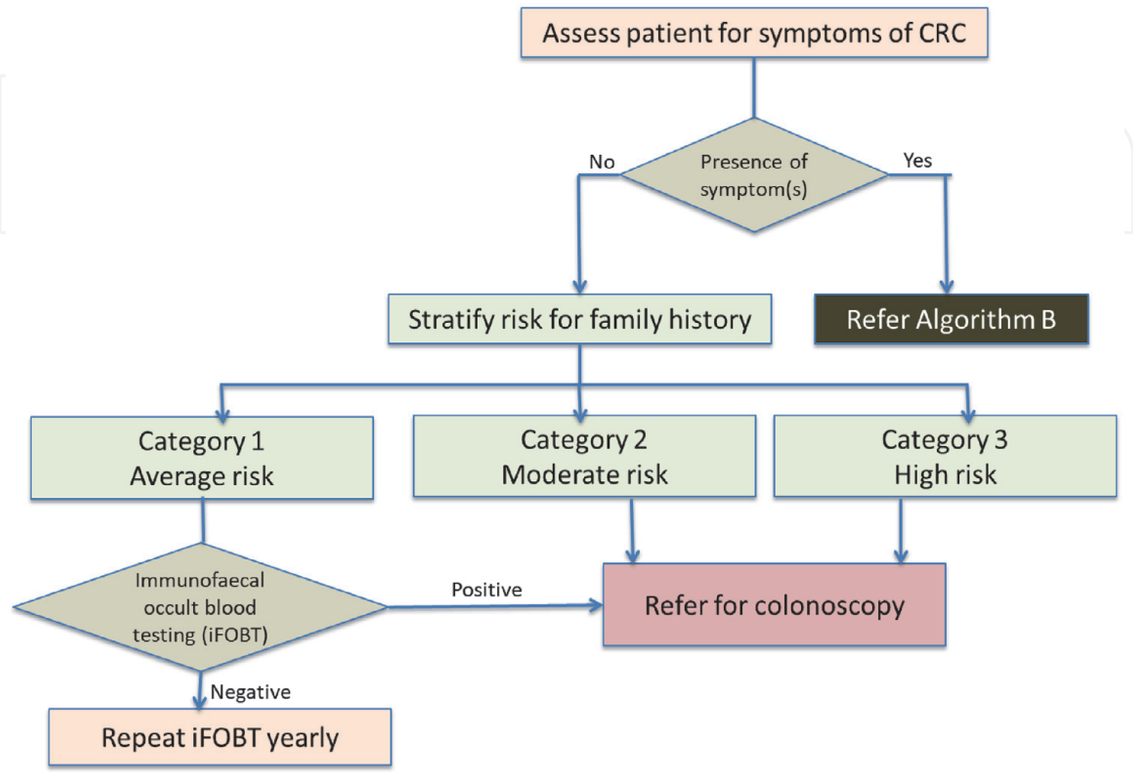

Figure 1.
Clinical pathway of screening for colorectal carcinoma. Source: Kamil et al. [6].

Category	Description	Screening recommendation
Category 1 Average risk	No family history and age >50 years	- Perform IFOBT - Stop screening at age 75
Category 2 Moderate risk	Family history of CRC either: - ≥ 1 FDR - 1FDR and > 1 SDR - > 3 and one of them must be FDR	- FDR with CRC diagnosed at age <60 years, colonoscopy should be performed at age 40 or 10 years younger than affected relative (whichever is younger) If normal, repeat every 3-5 years - FDR with CRC diagnosed at ≥60 years, colonoscopy should be performed at age 40 years. If normal, repeat every 10 years. - Stop screening at age 75
Category 3 High risk	Family history of: - CRC at age < 50 years - FAP - Lynch syndrome - Peutz-Jegher Syndrome - Juvenile polyposis - MAP	- For family history of CRC diagnosed at age <50 years, colonoscopy should be performed at age 40 or 10 years younger than affected relative (whichever is younger) If normal, repeat every 3-5 years. Stop screening at age 75.

Figure 2.
Risk categories for family history with CRC. Source: Kamil et al. [6].

population with average risk. While in a certain country, opportunistic CRC screening is provided at primary healthcare centres, also catering those with average risk. Therefore, most uptakes are due to routine recommendation offered by attending doctors, despite low.

Most of the significant CRC guidelines recommend screening of CRC to start at the age of 50 years old. For instance, the US Preventive Task Force recommends screening for CRC to begin at the age of 50 years and continues until age 75 years. The decision to screen for CRC in adults aged 76 to 85 years should be individualized, taking into account the patient's overall health and prior screening history [5]. For examples, according to Malaysian guideline, screening of colorectal carcinoma (CRC) should be offered at the age of 50 years and continues until age 75 years for the average-risk population. Immunochemical fecal occult blood test (iFOBT) is the preferred method to screen for CRC in an average-risk community. If iFOBT is positive, an early colonoscopy is necessary. Whereas, if iFOBT is negative, the yearly test should be performed (**Figures 1** and **2**) [6].

These screening tests are not only effective in the early discovery of malignant tumors, but also serves as a preventive procedure whereby polyps that could potentially become malignant can be found and removed before becoming cancerous [2].

3. Colorectal cancer screening modalities

There were several screening tests available for CRC which vary in terms of their performance accuracy, complication rates, screening uptake as well as costs associated with screening. Among several options available are fecal occult blood test (FOBT), flexible sigmoidoscopy (FS), colonoscopy, colon capsule endoscopy (CCE), and computed tomographic colonography (CTC).

3.1 Fecal test

Fecal test is a non-invasive tool for CRC screening in general population. It can detect presence of blood, proteins e.g. enzyme M2-PK and DNA. Fecal occult blood refers to blood in the feces that is not visibly apparent. A fecal occult blood test (FOBT) is designed to identify hidden or small quantities of blood in fecal sample. There are two main types of FOBTs: guaiac-based fecal occult blood test (gFOBT) and immunochemical fecal occult blood test (iFOBT) which is also known as fecal immunochemical test (FIT).

FOBT has qualitative and quantitative testing methods. In a meta-analysis of fair to high quality evidence, the pooled sensitivity to detect CRC was 74% (95% CI 62-83) for quantitative test methods and 79% (95% CI 61-90) for qualitative test methods [5]. Immunochemical FOBT (iFOBT) and guaiac-based FOBT (gFOBT) are two methods of qualitative FOBT. The sensitivities of iFOBT and gFOBT are 0.67 (95% CI 0.61-0.73) and 0.54 (95% CI 0.48-0.60) respectively. The specificities of iFOBT and gFOBT are comparable at 0.85 (95% CI 0.83-0.87) and 0.80 (95% CI 0.78-0.82) respectively [7].

Overall, screening with FOBT (either iFOBT or gFOBT) has a 16% reduction in the risk of CRC mortality (RR = 0.84, 95% CI 0.78-0.90) as compared to unscreened population [8], while screening with iFOBT can reduce CRC mortality by 22% as compared to screening with gFOBT [9].

Other fecal test include fecal M2-PK enzyme detection and fecal DNA tests. Fecal M2-PK has a pooled sensitivity and specificity of 79% (95% CI 73 to 83) and 80% (95% CI 73 to 86) respectively [10]. On the other hand, quantitative fecal DNA

test has a higher sensitivity at 92% (95% CI 84 to 97) to detect CRC [5]. These two fecal tests for CRC screening are, however, not widely used locally in screening for general population due to high cost incurred.

3.2 Flexible sigmoidoscopy (FS)

FS needs less rigorous bowel preparation and can be performed as a clinic-based procedure without the need for sedation. Small polyps can be biopsied during procedure but excision of larger lesions (>1 cm) may be performed during subsequent colonoscopy.

In two randomized controlled trial studies conducted in the United States and the United Kingdom, sigmoidoscopy reduces the CRC incidence by 18-26% and mortality by 26-30% in general population. The reduction in mortality, however, was limited to distal colon, with no significant effect in the proximal colon [11, 12].

3.3 Colonoscopy

Colonoscopy is the screening modality that has the ability to visualize the colonic mucosa directly, perform biopsy and excise polyps. It can detect proximal lesions that would be missed by screening sigmoidoscopy and has been shown to reduce risk of cancer in the right colon, while for those who has had colonoscopy especially for screening, the risk of CRC is strongly reduced by 91% up to 10 years [13]. In different study, it was also found that screening colonoscopy was associated with a substantial and comparably decreased mortality risk for both right-sided (65% reduction) and left-sided (75% reduction) cancers within a large community-based population [14].

According to the American College of Gastroenterology Guidelines, the preferred CRC prevention test (screening test) with strong recommendation is colonoscopy every 10 years, beginning at age of 50 based on the evidence of effectiveness, cost-effectiveness and acceptance by patients [15]. The National Cancer Comprehensive Network Clinical Practice Guidelines for Colorectal Cancer Screening also stated that colonoscopy is currently the preferred screening method. It is also the required procedure for confirmation of positive findings from other screening tests [16].

However, based on the updated Asia Pacific Consensus on Colorectal Cancer report in 2013, colonoscopy is recommended for those with an increased risk of CRC based upon the family history of CRC and other related risk factors for CRC. This recommendation has been suggested by the panel in view of colonoscopy being an invasive, labour intensive and more expensive method for CRC screening [17].

3.4 Colon capsule endoscopy (CCE)

CCE is used to obtain images of the colon by using video cameras embedded in an ingested capsule. The technique is less invasive but does not allow biopsy or polyp removal.

The sensitivity in detection of polyps >6 mm and > 10 mm increased substantially between development of first-generation (CCE-1) and second-generation (CCE-2) of CCE. CCE-2 and CCE-1 detect polyps >6 mm with sensitivity of 86% (95% CI 82–89%) and 58% (95% CI 44–70%) respectively, and specificity of 88.1% (95% CI 74.2%–95.0%) and 85.7% (95% CI 80.2%–90.0%) respectively. While for larger polyps >10 mm, CCE-2 and CCE-1 had sensitivity of 87% (95% CI 81–91%) and 54% (95% CI 29–77%) respectively, and specificity of 95.3% (95% CI, 91.5%–97.5%) and 97.4% (95% CI 96.0%–98.3%) respectively [18]. These high specificity

values for detection of polyps by CCE seem to be achievable with a 10-mm cutoff and in a screening setting.

3.5 Computed tomographic Colonography (CTC)

CTC uses multiple thin slice computed tomographic data to construct images of the bowel mucosa in two or three dimensions in detecting polyps. It requires bowel preparation similar to conventional colonoscopy and during the procedure, air or carbon dioxide is introduced into the rectum via a rubber catheter. No sedation is required and patient is usually able to return to work post procedure.

Estimated sensitivities for patients with polyps or adenomas ≥6 mm were 75.9% (95% CI 62.3–85.8) and 82.9% (95% CI 73.6–89.4), with corresponding specificities 94.6% (95% CI 90.4–97.0) and 91.4% (95% CI 84.1–95.5) respectively. On the other hand, estimated sensitivities for patients with polyps or adenomas ≥10 mm were 83.3% (95% CI 76.8–89.0) and 87.9% (95% CI 82.1–92.0), with corresponding specificities 98.7% (95% CI 97.6–99.3) and 97.6% (95% CI 95.0–98.9) respectively [19].

The major drawbacks of CTC are that it is non-therapeutic, with the need for colonoscopy after the identification of polyps for excision and tissue diagnosis. Other reasons include argument for radiation exposure, presence of flat adenomas that are more likely to be missed by CTC than colonoscopy, and issues of incidental extra-colonic pathological findings that may arise [19, 20].

4. Colorectal cancer screening uptake

Participation in screening has varied greatly among different regions. The Netherlands showed the highest participation rate (68.2%) and some areas of Canada showed the lowest (16%). Participation rates were highest among women and in programs that used the iFOBT test. The iFOBT test has been the most widely test used in screening program worldwide nowadays. The advent of this test has increased participation rates and the detection of positive results [13].

In a large scale study conducted in Asia Pacific region, 27% of respondents aged 50 years and older had undergone previous CRC testing; the Philippines (69%), Australia (48%), and Japan (38%) had the highest participation rates, whereas India (1.5%), Malaysia (3%), Indonesia (3%), Pakistan (7.5%), and Brunei (13.7%) had the lowest rates [21].

5. Barriers for colorectal cancer screening

Community with cancer tends to present to cancer services in the later stages of the disease, and this late presentation has severe, often fatal, consequences. Therefore, increasing awareness about cancer signs and symptoms could contribute to earlier presentation and improvements in cancer outcomes Despite the prevalence of colorectal cancer and the many screening tests available, the number of people going for these screening tests are very low [22]. This is rather alarming and many studies have been conducted worldwide to discover and analyze the causes of low turnout for colorectal cancer screening [23].

5.1 Poor knowledge of CRC symptoms and risk factors

A majority of the studies found that the largest barrier towards colorectal cancer screening is poor knowledge of the general public towards the risk factors,

symptoms and screening tests available for CRC. A recent multi-center, international study involving 14 countries or regions in the Asia Pacific region reported considerable deficiencies in knowledge of CRC symptoms and risk factors, and suggested that this could lead to poor uptake of CRC screening tests. One research indicates that there is a lack of awareness among community about CRC symptoms, i.e. only 40.6% of 2379 participants recognized 'blood in stool' as a warning sign for CRC. Other causes of delayed detection and diagnosis include denial, negative perceptions of the disease, the over-reliance on traditional medicine, misperceived risk, emotional barriers and negative perceptions towards screening. Cancer awareness campaigns and their evaluation are sparse in low- and middle-income countries.

Studies from Hong Kong, Australia and USA also reported low levels of knowledge of CRC [22]. Other than that, those with poor educational backgrounds are more likely to have language and communication barriers, and have a harder time understanding materials or recommendations. Also identified being the male gender to have poorer CRC knowledge, as females have better health knowledge due to their traditional role as carers. With particular focus to a multiracial country, the language barrier becomes a prominent problem. Subjects have complained of the limited language diversity in cancer screening awareness material, hence result in poorer understanding. This in particular would be a problem for the older generation, as many are less multilingual than the younger generation; and this becomes a large problem as CRC has a higher prevalence among those above 50 years of age [23]. Few Asian countries have established nationwide CRC awareness and screening programs, with Taiwan, Korea, Singapore and Japan being the only Asian countries that have existing national CRC screening guidelines and programs [23].

5.2 Lack of physician's recommendation

Another major factor of poor knowledge within the population is the severe lack of physician's recommendation to do CRC screening [23]. In Asia Pacific region, countries with low CRC screening participation were found to have the lowest physician recommendation rate [21]. According to an American study, failure of a clinician to suggest screening was identified as the most important barriers to CRC screening [24].

The most common barrier was "unavailability of the test". The two most common patient factors are "patient in a hurry" and "poor patient awareness". This may be related to the low availability of the test in the primary care setting and poor awareness and understanding of the importance of colorectal cancer screening among patients.

5.3 Lack of access of CRC screening

A notable category of barriers that people face that hinders them from CRC screening participation is access barriers. One of them is financial constraints. Another is time constraint. In a busy clinic, long patient waiting time may lead to patient in a hurry and refusal despite being recommended. It is known that the conventional gFOBT is troublesome and embarrassing for patients to do. Another drawback of the test is patient has to be on certain food restriction and the test has to be repeated at least twice. Therefore, many countries have now moving towards using immunological test since it is less troublesome and better detection rate [25].

Many stated that they were too busy, or the tests were too time consuming. Thirdly, there is limited access to centers that provide such screening tests [23]. The most common barrier for screening is because FOBT test is unavailable in the primary care clinic. FOBT is in fact easily available and free in certain health care facilities but only few health clinics have this test. In most of the primary care health clinics, the test needs to be sent to nearest hospital laboratory and because of that it become tedious and not commonly ordered [25].

Majority of patients will come to primary care as their first consult. Wellness clinic has been implemented in primary care clinics. This clinic is meant for patients to come for screening. However, the programme in the certain clinic is mainly targeting on screening cardiovascular risk factors such as diabetes, hypertension and hypercholesterolaemia. Little is done for cancer screening. Cervical cancer screening has the highest patient uptake (43%) because of the incorporation of Pap smear programme in maternal and child health clinic which is run in primary care facilities [25].

5.4 Patient's negative perception towards CRC screening

There are many people who do not perceive that they are at risk of getting CRC. This low perceived risk is attributable to several factors, such as not having a family history of CRC, not experiencing any signs or symptoms, living a healthy or low-risk lifestyle or being free from health problems in general [23]. Another barrier that many studies report is the negative perception towards screening methods, with a more negative view towards more invasive procedures such as endoscopic-based procedures. Among the negative views reported were fear, pain experienced or perceived pain towards screening procedures, feeling of embarrassment, health damage, inconvenience and lack of confidence in screening efficacy. Fear of test result is a common barrier for any test. It is especially when most people relate cancer to untreatable and fatal disease. A study in Italy also showed the same finding where being concern with the test result is the most important reason of patient's noncompliance.

5.5 Others factor

Throughout the world there are widespread differences in CRC screening implementation status and strategy. Differences can be attributed to geographical variation in CRC incidence, economic resources, healthcare structure and infra-structure to support screening such as the ability to identify the target population at risk and cancer registry availability. Despite well-developed CRC screening guide-lines, implementation of screening is markedly different among countries and regions worldwide [26]. What is more, there is also inequitable access to CRC screening, at least in relation to socioeconomic status and ethnicity. The mecha-nism, however, is not well understood [27].

6. Intervention related to CRC screening

Table 1 showed some evidence from previous studies on CRC screening and intervention modalities. Mixed of intervention through telephone counseling, a mail invitation, email/text-message reminder, health talk, video and brochure are some intervention has been done and showed a positive finding on CRC screening uptake. The government needs to take action for CRC screening programme and

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
1	2010	San Francisco, United States	RCT. Participants were randomized to (1) basic intervention: culturally tailored brochure plus FOBT kit (n = 765); (2) enhanced intervention: brochure, FOBT plus telephone counseling (n = 768); or (3) usual care (n = 256).	Culturally tailored telephone counseling by community health advisors employed by a community-based organization, culturally tailored brochures, and customized FOBT kits.	Usual care (no further description).	1789 Latino and Vietnamese primary care patients at a large public hospital, aged 50-79.	Self-reported receipt of FOBT or any CRC screening at 1-year follow-up.	1358 individuals (718 Latinos and 640 Vietnamese) completed the follow-up survey. Self-reported FOBT screening rates increased by 7.8% in the control group, by 15.1% in the brochure group, and by 25.1% in the brochure/telephone counseling group ($p < 0.01$ for differences between each intervention and usual care and for the difference between brochure/telephone counseling and brochure alone). For any CRC screening, rates increased by 4.1% in the usual care group, by 11.9% in the FOBT/brochure group, and by 21.4% in the brochure/telephone	An intervention that included culturally tailored brochures and tailored telephone counseling increased CRC screening in Latinos and the Vietnamese. Brochure and telephone counseling together had the greatest impact.	[28]

Public Health: Prevention
DOI: http://dx.doi.org/10.5772/intechopen.94396

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								counseling group ($p < 0.01$ for differences between each intervention and usual care and for the difference between the basic and the enhanced intervention).		
2	2014	Florida, United States	Ecological study. From cases reported to the Florida Cancer Registry.	SaTScan ver 9.1.1, a free cluster-detection software application was used to describe spatial clusters of CRC	NA	36,094 cases with CRC diagnosed at late stages from 1996 through 2010 in Florida, aged more than 50.	Clusters of CRC	Much of analysis was underpowered and that no single method detected all clusters of statistical or public health significance.	The high risk area is potentially a priority area for a screening intervention. Cluster detection can be incorporated into routine public health operations, but the challenge is to identify areas in which the burden of disease can be alleviated through public health intervention.	[29]
3	2013	Washington, United States	RCT. 4-group, parallel-design, randomized, controlled	EHR-linked mailings ("automated"), automated plus	Usual care; involved services to promote CRC screening,	4675 patients attended to 21 primary care medical centres in	The proportion of participants current for screening in both	Compared with those in the usual care group, participants in the	Compared with usual care, a centralized, EHR-linked, mailed	[30]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
			comparative effectiveness trial with concealed allocation and blinded outcome assessments.	telephone assistance ("assisted"), or automated and assisted plus nurse navigation to testing completion or refusal ("navigated"). Interventions were repeated in year 2.	including guidelines, patient handouts, and an annual systems delivered involved services patient-tailored "birthday letter" with previous completion and subsequent due dates for immunizations, screening tests, and long-term care tests (such as influenza shots, CRC screening, or hemoglobin A1c tests).	Washington, not current for CRC screening, aged 50 to 73.	years, defined as colonoscopy or sigmoidoscopy (year 1) or fecal occult blood testing (FOBT) in year 1 and FOBT, colonoscopy, or sigmoidoscopy (year 2).	intervention groups were more likely to be current for CRC screening for both years with significant increases by intensity (usual care, 26.3% [95% CI, 23.4% to 29.2%]; automated, 50.8% [CI, 47.3% to 54.4%]; assisted, 57.5% [CI, 54.5% to 60.6%]; and navigated, 64.7% [CI, 62.5% to 67.0%]; $P < 0.001$ for all pair-wise comparisons). Increases in screening were primarily due to increased uptake of FOBT being completed in both years (usual care, 3.9% [CI, 2.8% to 5.1%]; automated, 27.5% [CI, 24.9% to 30.0%]; assisted, 30.5% [CI, 27.9% to 33.2%]; and navigated, 35.8% [CI, 33.1% to 38.6%]).	CRC screening program led to twice as many persons being current for screening over 2 years. Assisted and navigated interventions led to smaller but significant stepped increases compared with the automated intervention only. The rapid growth of EHRs provides opportunities for spreading this model broadly.	

Public Health: Prevention
DOI: http://dx.doi.org/10.5772/intechopen.94396

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
4	2011	Massachusetts, United States	RCT. We randomly allocated patients to receive a patient navigation–based intervention or usual care.	Intervention patients received an introductory letter from their primary care provider with educational material, followed by telephone calls from a language-concordant navigator. The navigators offered patients the option of being screened by fecal occult blood testing or colonoscopy.	Usual care (no further description).	465 patients from 4 community health centers and 2 public hospital–based clinics who were not up-to-date with CRC screening, aged 52 to 74.	The primary outcome was completion of any CRC screening within 1 year. Secondary outcomes included the proportions of patients screened by colonoscopy who had adenomas or cancer detected.	During a 1-year period, intervention patients were more likely to undergo CRC screening than control patients (33.6% vs. 20.0%; $P < .001$), to be screened by colonoscopy (26.4% vs. 13.0%; $P < .001$), and to have adenomas detected (8.1% vs. 3.9%; $P = .06$). In prespecified subgroup analyses, the navigator intervention was particularly beneficial for patients whose primary language was other than English (39.8% vs. 18.6%; $P < .001$) and black patients (39.7% vs. 16.7%; $P = .004$).	Patient navigation increased completion of CRC screening among ethnically diverse patients. Targeting patient navigation to black and non–English-speaking patients may be a useful approach to reducing disparities in CRC screening.	[31]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
5	2014	Chicago, United States	RCT. Patient-level randomized controlled trial conducted in a network of community health centers.	The intervention group received (1) a mailed reminder letter, a free FIT with low-literacy instructions, and a postage-paid return envelope; (2) an automated telephone and text message reminding them that they were due for screening and that a FIT was being mailed to them; (3) an automated telephone and text reminder 2 weeks later for those who did not return the FIT; and (4) personal telephone outreach by a CRC screening navigator after 3 months.	Usual care; included computerized reminders, standing orders for medical assistants to give patients home fecal immunochemical tests (FIT), and clinician feedback on CRC screening rates.	450 patients who were previously negative for FOBT from March 2011 through February 2012. aged 51 to 75.	Completion of FOBT within 6 months of the date the patient was due for annual screening.	Intervention patients were much more likely than those in usual care to complete FOBT (82.2% vs. 37.3%; $P < .001$). Of the 185 intervention patients completing screening, 10.2% completed prior to their due date (intervention was not given), 39.6% within 2 weeks (after initial intervention), 24.0% within 2 to 13 weeks (after automated call/text reminder), and 8.4% between 13 and 26 weeks (after personal call).	This intervention greatly increased adherence to annual CRC screening; most screenings were achieved without personal calls. It is possible to improve annual CRC screening for vulnerable populations with relatively low-cost strategies that are facilitated by health information technologies.	[32]
6	2010	Atlanta, United States	RCT. Community intervention trial.	The three interventions are 1) one-on-one education 2)	Control group; Participants attended the introductory	African-American men and women, aged ≥50 years.	Post intervention increase in CRC knowledge and obtaining a	257 participants completed the intervention and were available for	The current results indicated that group education could increase	[33]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
				group education, and 3) reducing out-of-pocket costs (financial support). Two of the interventions were educational, and the third intervention responded to financial barriers (participants were offered financial reimbursement up to $500 for out-of-pocket expenses incurred for CRC screening, including transportation and other nonmedical expenses).	session but received no intervention other than accepting the contents of the gift bag with the educational pamphlets. They received pretesting (at the introductory session), post-testing, and follow-up on a schedule identical to that of the participants in the other cohorts.		screening test within 6 months.	follow-up 3 months to 6 months later. Among completers, there were significant increases in knowledge in both educational cohorts but in neither of the other 2 cohorts. By the 6-month follow-up, 17.7% (11 of 62 participants) of the Control cohort reported having undergone screening compared with 33.9% (22 of 65 participants) of the Group Education cohort (P = .039). Screening rate increases in the other 2 cohorts were not statistically significant.	CRC cancer screening rates among African Americans. The screening rate of <35% in a group of individuals who participated in an educational program through multiple sessions over a period of several weeks indicated that there still are barriers to overcome.	
7	2011	Georgia and Florida, United States	RCT. Health plan members intervention trial.	Intervention practices received 1) academic detailing (2	Usual care; at patient level - participants received neither	Members of a large health plan (Aetna's health maintenance	Primary: Self-reported completion of any CRC screening test	Among 443 active participants, 75.8% were ages 52 to 59 years, 80.9%	Interventions combining a patient-directed decision aid and	[34]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
				physician detailers conducted 2 sessions for each practice that included information about colon cancer and screening tests, practice-specific screening rates, clips of the decision aid, and the development of practice-specific plans to address requests for screening) to facilitate CRC testing once patients were activated by the 2) decision aid (a personalized letter, the decision aid in DVD and VHS formats with instructions for viewing, stage-targeted brochures, Aetna-specific copayment and referral	academic detailing nor decision aid. All Aetna members (including those in our study's intervention and usual care groups) annually received brief mailed reminders from Aetna encouraging them to obtain CRC screening.	organization [HMO] product) from selected metropolitan areas in Georgia and Florida, aged 52 to 75.	at 12 months. Secondary: The effect of the decision aid in the subtrial of nonrespondents.	were white, 62.1% were women, and 46.4% had college degrees or greater education. Among 380 active participants with known screening status at 12 months based on survey results, 39% in the intervention group reported receiving CRC screening compared with 32.2% in the usual care group (unadjusted odds ratio [OR], 1.34; 95% confidence interval; [CI], 0.88-2.05; P = .17). After adjusting for baseline differences and accounting for clustering, the effect was somewhat larger (OR, 1.64; 95% CI, 0.98-2.73; P = .06). Claims analysis produced similar effects for active	practice-directed academic detailing had a modest but statistically nonsignificant effect on CRC screening rates among active participants	

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
				information, CRC screening options chart, and the decision aid survey).				participants. The intervention was more effective in those who had incomes >$50,000 (OR, 2.16; 95% CI, 1.07-4.35) than in those who had lower incomes (OR, 1.25; 95% CI, 0.53-2.94; P = .03 for interaction).		
8	2016	Texas, United States	Quasi experiment. Two arm parallel non-equivalent control group design in which participants were randomly allocated to three education intervention delivery groups in a 1:1:1 ratio.	Eligible subjects were randomized to either 1) promotora (P), 2) video (V), or 3) combined promotora and video (PV) education, and also received no-cost screening with fecal immunochemical testing or colonoscopy and navigation.	Controls were recruited from a similar county, received no intervention.	Population from community and clinic sites in Texas, aged 50-75.	6 month self-reported CRC screening.	784 subjects (467 in intervention group, 317 controls) were recruited; mean age was 56.8 years; 78.4% were female, 98.7% were Hispanic and 90.0% were born in Mexico. In the worst case scenario analysis (n = 784) screening uptake was 80.5% in the intervention group and 17.0% in the control group [relative risk 4.73, 95% CI: 3.69–6.05, P < 0.001]. No	A multicomponent community-wide, bilingual, CRC screening intervention significantly increased CRC screening in an uninsured predominantly Hispanic population.	[35]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								educational group differences were observed. Covariate adjustment did not significantly alter the effect.		
9	2017	Hamadan, Iran	1) FGD and IDI. Focused group discussion and in-depth interview were held among physicians and adult population. 2) RCT. Cluster intervention trial.	A multi-component intervention was developed and piloted. In final intervention trial stage, participants received either 1) education and free FOBT, or 2) education only, or 3) free FOBT. Education materials were reminder pack that contains postcards and pamphlet, and an educational video with title "Being a winner in life: how to prevent CRC cancer".	Controls received only questionnaire (regarding the determinants of the CRC screening behaviors).	Patients in 8 health centres in Hamadan, aged 40-70.	4 month CRC screening.	The preliminary evaluation findings revealed that during the 4-month follow up period, CRC screening rates were 87.1%, 61.3%, 54.8 and 1.6% for participants assigned to education with free FOBT, only education, only free FOBT and control group, respectively. Adults in either of the 3 intervention groups were significantly more likely to undergo screening compared to adults in the control group. There were significant differences in CRC	Intervention Mapping (IM) is a useful process in the design of a theory-based intervention addressing CRC screening among Iranian population.	[36]

Public Health: Prevention
DOI: http://dx.doi.org/10.5772/intechopen.94396

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								screening uptake between intervention groups and control ($P < 0.001$).		
10	2010	United States	RCT. Randomized from nation-wide database.	A narrative intervention within educational message was used to promote colorectal cancer screening i.e. first-person narrative from a similar other (i.e., an individual who matched participants in gender, age, and race), who described a personal experience with the colon cancer screening decision.	Control participants did not receive a narrative.	Participants were recruited from Survey Sampling International (SSI), aged 49-60.	Perceptions of the impact of the barriers on screening, risk perception, knowledge, and interest in screening.	Compared to participants who received only the educational message, participants who received the message along with a narrative reported that the barriers to screening would have less of an impact on a future screening experience.	The narrative also increased risk perception for colorectal cancer and interest in screening in the next year.	[37]
11	2011	Germany	RCT. Randomized from German statutory health insurance scheme.	Intervention group received 38 pages brochure with evidence based risk information on	Controls received official information leaflet of the German colorectal cancer	Insured people who were members of the target group for colorectal cancer	The primary end point was "informed choice," comprising "knowledge,"	The response rate for return of both questionnaires was 92.4% (n = 1457). 345/785 (44.0%) participants in the	Evidence based risk information on colorectal cancer screening increased informed choices	[38]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
				colorectal cancer screening and two optional interactive internet modules on risk and diagnostic tests.	screening programme	screening, age 50-75.	"attitude," and "combination of actual and planned uptake." Secondary outcomes were "knowledge" and "combination of actual and planned uptake." Knowledge and attitude were assessed after 6 weeks and combination of actual and planned uptake of screening after 6 months.	intervention group made an informed choice, compared with 101/792 (12.8%) in the control group (difference 31.2%, 99% confidence interval 25.7% to 36.7%; $P < 0.001$). More intervention group participants had "good knowledge" (59.6% (n = 468) v 16.2% (128); difference 43.5%, 37.8% to 49.1%; $P < 0.001$). A "positive attitude" towards colorectal screening prevailed in both groups but was significantly lower in the intervention group (93.4% (733) v 96.5% (764); difference − 3.1%, −5.9% to −0.3%; $P < 0.01$). The intervention had no effect on the combination of	and improved knowledge, with little change in attitudes. The intervention did not affect the combination of actual and planned uptake of screening.	

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DOI: http://dx.doi.org/10.5772/intechopen.94396

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								actual and planned uptake (72.4% (568) v 72.9% (577); P = 0.87).		
12	2013	California, United States	RCT. Patients were assigned randomly to 1 of 3 groups.	One group was assigned to fecal immunochemical test (FIT) outreach, consisting of mailed invitation to use and return an enclosed no-cost FIT (n = 1593). A second was assigned to colonoscopy outreach, consisting of mailed invitation to schedule a no-cost colonoscopy (n = 479). These groups also received telephone follow-up to promote test completion.	Usual care; consisting of opportunistic primary care visit–based screening (n = 3898).	Uninsured patients, not up to date with CRC screening, served by the John Peter Smith Health Network, a safety net health system, aged 54 to 64.	Screening participation in any CRC test within 1 year of recruitment.	Mean patient age was 59 years; 64% of patients were women. The sample was 41% white, 24% black, 29% Hispanic, and 7% other race/ethnicity. Screening participation was significantly higher for both FIT (40.7%) and colonoscopy outreach (24.6%) than for usual care (12.1%) (P < .001 for both comparisons with usual care). Screening was significantly higher for FIT than for colonoscopy outreach (P < .001). In stratified analyses, screening was	Among underserved patients whose CRC screening was not up to date, mailed outreach invitations resulted in markedly higher CRC screening compared with usual care. Outreach was more effective with FIT than with colonoscopy invitation.	[39]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								higher for FIT and colonoscopy outreach than for usual care, and higher for FIT than for colonoscopy outreach among whites, blacks, and Hispanics ($P < .005$ for all comparisons). Rates of CRC identification and advanced adenoma detection were 0.4% and 0.8% for FIT outreach, 0.4% and 1.3% for colonoscopy outreach, and 0.2% and 0.4% for usual care, respectively ($P < .05$ for colonoscopy vs. usual care advanced adenoma comparison; $P > .05$ for all other comparisons). Eleven of 60 patients with abnormal FIT results did not		

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No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								complete colonoscopy.		
13	2012	Massachusetts, United States	RCT. Participants were randomized to one of two intervention arms and one control group.	Intervention groups received either 1) decision aid plus personalized risk assessment, or 2) decision aid alone. Interventions took place just prior to a routine office visit with their primary care providers.	Controls reviewed a modified online version of "9 Ways to Stay Healthy and Prevent Disease," which discussed generic lifestyle changes other than screening for minimizing risk of preventable diseases.	Population in an urban, academic safety-net hospital and community health center, aged 50-75.	Completion of a CRC screening test within 12 months of the study visit.	Patients in the decision-aid group were more likely to complete a screening test than control patients (43.1% vs. 34.8%, p = 0.046) within 12 months of the study visit; conversely, test uptake for the decision aid and decision aid plus personalized risk assessment arms was similar (43.1% vs. 37.1%, p = 0.15). Assignment to the decision-aid arm (AOR = 1.48, 95% CI = 1.04, 2.10), black race (AOR = 1.52, 95% CI = 1.12, 2.06) and a preference for a patient-dominant decision-making approach (AOR = 1.55, 95%	Decision aid–assisted SDM has a modest impact on CRC screening uptake. A decision aid plus personalized risk assessment tool is no more effective than a decision aid alone.	[40]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								CI = 1.02, 2.35) were independent determinants of test completion. Activation of the screening discussion and enhanced screening intentions mediated the intervention effect.		
14	2010	California, United States	RCT. Community based trial.	Intervention groups received either 1) an education session on CRC screening and free fecal occult blood test (FOBT) kits, or 2) an education session but no free FOBT kits	Control group received an education session on the health benefits of physical activity.	Filipino American population, aged 50-75.	Self-reported CRC screening rates during the 6-month follow-up period.	Self-reported CRC screening rates during the 6-month follow-up period were 30%, 25%, and 9% for participants assigned to intervention with FOBT kit, intervention without the kit, and control group, respectively. Participants in either of the 2 intervention groups were significantly more likely to report screening at follow-up than	A multicomponent intervention that includes an educational group session in a community setting can significantly increase CRC screening among Filipino Americans, even when no free FOBT kits are distributed.	[41]

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No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
								were participants in the control group.		
15	2011	Texas, United States	RCT. Randomized from a baseline survey into one of three groups.	Intervention groups received either 1) a tailored intervention about CRC screening (tailored group), or 2) a public web site about CRC screening (web site group).	Control group; survey-only group.	Patients from Kelsey-Seybold Clinic, overdue for CRC screening, aged 50-70.	Completion of any recommended CRC screening by 6 months.	There was no statistically significant difference in screening by 6 months: 30%, 31%, and 28% of the survey-only, web site, and tailored groups were screened. Exposure to the tailored intervention was associated with increased knowledge and CRC screening self-efficacy at 2 weeks and 6 months. Family history, prior screening, stage of change, and physician recommendation moderated the intervention effects.	A tailored intervention was not more effective at increasing screening than a public web site or only being surveyed.	[42]

No	Year	Country	Design	Intervention	Comparison	Population	Main Outcome Measured	Result	Conclusion	Reference
16	2010	Washington, United States	RCT. A clinic-based individual randomized trial.	Intervention groups received either 1) mailed fecal occult blood test (FOBT) card and instructions on how to complete the test (mailed FOBT only); or 2) mailed FOBT card and instructions on how to complete the test, telephone reminders, and home visits (mailed FOBT and outreach)	Usual care; no formal prompting of colorectal cancer screening, other than what is provided during a physician visit.	Hispanic patients who had been seen in the Seattle-based community clinic, aged 50-79.	Post intervention differences in rates of FOBT screening in intervention and usual care group.	Data analysis occurred between November 2008 and September 2009. Nine-month postintervention screening rates were 26% among patients who received the mailed packet only intervention ($P < .001$ compared with usual care) and 31% in the group that received the mailed packet and outreach intervention ($P < .001$ compared with usual care). This compared with 2% in the group that received usual care. Screening rates in the mailed FOBT only group and in the mailed FOBT and outreach group were not significantly different ($P = .28$).	Culturally appropriate clinic-based interventions may increase colorectal cancer screening among underserved Hispanics.	[43]

Table 1.
Evidence from previous studies on CRC screening and intervention modalities.

promote it. The example from **Table 1** can be part of promoting the CRC screening using FOBT for early detection of cancer.

7. Others prevention strategies

Findings from a systematic review suggest that small media interventions (eg, interventions using mailed materials, text messages, and telephone calls) may be effective in improving screening uptake for breast, cervical, colorectal, and gastric cancer in Asian countries. Therefore, there is a priority need for programs that raise awareness about the warning signs and symptoms of cancer and the benefits of early detection. This form of secondary prevention should be implemented in countries in which resources for population-based screening are lacking, particularly for cancers. Overall, the findings of the evaluation indicate that a culturally adapted, evidence-based mass media intervention appears to impact positively in terms of improving CRC symptom awareness among population; and that impact is more likely when a campaign operates a differentiated approach that matches modes of communication to the ethnic and religious diversity in a population. Research shown that there was a significant improvement in the recognition of all CRC symptoms (prompted) at follow up and a significant improvement in the knowledge of three unprompted symptoms, i.e. 'blood in stool', 'feeling that the bowel does not empty after using the lavatory' and 'unexplained weight loss'.

A recommendation from a physician is the most influential factor in determining whether a patient is screened for colorectal cancer. While the vast majority of primary care physicians report that they screen for colorectal cancer, many patients do not receive the recommendation they need. People with a high risk for CRC should not be included in a routine screening used for the general population. Their screening must be started early in a shorter period, and using various tests. The United States Preventive Task Force recommends CRC screening for the average at-risk population, using an annual fecal occult blood test (FOBT), a periodic flexible sigmoidoscopy (FS), or a colonoscopy [22]. One of the solutions is to engage the primary care doctors and family physician in identifying and recommending high risk patients for colorectal cancer screening. The effectiveness of the family doctor's role has been proven in previous studies and should be the way forward to increase awareness and cancer screening uptake.

Simultaneously, concerted effort is needed to increase numbers of skill operators and availability of the procedure throughout the country. In certain Europe countries, nurses have been trained to perform endoscopy to reduce patient's waiting time. On the other hand, fecal occult blood test can be utilized for mass screening among low risk or asymptomatic patients.

All these barriers could be overcome with the implementation of government-subsidized nationwide population screening, with the provision of more accessible screening times such as having them available during non-working hours or non-working days. However, even if the above-mentioned barriers have been overcome, it would not solve the problem if the people inherently do not wish to participate due to certain psychological barriers that are more difficult to tackle. Among these is the fatalistic belief that their lives are in the hands of fate or God. They believe that if it is destined that they are to have cancer, there is nothing they can do about it and early detection of cancer would not benefit them [23].

A patient's personal awareness of his or her risk level is important. Awareness of the health status of family members is also needed and should be encouraged. Awareness of discrepancies in screening rates for people in racial and ethnic groups can help to reduce these disparities.

8. Conclusions

Public health prevention on CRC screening uptake is very important for reducing the incidence and mortality. Population will benefit more with an early CRC screening uptake. There are multiple barriers that can hinder person from undergoing CRC screening for early prevention, detection and treatment. Majority of these barriers encountered regarding the poor rates of CRC screening are similar across countries in Asia, except for specific barriers that are due to unique circumstances. Lack of knowledge/education is the most critical barrier that is linked to a majority of other barriers. Continuous effort is important to reduce CRC related morbidity and mortality. Previous evidence showed positive effect on promoting CRC screening among community. The increased uptake of CRC screening also needs multicomponent in the intervention such as health communication, employer as well as the commitment from the physician itself. The enhancement of multicomponent screening programme will leads to successful rate of CRC screening uptake among the community.

Conflict of interest

No potential conflict of interest.

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