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Mini Review

Colorectal Cancer Screening Pathways and Regional Prevention and Control in Primary Healthcare

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Abstract

Colorectal cancer is a major cause of cancer morbidity and mortality worldwide, including in China. Screening can facilitate earlier detection and reduce disease burden, while primary healthcare institutions are central to population outreach, risk assessment, referral, and follow-up. However, resource constraints, limited public awareness, low screening adherence, and fragmented coordination continue to hinder implementation in community and rural settings. This mini review summarizes the epidemiological and health-economic rationale for colorectal cancer screening in primary healthcare and discusses organizational models, risk-stratified screening and referral, workforce training, quality control, data management, and information sharing. Available evidence supports coordinated pathways that link noninvasive initial screening to timely colonoscopy and follow-up, supported by clear governance, trained personnel, and traceable data systems. The ongoing Yazhou District program is included briefly as a descriptive example of how these components may be organized in practice. Future research should evaluate uptake, positivity, colonoscopy completion, lesion detection, adverse events, costs, and longer-term outcomes in diverse primary-care settings.

Introduction

Colorectal cancer, including cancers of the colon and rectum, has high incidence and mortality rates worldwide. Colorectal cancer incidence is increasing in many countries undergoing socioeconomic and lifestyle transitions.[1] The incidence of colorectal cancer in China has increased, whereas age-standardized mortality has been stable or declining overall, with substantial regional variation.[2,3] Observed declines in colorectal cancer mortality in some countries have been attributed in part to improved access to early detection and specialized care,[4] supporting the importance of effective screening systems for reducing disease burden.

Primary healthcare institutions play an important role in cancer prevention and control. However, colorectal cancer screening in primary-care and community settings faces implementation and uptake challenges.[5,6] Developing coordinated pathways that connect population outreach, risk assessment, screening tests, diagnostic colonoscopy, treatment, and follow-up remains a public health priority, particularly in resource-constrained settings. The aim of this mini review is to synthesize evidence on primary-care colorectal cancer screening and identify key components of regional prevention and control systems.

Epidemiological background of colorectal cancer and significance of screening

Global and Chinese epidemiological status of colorectal cancer

The global epidemiology of colorectal cancer shows substantial geographic and population heterogeneity. Patterns of colorectal cancer incidence differ across countries and stages of socioeconomic development. Projections suggest that by 2035, the mortality rate of colorectal cancer in Latin American countries may continue to increase, while it may continue to decline in most countries in North America and Oceania.[4] These contrasting trends highlight the importance of prevention and control measures.

The disease burden of colorectal cancer in China is substantial and varies regionally. A comparison of clinical data between Hong Kong and Chongqing showed differences in the anatomical site distribution of colorectal cancer between the two regions: rectal cancer predominated in Chongqing (61.3%), while right-sided colon cancer accounted for a higher proportion in Hong Kong.[7] An epidemiological survey of a southern Chinese population showed that alcohol intake (odds ratio (OR) = 8.61), higher body

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mass index (OR = 1.39), and family history of tumors (OR = 1.62) were significantly associated with the occurrence of sporadic colorectal cancer.[8] An analysis of the incidence trend of colorectal cancer in Shanghai from 1973 to 2005 showed that the age-standardized incidence rate of colon cancer increased by 3.03% annually, significantly higher than that of rectal cancer (1.34%), and proximal colon cancer increased notably, suggesting a shift in colorectal cancer epidemiologic patterns in large Chinese cities.[9] A further comparison of the disease burden of early-onset and late-onset colorectal cancer in China from 1990 to 2019 identified intergenerational differences in the risk factor profiles of the two populations, highlighting population differences relevant to prevention and control strategies.[10]

Public health value of primary care screening

Evidence supports a role for screening in improving outcomes for patients with colorectal cancer. A study in a veteran population showed that the 5-year survival rate of patients diagnosed through screening was significantly higher than that of the symptomatic treatment group.[11] Evidence from Germany supports reductions in colorectal cancer mortality with established screening methods and a reduction in incidence with colonoscopy.[12] In terms of health economics, Pignone *et al.*[13] estimated that the incremental cost-effectiveness ratio of colorectal cancer screening is generally US$10,000-25,000 per life-year gained, which is below commonly used willingness-to-pay thresholds. Guidelines issued by the British Society of Gastroenterology provide colonoscopy-based screening and surveillance recommendations for individuals at moderate or high risk of colorectal cancer.[14]

Studies from China also support the economic feasibility of primary care screening. A cost-effectiveness analysis of the community-based colorectal cancer screening program in Shanghai estimated a cost of US$712.08 per quality-adjusted life-year gained, far below the study's prespecified cost-effectiveness threshold of three times Shanghai's gross domestic product per capita.[15] A cost-benefit analysis of colorectal cancer screening in Changsha City, Hunan Province from 2023 to 2024 showed that the cost-benefit ratio of colorectal cancer screening in Changsha was 1:3.5 (i.e., a return of 3.50 yuan per yuan invested),[16] higher than that of Xixiangtang District in Nanning City, Guangxi (1:2.90),[17] but slightly lower than that of Yuexiu District in Guangzhou (1:3.63).[18] These findings collectively suggest that promoting colorectal cancer screening at the primary care level may have public health value and be economically feasible.

Key components of primary-care colorectal cancer screening

Program context and governance

Organized colorectal cancer screening in primary healthcare requires clear governance, sustainable coordination, referral-hospital support, and community-based outreach. These functions should link population invitation and initial screening with diagnostic evaluation, treatment, and follow-up.

Organizational coordination and community linkage

Organizational readiness influences the implementation of evidence-based colorectal cancer screening interventions in primary-care settings.[19] Effective models define responsibilities across health authorities, referral hospitals, primary-care institutions, and community teams, while family doctors or patient navigators support outreach and follow-up.

Risk stratification and screening pathways

Primary-care pathways commonly use a noninvasive initial test followed by colonoscopy for individuals with positive results or elevated risk. Risk assessment may incorporate age, family history, symptoms, lifestyle, and other established factors, and Chinese screening research has evaluated low-, intermediate-, and high-risk classification.[20]

Timely diagnostic referral is essential because the benefit of initial screening depends on completion of colonoscopy and appropriate follow-up. In a Shanghai community-based program, a combined fecal immunochemical test and risk-assessment strategy achieved an initial-screening completion rate of 97.7%,[21] while a multifaceted quality-improvement initiative combining provider education, patient-facing materials, and electronic outreach improved screening completion.[22]

Quality assurance and data management

Screening programs require reliable referral, standardized testing and colonoscopy procedures, trained personnel, equipment maintenance, monitoring of adverse events, and traceable data systems. Closed-loop management should connect screening, diagnosis, treatment, and follow-up, with data-quality review used to identify gaps in completion and service delivery.

Regional prevention and control: implementation considerations

Community engagement and patient navigation

Regional prevention and control require coordination among health authorities, primary-care institutions, referral hospitals, local governments, and communities. The UK National Health Service bowel cancer screening program provides an example of a nationally coordinated structure.[6] Clearly defined responsibilities and referral pathways can improve continuity from population invitation to diagnostic evaluation and follow-up.

Community engagement should combine consistent health education with individualized reminders and navigation. Standardized patient navigation may improve screening completion,[23] and family-doctor teams, community nurses, or trained volunteers can assist with appointments, examination guidance, and follow-up.

Risk-stratified resource allocation

Identifying high-risk populations can improve screening efficiency and help allocate limited colonoscopy capacity. Combined environmental and genetic risk scores have shown better predictive performance than either score alone (AUC = 0.64),[24] and health-economic modeling projected that risk stratification could prevent 156 colorectal cancer deaths per 100,000 people with a 96% probability of being cost-effective.[25] These findings support risk-adapted screening, although tools and thresholds require calibration and validation in the intended population.

Risk-stratified pathways may direct high-risk individuals to colonoscopy while using periodic fecal immunochemical testing and health education for lower-risk groups. A Chinese decision-analysis model suggested that screening beginning at age 40, with

colonoscopy every 5 years for high-risk populations and annual fecal immunochemical testing for medium- and low-risk populations, may maximize quality-adjusted life-years.[26]

Referral networks and information systems

Integration of medical resources and information systems supports continuity across the screening pathway. In a large community-based study, adoption of a population health management approach was associated with substantial increases in screening; among White participants, screening increased from 35.2% to 81.1% over 10 years.[27] Effective regional systems require two-way referral, access to pathology and specialist treatment, interoperable data, and feedback to primary-care teams.

Yazhou District as a descriptive implementation example

The ongoing colorectal cancer screening program in Yazhou District, initiated in 2025, provides a descriptive example of how several components discussed above may be organized within a regional primary-care setting. The program follows a government-led, hospital-supported, and community-linked model, with four community health centers supporting local implementation, primary-care institutions supporting community-based screening, and Sanya Central Hospital providing technical, referral, and pathology support. Initial screening combines risk assessment with fecal immunochemical testing, while fecal DNA methylation testing is being piloted as a supplementary method; individuals classified as high risk or with positive test results are referred for colonoscopy. The implementation framework also incorporates quality control, data traceability, and closed-loop follow-up across screening, diagnosis, treatment, and follow-up. The local eligibility threshold of 35 years is a program-specific administrative criterion rather than a general screening recommendation. The program is currently being implemented through local primary-care institutions with technical support from Sanya Central Hospital, and the screening, referral, quality-control, and data-management pathways described above have been incorporated into the local implementation framework (Fig. 1). However, no program outcome data are evaluated in this mini review.

Discussion and prospects

Community-based screening reports from Shanghai and Guangzhou illustrate that eligibility criteria, test strategies, and health-system contexts vary across regions.[28,29] The Shanghai program cited here enrolled residents older than 50 years,[15] whereas Yazhou uses a local threshold of 35 years. Such thresholds should be interpreted within their administrative and population contexts rather than generalized as universal screening recommendations. Comparative evaluation should therefore account for differences in population risk, available diagnostic capacity, follow-up, and outcome definitions.

Taken together, the literature indicates that primary-care colorectal cancer screening should be understood as a coordinated continuum rather than a single test. Governance, community engagement, risk stratification, diagnostic capacity, quality assurance, and follow-up must function together to translate screening availability into population benefit. Local implementation examples can illustrate workflow, but effectiveness and transferability require evaluation using predefined process and clinical outcomes.

Screening adherence remains a major implementation challenge. Low perceived susceptibility, uncertainty about benefits, and barriers to fecal testing or colonoscopy can reduce participation. Health Belief Model research among urban Chinese populations identified perceived disease severity, perceived screening benefits, and screening barriers as important determinants of screening behavior.[30] One study found that patients cared for by primary-care physicians who performed flexible sigmoidoscopy were more likely to undergo colorectal cancer screening (OR = 1.73), whereas physician training alone was not significantly associated with uptake.[31] These findings support combining workforce development with patient-centered education, navigation, and reminders.

Limited primary-care endoscopy capacity is another common constraint. A review tracing colorectal cancer screening in China from rural practice to national strategy highlights the long development of implementation models.[32] Regional systems may mitigate capacity gaps through referral networks, mentorship, periodic training, and remote guidance, while noninvasive tests can help prioritize colonoscopy.

At the technical level, noninvasive screening methods provide additional options for primary care screening. Molecular-marker approaches, including fecal DNA methylation testing, may offer practical advantages, but their diagnostic performance, implementation feasibility and cost-effectiveness require evaluation in the intended population before large-scale adoption. Emerging stool RNA and blood-based tests have also shown promise as noninvasive screening approaches.[33,34] The future use of artificial intelligence to support risk assessment and endoscopic image interpretation likewise requires prospective validation. Continued development of regional coordination and whole-process management of "screening-diagnosis-treatment-follow-up" remains an important direction for colorectal cancer prevention and control.

Limitations

This mini review did not use a formal systematic-review protocol or risk-of-bias assessment, and selection bias cannot be excluded. In addition, the cited studies vary in design, screening protocols, eligibility criteria, and follow-up duration, which limits direct comparison across screening approaches and implementation models.

Conclusions

Effective colorectal cancer screening in primary healthcare requires coordinated pathways linking risk assessment and noninvasive screening with timely colonoscopy referral and follow-up. Trained personnel, quality assurance, data management, community engagement, and coordination among primary-care institutions, referral hospitals, and relevant health authorities are important components of regional prevention and control. Further evaluation of screening implementation, clinical outcomes, costs, and applicability across different primary-care settings is needed.

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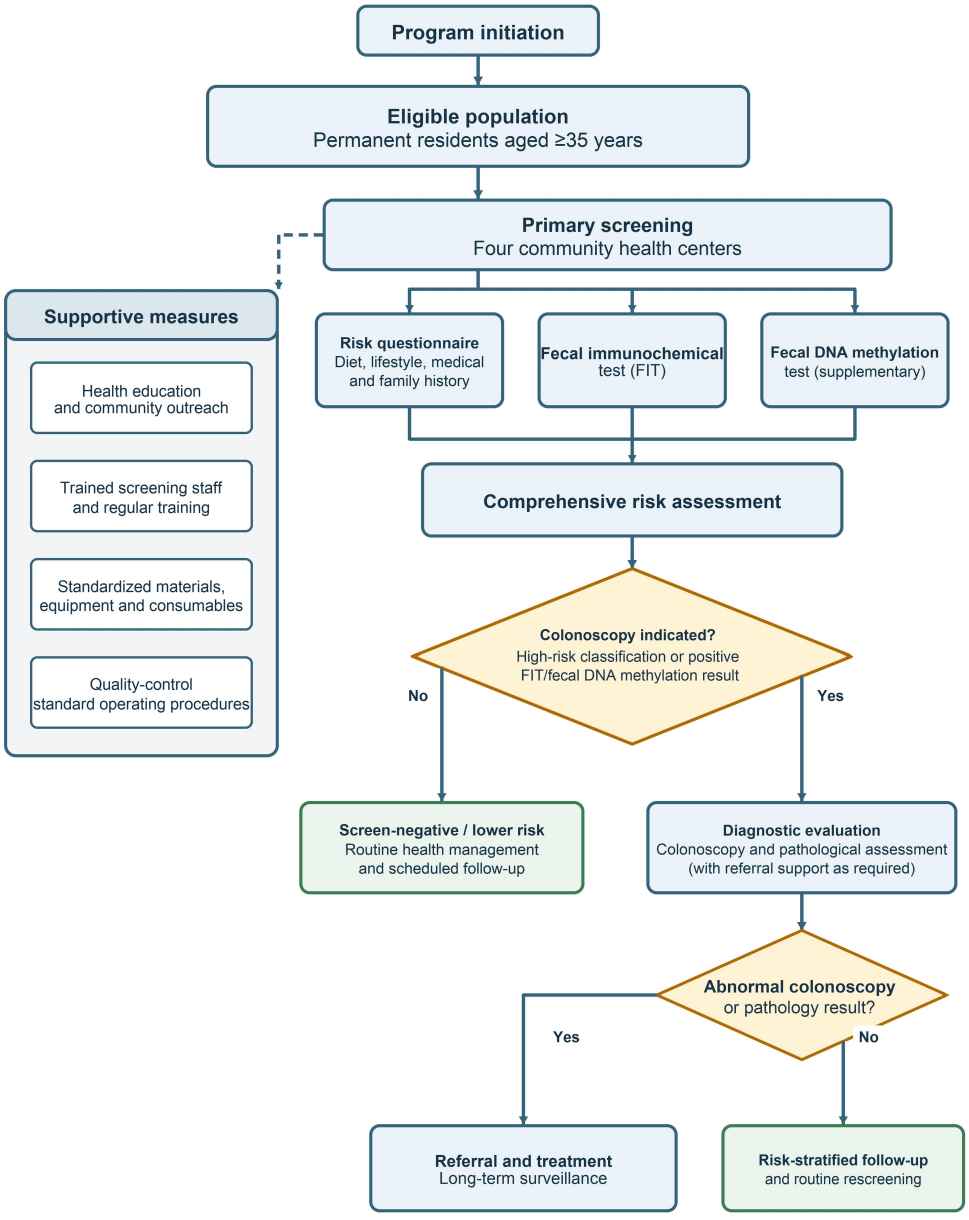

Fig. 1. Screening pathway for the Yazhou District colorectal cancer screening program. FIT, fecal immunochemical test.

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Conflict of interest

The author declares no competing interests.

Author contributions

LG is the sole author of the manuscript.

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