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Eustes Kigongo, Carmel Heaney, Louise McBride, Gabriela Gliga & Richéal M. Burns

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A global scoping review of interventions to increase participation in screening programmes for breast, cervical and colorectal cancer between 2016 and 2025

Authors

Eustes Kigongo[1,2,3], Carmel Heaney[2,4], Louise McBride[2,5], Gabriela Gliga[6] and Richéal M. Burns[1,2*]

Author affiliations

[1]Faculty of Science and Health, Atlantic Technological University, Ash Lane, County Sligo, F91 YW50, Ireland

[2]The Health and Biomedical (HEAL) Research centre, Atlantic Technological University, Ash Lane, County Sligo, F91 YW50, Ireland

[3]Department of Health Policy Planning and Management, Faculty of Public Health, Lira University, P.O Box 1035, Lira City, Uganda.

[4]Department of Nursing, Health Science and Integrated Care, Atlantic Technological University, Westport Road, Castlebar, County Mayo, F23 X853, Ireland

[5]Department of Nursing and Healthcare, Atlantic Technological University, Port Road, Letterkenny, County Donegal, F92 FC93, Ireland

[6]Department of Enterprise and Technology, Atlantic Technological University, Dublin Road, Galway City, H91 T8NW, Ireland

***Corresponding author**

Dr. Richéal Burns, PhD

Ash Lane, County Sligo, F91 YW50, Ireland

Richeal.Burns@atu.ie

+353879223521

Abstract

Background: Implementation of timely and targeted health screening programmes is strongly aligned with the United Nations Sustainable Development Goals (SDGs) in

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promoting prevention, early detection, and timely intervention across populations. However, participation in breast, cervical, and colorectal cancer screening remains suboptimal and inequitable, and is increasingly challenged. This review synthesised global evidence on implementation interventions aimed at increasing screening participation and reducing disparities, to identify gaps that must be addressed to achieve screening targets.

Methods: This scoping review was conducted and reported in accordance with PRISMA-ScR and the Joanna Briggs Institute methodological guidance. The Consolidated Framework for Implementation Research (CFIR) was used to extract and synthesise barriers and facilitators, while the RE-AIM framework for the performance of interventions. We used descriptive quantitative methods and a hybrid (deductive–inductive) thematic analysis to summarise and interpret the evidence.

Results: One hundred ten studies were included and identified ten intervention categories: educational, reminders, self-sampling, outreach, peer education and counselling, quality improvement, promotional messages, patient navigation and tracking, mass media, and multicomponent interventions. Barriers and facilitators to screening participation were assessed using the CFIR framework, while intervention performance was synthesised using RE-AIM components. Although most interventions demonstrated promising effectiveness, multicomponent interventions showed the greatest impact. However, most interventions were implemented in highly controlled settings, limiting their real-world applicability and scalability.

Conclusion: Findings revealed important gaps in culturally responsiveness and real-world intervention approaches for cancer screening. Future research should prioritise pragmatic, culturally appropriate, and multiple component interventions, supported by sufficiently long follow-up periods to assess sustainability and real-world effectiveness.

Keywords: Cancer, Screening, Implementation, Interventions, Strategies, Uptake, Coverage, Equity, Participation, Health

Background

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The global cancer burden is growing. Cancer has a huge social economic burden on families, communities and the government. Currently, cancer deaths are attributed to one in six (16.8%) of the total global deaths and one in four (22.8%) of non-communicable disease (NCD) deaths [1]. The lifetime prevalence of cancer is one in five with more deaths among men compared to women. The current cancer cases are expected to increase by 77% (and reach 35 million) by 2050 and deaths are expected to double. In addition, countries with the high Human Development Index (HDI) are expected to have the highest absolute increase in incidence compared to low HDI countries [1]. According to the World Health Organisation (WHO), breast, cervical and colorectal cancers are among the most prevalent [2]. In 2022, the most common cancers among both sexes across Europe were lung, breast, and colorectal cancers [3]. Although cervical cancer ranked eighth in incidence and ninth in cancer mortality worldwide, it was the leading cancer among women in sub-Saharan Africa [1]. Additionally, cancer causes one in four of all deaths in the European region which reported 4.47 million cases with 2.36 million among males and 2.11 million among females in 2022 [4]. This highlights substantial geographic and population-level disparities in the global cancer burden. These disparities have been attributed to multiple factors including healthcare access, socioeconomic status, screening programmes and influence of public health policies [5,6].

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The growing burden of NCDs and other preventable disease conditions has positioned early detection and prevention as central priorities within the global public health policy. The United Nations adopted the 2030 Agenda for Sustainable Development in September 2015. This agenda established 17 interconnected Sustainable development Goals (SDGs) and 169 targets intended to guide coordinated global action towards improved social, economic and health outcomes by 2030 [7]. Among these, SDG 3 seeks to “ensure healthy lives and promote well-being for all ages,” which specifically emphasises reducing premature mortality from NCDs. Population-based screening programmes are therefore recognised as critical public health interventions as they facilitate identification of disease risk at early and more treatable stages, improve timely access to care, and contribute to universal health coverage.

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Well-organised screening also supports the reduction of health disparities (SDG 10), promotes gender-responsive preventive healthcare (SDG 5), strengthens public health literacy (SDG 4), and fosters multisectoral partnerships for health (SDG 17). Evidence consistently demonstrates that well-organised, evidence-based screening programmes can prevent disease progression, reduce disability, and lower cancer-related mortality [8,9]. Nevertheless, screening participation remains suboptimal across both high-income and low- and middle-income countries, and service disruptions following the COVID-19 pandemic have further exacerbated existing access gaps [10,11]. Recent studies increasingly highlight widening inequalities in screening uptake, particularly among socioeconomically deprived, under-screened, and marginalised populations[12,13]. This suggests that persistent barriers related to health literacy, socioeconomic disadvantage, and demographic vulnerability continue to hinder equitable engagement with preventive health services.

For example, the WHO aims to reduce the incidence of cervical cancer to fewer than 4 cases per 100 000 women-years by 2030, contingent on achieving 70% screening coverage among women by age 35 years and again by age 45 years [14]. However, despite substantial investments in cancer prevention and early detection strategies, current participation levels remain highly variable and, in many settings, far below the target. A recent review across 45 countries reported colorectal cancer screening uptake ranging from 1% in China in 2020 to 79.4% in Finland in 2021, highlighting marketed global disparities [15]. Similarly, evidence from 38 HICs demonstrated persistently suboptimal participation across breast, colorectal and cervical cancer screening programmes in 2023 [16]. Particularly low participation was reported in countries such as Costa Rica (4% for cervical cancer screening), Greece (15% for breast cancer screening), and Hungary (9% for colorectal cancer screening). Available evidence further suggests that screening participation is lowest in LMICs where data remains sparse and screening systems are often poorly organised [17]. Collectively, these findings indicate that existing global targets are unlikely to be achieved under current trajectories, despite implementation of numerous interventions to improve uptake.

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While interventions to improve cancer screening participation have been synthesised in previous reviews, important limitation continue to compromise the applicability of this evidence to contemporary policy and practice. These reviews are characterised by narrow clinical or intervention focus, with many restricted to single cancer types, specific delivery modalities, and selected populations such as migrants, rural residents, or under-screened communities [18–23]. They also show a marked geographic imbalance, with a substantial proportion of evidence originating from HICs, while evidence from LMICs and more diverse health systems remains comparatively underrepresented [21,24–30]. Moreover, many reviews are based on tightly controlled trials, clinic-based evaluations, or highly resourced pilot interventions that may demonstrate efficacy but offer limited insights into real-world effectiveness [19,25,26,30]. Several also dwell on studies conducted before 2016 or prior to the COVID-19 pandemic, thereby insufficiently capturing contemporary barriers to participation spanning social inequalities, digital exclusion, misinformation, and declining public trust of preventive healthcare [18,31]. Therefore, these gaps suggested undertaking comprehensive and real-world applicable syntheses to guide present-day efforts to strengthen cancer screening uptake across diverse populations and implementation contexts.

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This review therefore aimed to provide a comprehensive global synthesis of interventions implemented to improve uptake, coverage and equity of screening for breast, cervical, and colorectal cancer screening, while moving beyond conventional assessments of intervention effectiveness to examine how and why such interventions succeed or fail within real-world health systems. Unlike prior reviews that catalogued intervention types and whether screening participation improved, this review was informed by an implementation science approach combining the Consolidated Framework for Implementation Research (CFIR) and the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework to systematically assess the barriers, facilitators, and implementation outcomes shaping intervention performance. CFIR provides a structured lens for understanding how intervention characteristics, health system contexts, organisational readiness, and

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participant needs influence delivery [32,33]. RE-AIM enables evaluation of the extent to which interventions achieve meaningful population reach, real-world effectiveness, institutional uptake, implementation consistency, and sustainability [34,35]. This integration helped to generate a deeper understanding of persistent implementation bottlenecks and transferable strategies necessary for strengthening cancer screening programmes.

Methods

Design

This was a systematic scoping review conducted following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) extension for scoping reviews. As guided by the Joanna Briggs Institute (JBI) updated methodology, the authors followed the population, concept, context (PCC) framework to formulate the review question and the inclusion and exclusion criteria [36].

Identifying relevant literature

Literature search was conducted across six major electronic databases: MEDLINE (via PubMed), Scopus, Science Direct, Web of Science, Embase and Google Scholar. Additional articles were identified through manual searching of reference lists of included reviews. The primary search strategy was developed in MEDLINE by combining relevant search terms using two Boolean operators (“AND” and “OR”) and performing truncation, and phrase searching. Database-specific thesauri, including the Medical Subject Heading (MeSH) were incorporated into the search strategies where applicable. The search strings were peer-reviewed by a certified university librarian to ensure robustness and comprehensiveness prior to the final search. All retrieved records were imported into the Covidence platform (Veritas Health Innovation, Melbourne, Australia) for screening and data charting. The complete MEDLINE search strategy and the corresponding records retrieved are presented in **Additional File 1**.

Eligibility criteria and article selection

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Based on the PCC framework, the inclusion criteria included studies reporting interventions to improve uptake, coverage, equity and responsiveness of screening programmes for breast, cervical and colorectal cancer for eligible populations. All primary and secondary peer-reviewed articles published between 2016 and 2025 were included. This study period was selected to coincide with the SDGs and current global cancer prevention and control agendas [7,37]. Both primary studies and review articles were eligible for inclusion. Where overlap existed between primary studies and included reviews, each source was treated as a distinct evidence source for mapping purposes; however, duplicate reporting of findings was considered during synthesis to avoid overrepresentation of evidence. However, study protocols and studies not published in English language were excluded because of the limited capacity for translation services. Methodology and correspondence publications were also excluded due to non-rigorous methods. After deduplication, the selection process was conducted at two phases by two reviewers (EK and RB). First were titles and abstracts, then retrieval and selection of full-texts based on felt best-fit. Disagreements arising were resolved by dialogue and discussion with a third reviewer (LM). **Figure 1** shows the selection process.

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Data charting and quality assessment

A data charting tool was developed, piloted, and refined to capture study characteristics and implementation-related data items aligned with the review question. The charting process was explicitly guided by the CFIR and RE-AIM frameworks, which were operationalised as predefined extraction domains. Application of the CFIR facilitated the identification of contextual factors influencing the implementation and uptake of cancer screening interventions across diverse populations, healthcare systems, and community settings. This was according to the five CFIR domains: innovation (the “thing” being implemented), outer setting influences (such as policy and community factors), inner factors (including organisational readiness and health systems capacity), individuals (the characteristics of implementers and target populations), and implementation process (the methods and strategies used for implementation) [32]. RE-AIM framework was used to chart

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implementation outcomes related to interventions designed to enhance participation in cancer screening programmes across the five framework domains: reach (population groups engaged and screening participation achieved), effectiveness (reported changes in the desired outcomes), adoption (extent of uptake by providers, organisations, and health systems), implementation (fidelity, delivery approaches, resource requirements, and implementation challenges), and maintenance (evidence of sustainability, continuation, or integration into routine practice) [34]. These predefined domains enabled structured and systematic extraction of both intervention effectiveness and real-world implementation performance across included studies. Data charting was conducted independently by two reviewers (EK and RB), with regular comparison meetings held to review consistency, and resolve discrepancies. Where disagreements persisted, a third reviewer (LM) was consulted. In keeping with scoping review methodology, formal quality assessment of included studies was not undertaken to allow for inclusion and mapping of the full breadth of relevant literature [36].

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Collation, summarising and reporting

This review utilised descriptive quantitative analysis and a hybrid approach to thematic analysis. Quantitative summarisation was performed on key study variables and presented in appropriate tables and graphs. Frequencies, proportions and trends were reported. Qualitatively, overarching themes were identified deductively following originally developed themes and additional themes inductively from increasing familiarisation with data [38]. The final naming, organisation and presentation of findings was guided by the CFIR and RE-AIM frameworks. Review data is attached as **Additional File 2.**

Results

The identification process yielded 4728 references **(Figure 1)**. Deduplication left 4078 references, and after the first phase of screening, 3857 were excluded. A total of 221 records were retrieved and assessed as full texts. Of these, 58 reported on a different outcome, 10

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different publication type, 36 different publication timeline, and seven for other reasons. The final review included 110 studies.

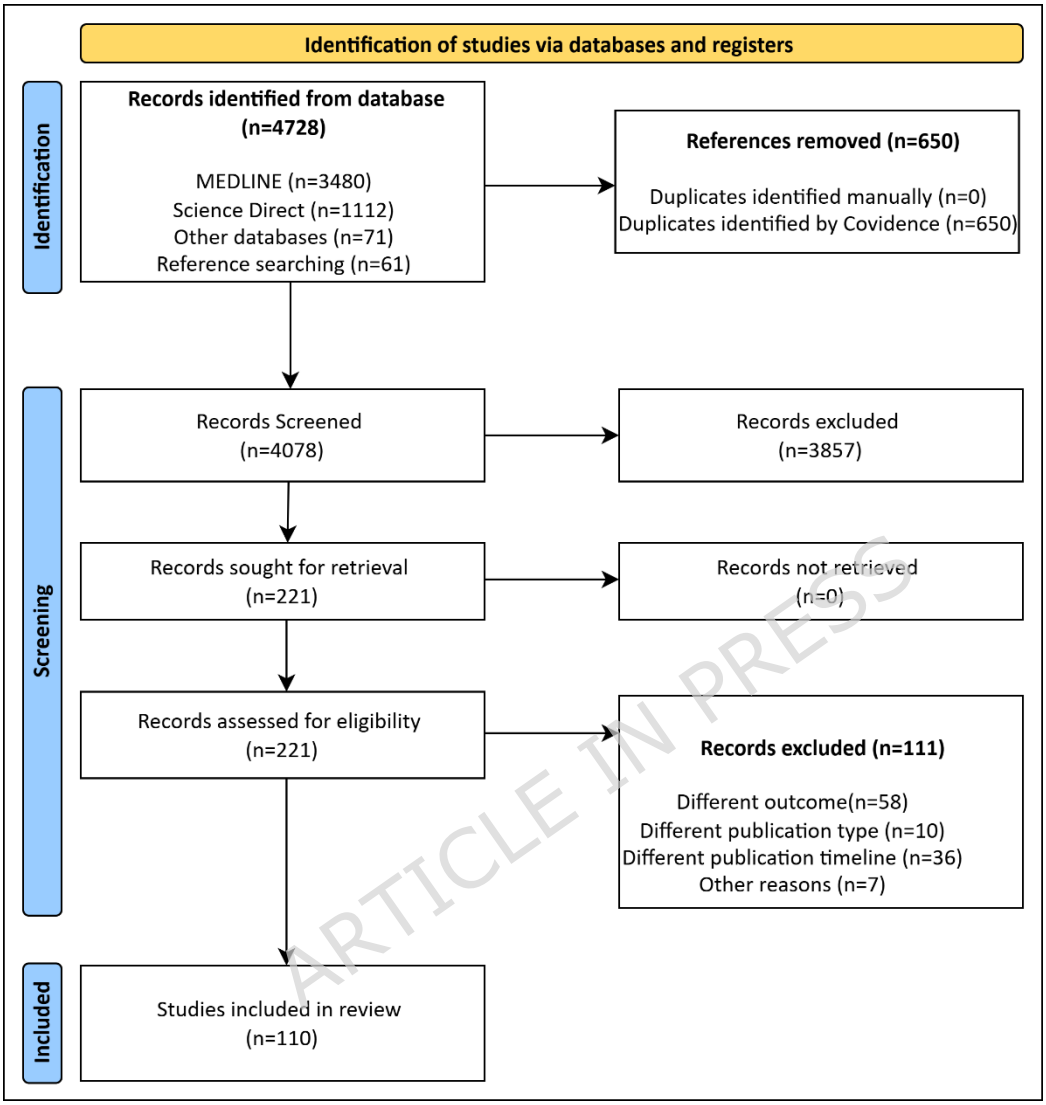


Figure 1: *PRISMA diagram showing the selection process.*

Characteristics of included studies

Table 1 shows that randomised controlled trials were the most common studies (n=50, 45.5%), targeted cervical cancer (n=42, 38.2%), and conducted in the general population samples (n=46, 41.8%). More than half of the studies were published in the region of Americas (n=57, 51.8%) followed by Europe (n=15, 13.6%). Majority of the studies (n=21, 19.1%) were published in 2018, and two studies in 2025 (n=2, 1.8%).

Table 1: *Characteristics of included studies.*

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Characteristic	Studies (n=110)
Nature of study	
RCT	50(45.5%)
Non-RCT	23(20.9%)
Reviews	9(8.2%)
Prevalence	9(8.2%)
Other	11(10.0%)
Qualitative	4(3.6%)
Cohort	2(1.8%)
Mixed methods	2(1.8%)
Disease condition	
Cervical cancer	42(38.2%)
Bowel cancer	28(25.5%)
Breast cancer	27(24.5%)
Breast, Bowel and Cervical cancer	9(8.2%)
Breast and Cervical cancer	3(2.7%)
Breast and Bowel cancer	1(0.9%)
Population category	
General population	46(41.8%)
Minority population	27(24.5%)
Special population	22(20.0%)
WHO regions	
America	57(51.8%)
Europe	15(13.6%)
South and East Asia	24(21.8%)
Africa	6(5.5%)
Multiple	5(4.5%)
Western pacific	3(2.7%)
Publication timeline	
2016	13(11.8%)
2017	12(10.9%)
2018	21(19.1%)
2019	10(9.1%)
2020	13(11.8%)
2021	10(9.1%)
2022	9(8.2%)
2023	9(8.2%)
2024	11(10.0%)
2025	2(1.8%)

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Intervention categories

Following a deductive approach, four original themes including communication (n=31), education and training (n=34), policy change or modification (n=27), and theory-based interventions (n=3) were identified prior to evidence synthesis. Four original themes were

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identified from preliminary review of a few studies, however, following inductive coding and gathering of themes, 10 different categories of interventions were mapped alongside different populations. **Figure 2** shows a summary of syntheses incorporating the CFIR and RE-AIM framework components.

Educational interventions primarily targeted knowledge, awareness, and attitudinal barriers using brochures, educational videos, lectures, and tailored information materials, with several interventions drawing on behavioural theories such as the Theory of Planned Behaviour [39–59]. Invitation reminder interventions employed short message service (SMS) texts, voice calls, mailed letters, and electronic mail reminders, with some integrating educational content or direct links to screening information and booking systems [60–76]. Self-sample collection interventions sought to improve convenience and privacy by mailing screening kits to participants' homes with instructions for use or by providing designated self-sampling spaces within health facilities [77–92].

Peer education and counselling interventions involved one-to-one or group-based engagement facilitated by healthcare professionals, trained adolescents, lay health educators, or model clients through face-to-face, telephone, or video-based interactions [93–102]. Promotion-focused interventions utilised social media campaigns, healthcare worker recommendations, celebrity endorsements, and financial incentives to encourage screening participation [103–110]. Community outreach interventions aimed to improve accessibility through mobile clinics, community pharmacies, opportunistic screening services, and outreach activities conducted in traveller lodging facilities [111–120]. Patient navigation and tracking interventions involved manual or web-based review of health facility records to identify non-adherent individuals, followed by personalised follow-up, screening recommendations, and appointment scheduling support [121–124].

Quality improvement and capacity strengthening interventions focused on optimising service delivery through operational improvement strategies including workforce training, workflow redesign, patient engagement activities, case management systems, eligibility screening,

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outreach coordination, infrastructure strengthening, and multidisciplinary team meetings [125–135]. Mass media and culturally tailored interventions employed television and online advertising, interactive kiosks, education through entertainment such as drama and video content, and expert interviews delivered in local dialects to address communication barriers and improve population reach [136–140]. Multiple-component interventions combined several approaches either within a single intervention domain, such as integrated SMS, voice call, and email reminders, or across domains through combinations of educational, navigational, counselling, and reminder-based strategies [141–148].

Implementation determinants and contextual influences

Innovation characteristics: Different interventions adopted specific characteristics that strongly influenced the acceptability and feasibility of the intervention itself. For instance, cervical and bowel self-sampling was consistently viewed as convenient, adaptable, and privacy-enhancing for clients experiencing sociocultural discomfort with facility-based screening [77,80]. Moreover, emailed sampling kits reduced travel burden, waiting times, and procedural barriers, thereby improving accessibility and participation [79,89,90]. However, some studies reported concerns regarding complexity of sample collection procedures, limited confidence in self-administration, and uncertainty regarding result interpretation. Digital reminder systems and mobile health interventions were valued for their flexibility and scalability, although technological access, digital literacy, and cost-related constraints affected implementation in some settings [60,62,114]. Multiple-component interventions demonstrated greater adaptability to local needs but were often resource intensive and operationally complex to coordinate and sustain [144,145].

Outer setting: This synthesis demonstrated that the success of intervention implementation is often shaped by external contextual factors. The sociocultural beliefs, stigma, fear of cancer diagnosis, gender norms, and misconceptions regarding screening procedures influenced willingness to participate in screening programmes [97,101,102]. Misinformation and low trust in healthcare systems emerged as important barriers, especially where

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communities relied heavily on informal information sources or social media [47,50,52,55]. In addition, structural inequities including transportation barriers, geographic inaccessibility, financial hardship, and limited health insurance coverage further constrained participation among underserved populations [114–116]. Conversely, policy support, organised national screening programmes, and community partnerships facilitated wider implementation reach and improved continuity of screening services [128,132].

Inner setting: Several community, organisational and health system characteristics influenced the implementation success. Within health facilities, workforce shortages, inadequate infrastructure, fragmented referral pathways, and competing clinical priorities limited the capacity to sustain screening activities [125,126,132]. In addition, workflow inefficiencies, poor coordination between departments, and limited data management systems contributed to missed follow-up opportunities and low continuity of care [123,124,132]. In contrast, interventions integrated into existing clinical workflows, supported by leadership engagement, staff training, and multidisciplinary collaboration, demonstrated improved feasibility and operational performance [128,132]. Quality improvement initiatives further highlighted the importance of organisational readiness, resource availability, and continuous performance monitoring in strengthening screening delivery.

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Individual characteristics: Individual-level determinants including awareness, motivation, trust, literacy, and perceived susceptibility to cancer significantly influenced engagement with screening interventions. Educational and counselling interventions frequently improved knowledge and awareness [39,40,43,53]. However, increased knowledge alone did not consistently translate into screening uptake where fear, embarrassment, fatalistic beliefs, or distrust remained unaddressed [41,42,44,46]. Peer educators, community health workers, and culturally tailored communication approaches were particularly effective in improving confidence, motivation, and trust among under-screened and minority populations [101,137,140]. Furthermore, health literacy limitations and language barriers also reduced

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comprehension of screening information and hindered informed participation in some settings [50,138,140].

Implementation process: Successful implementation commonly involved active stakeholder engagement, community participation, and tailored delivery strategies. Interventions incorporating peer educators, patient navigators, healthcare worker engagement, and community outreach demonstrated greater acceptability and responsiveness to local needs [116,121,122]. Reminder systems, personalised follow-up, and co-designed educational approaches improved participant engagement and facilitated continuity across screening pathways [55,64,67]. Several studies emphasised the importance of collaboration between healthcare providers, community organisations, and policymakers in supporting implementation sustainability [108,125,126]. Nonetheless, inconsistent stakeholder involvement, limited coordination, and insufficient long-term implementation planning were identified as barriers to maintaining intervention effectiveness over time.

Implementation outcomes

Reach: Several interventions demonstrated substantial potential for improving reach among underserved, non-adherent, and geographically isolated populations. Community outreach services, mobile clinics, peer education, culturally tailored education, and self-sampling approaches were particularly effective in extending screening opportunities to populations experiencing structural, sociocultural, and accessibility barriers [93,99,111,112]. Self-sampling interventions improved participation among women overdue for cervical cancer screening and individuals reluctant to attend facility-based services due to privacy concerns, stigma, or transportation difficulties [79,89,90]. Community-based interventions delivered through pharmacies, outreach clinics, and lay health educators also enhanced engagement among rural populations, migrants, and minority groups [114,115]. However, some digitally delivered interventions were limited by unequal access to mobile technologies, internet connectivity, and digital literacy, potentially restricting reach among socioeconomically disadvantaged populations [104,105,109].

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Effectiveness: Most interventions demonstrated some level of effectiveness in improving screening-related outcomes, although the magnitude and consistency of effects varied across intervention categories and cancer types. A recommendation from a healthcare provider was highly linked to increased screening participation [90]. Invitation reminders delivered through SMS messages, phone calls, mailed letters, and electronic communication generally improved appointment attendance, adherence to screening schedules, and overall participation rates [60,64,70]. However, the absence of two-way communication limited the success of reminders [61]. Self-sampling interventions showed promising effectiveness, particularly for cervical and colorectal cancer screening among previously under-screened populations [78,80,82]. Multiple-component interventions demonstrated the most consistent improvements in screening participation, largely due to their ability to address barriers across several levels simultaneously [144,145]. In contrast, standalone promotion campaigns and some mass media interventions produced mixed and inconclusive effects on screening uptake [105,106,139].

Adoption: Adoption of interventions by healthcare providers and organisations varied according to intervention complexity, resource requirements, and compatibility with existing workflows. Reminder systems, educational interventions, and patient navigation approaches were generally well accepted because they could be integrated into routine screening practices with relatively minimal disruption [60,62,122]. Community outreach and mobile screening initiatives were also positively received where partnerships existed between healthcare providers and community organisations [113,115,116]. In contrast, interventions requiring substantial technological infrastructure, specialised workforce capacity, or intensive operational coordination experienced more limited organisational uptake, particularly in resource-constrained settings [123,138]. Quality improvement and capacity-strengthening interventions demonstrated stronger adoption where leadership support, staff engagement, and multidisciplinary collaboration were present [126,128].

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Implementation: Implementation outcomes highlighted several facilitators and barriers affecting intervention fidelity, feasibility, and scalability. Interventions that were simple, adaptable, and culturally appropriate were more feasible to implement across diverse settings. Self-sampling and reminder systems benefited from operational simplicity and flexibility [77,85], while peer education and patient navigation approaches improved participant engagement through personalised support [97,101]. However, implementation challenges included workforce shortages, limited funding, inadequate infrastructure, workflow inefficiencies, poor interoperability of health information systems, and difficulties maintaining participant follow-up. Some interventions also experienced reduced effectiveness where communication strategies lacked cultural tailoring or opportunities for two-way interaction [61]. Multiple-component interventions demonstrated stronger implementation performance overall but frequently required greater coordination, staffing, and financial resources [144,145].

Maintenance: Evidence regarding long-term maintenance and sustainability of interventions was comparatively limited across the included studies. Nevertheless, interventions integrated into existing health system structures, such as reminder systems embedded within routine care, patient navigation have greater potential for sustainability [60,124]. Community partnerships were also identified as important facilitators of continued implementation [128]. In contrast, resource-intensive interventions, externally funded pilot programmes, and interventions dependent on short-term project support frequently lacked evidence of long-term continuation or scale-up beyond the study period [123,138]. Overall, sustainability of cancer screening interventions depends not only on intervention effectiveness, but also on health system readiness, implementation capacity, and ongoing institutional support.

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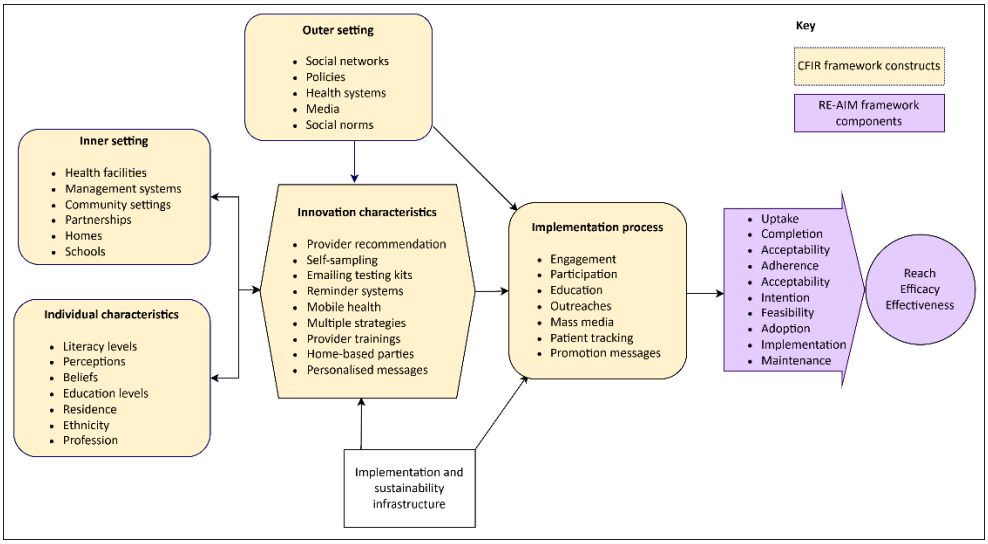


Figure 2: *Summary of interventions synthesis (modified by the researcher from original frameworks).*

Differences across cancer types

During the syntheses, important differences were observed across breast, cervical, and colorectal cancer screening interventions in relation to implementation barriers and facilitators, and intervention success. Across all programmes, multiple-component interventions demonstrated greater effectiveness than single-strategy approaches because they addressed barriers operating simultaneously at individual, organisational, and community levels [144,145]. In addition, reminder invitations were relevant for all screening programmes.

Cervical cancer screening interventions most frequently emphasised self-sampling approaches, which demonstrated considerable promise for improving participation among under-screened women by addressing privacy concerns, embarrassment, fear of facility-based procedures, and sociocultural barriers associated with clinician-administered screening [80,88]. Tailored education and peer-support were also particularly relevant in cervical cancer screening due to persistent stigma, misconceptions, and low awareness in some populations [95,100]. In colorectal cancer screening, mailed faecal immunochemical test (FIT) kits, and patient navigation approaches were among the most effective strategies

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for improving participation and adherence to screening schedules [78]. However, maintaining adherence to repeat or follow-up screening remained a persistent challenge, particularly where communication systems and continuity of care were weak. Breast cancer screening interventions more commonly focused on improving physical accessibility through community outreach programmes, mobile mammography services, and opportunistic screening initiatives, reflecting the logistical and infrastructural barriers associated with facility-based imaging services [115,116].

Geographical distribution of interventions

Figure 3 is a Heatmap showing the distribution of intervention categories across the global regions. It illustrates a marked geographical imbalance in intervention evidence base with North America contributing most of the evidence across nearly all intervention categories. Europe showed strong representation in sample self-collection and, peer education and counselling. The African region showed educational, reminders and promotional message interventions. The Pacific and South America have very limited evidence.

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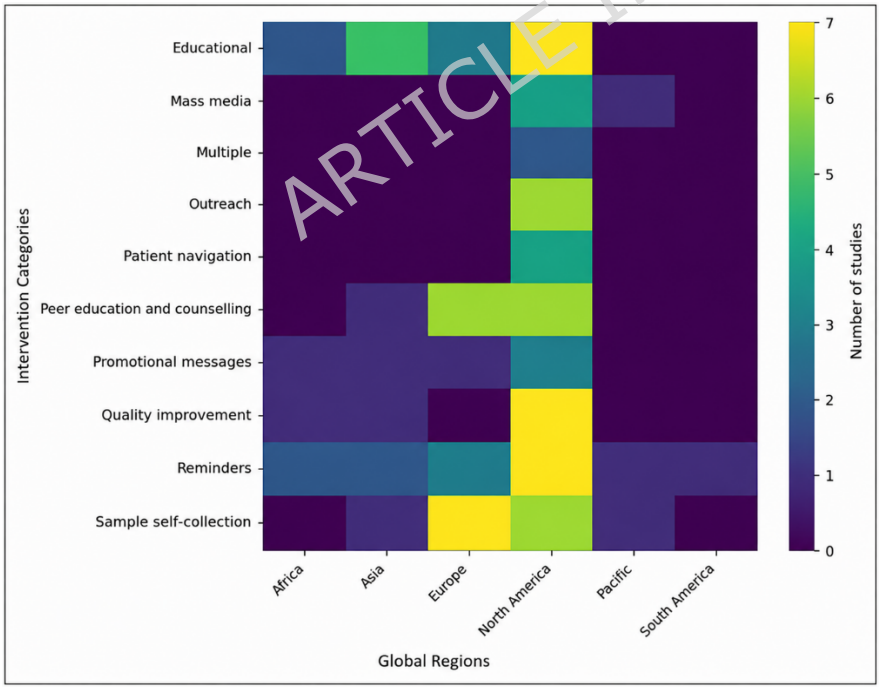


Figure 3: *Heatmap showing distribution of intervention categories across global regions.*

Gaps for future research

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Several important gaps were identified. Evidence was geographically skewed, with most studies conducted in high-income settings, yet even within these regions some countries lacked sufficient data to inform decision-making. For example, the Republic of Ireland has a paucity of current evidence to guide cancer prevention efforts, despite having the third highest age-standardised cancer burden in Europe [4]. The literature further showed inconsistent and sometimes contradictory findings. For instance, some studies reported reminder interventions to be effective, others did not, and many interventions were evaluated in only a small number of studies, limiting the strength of conclusions. Although such variability may reflect differences in context or methodological quality, a major gap remains in identifying which interventions reliably improve cancer screening participation. Moreover, most interventions were tested in highly controlled research settings, creating a knowledge-to-practice gap and highlighting the need for approaches that are feasible, pragmatic, and scalable in routine healthcare systems. While controlled environments improve internal validity, they may limit the generalizability and sustainability of interventions in diverse real-world contexts. Future studies should therefore prioritize pragmatic trial designs and implementation-focused approaches such as PRECIS-2 [149], to reflect routine practice and support translation into policy and practice. Finally, although several interventions have been recommended, they cannot be assumed to be transferable across settings. Moreover, most studies included in this review had short follow up periods. Health systems differ widely in governance, population dispersion challenges, resources, and capacity, indicating that locally appropriate and context-specific solutions are essential.

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Discussion

The study identified a range of interventions aimed at improving breast, cervical, and colorectal cancer screening programme engagement. These interventions showed varying levels of efficacy and effectiveness on improving awareness, knowledge, attitudes, perceptions, intention to screen, and actual screening uptake. They drew on diverse behaviour change theories, educational approaches, and implementation strategies, and

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were tested across different settings. The target populations were also wide-ranging, including healthcare workers, adolescents, parents and guardians, the general population, and more specific groups defined by demographic or social characteristics, such as rural women, professionals like teachers, and disadvantaged populations, including migrants.

Most educational and communication interventions were necessary to improve knowledge and attitudes towards screening, but not sufficient to increase eventual screening participation. Drawing from different behaviour change models such as Behavioural and Social Determinants (BeSD) framework and Health Belief Model (HBM), there are several practical issues such as ease of access, availability and affordability, respect from healthcare professionals and several cues to action that mediate or moderate behaviour change [150,151]. Education and communication are important components of improving screening participation; however, evidence suggests that sustainably increasing uptake also requires addressing barriers at multiple levels of the health system. Studies have shown that while informational interventions can raise awareness, multi-level strategies that integrate system-wide policies, organizational support, and tailored outreach are essential for improving and sustaining screening participation across diverse populations [152–155].

Across all intervention groups, a recommendation from a healthcare worker was strongly associated with higher screening participation, consistent with findings from multiple prior studies [156,157]. Over the past decade, misinformation fuelled by negative beliefs, conspiracy narratives, and unverified causal claims has increasingly undermined confidence in public health programmes, a trend that has intensified since the emergence of COVID-19 [158–160]. In this context, healthcare workers remain among the most trusted sources of health information within communities [156]. Their recommendations, often delivered through direct interpersonal communication, provide reassurance regarding the safety, legitimacy, and benefits of screening programmes. By actively addressing myths, misconceptions, and fears, healthcare workers play a critical role in counteracting misinformation and strengthening community engagement with screening services.

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Although the evidence for outreach interventions remains limited and, in some cases, inconclusive, approaches that actively engaged communities and multiple stakeholder groups were consistently more acceptable and showed promising results. Community engagement and partnership are central to improving the uptake and sustainability of public health programmes and are increasingly recognised as core principles of effective health system strengthening. These approaches align closely with global health priorities, including the WHO strategy to eliminate cervical cancer as a public health problem by 2030 [14,161,162]. By fostering local ownership, trust, and shared responsibility, community-engaged interventions are more likely to generate durable changes in health-seeking behaviour and programme performance. Similarly, a growing body of literature supports the role of community participation and multisectoral partnerships in accelerating progress towards global health targets and reducing persistent inequities in service coverage [163,164].

Interventions that combined multiple approaches were consistently reported to be more effective than single-component strategies. This likely reflects their ability to address multiple gaps across the health system simultaneously, rather than targeting isolated barriers. Such multicomponent interventions align with systems-thinking frameworks, which conceptualise health outcomes as the product of interacting social, behavioural, and structural determinants and emphasise the need for integrated responses that address root causes to achieve sustainable change [165]. Evidence from both single- and multicomponent intervention studies supports this perspective [78,121,144]. However, many studies also highlight the importance of disentangling the contributions of individual components to overall effectiveness, as well as the need for longer follow-up periods to assess durability and sustainability of impact.

Findings also show that quality improvement interventions led to identification and redress of health facility gaps in efficient delivery of screening services. Quality improvement at operational level is a low-cost, highly effective approach that was associated with improved screening participation. This is attributed to the alternative strategies such as workflow

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changes, staff capacity strengthening and infrastructure development which address practical gaps such as long waiting time and healthcare professional attitudes. Our findings concur with a wide body of literature that has highlighted several health system disruptions since the COVID-19 emergency [166]. Therefore, operational research is recommended to identify and address existing gaps within health facilities and enhance efficiency and optimise service delivery.

Strengths and limitations

This scoping review included evidence from both HICs and LMICs, affording a broader global perspective. However, most of the included studies originated from the Region of the Americas, which may limit the generalisability of the findings to low- and middle-income settings. Secondly, although the review covered literature published between 2016 and 2025, this time frame was considered appropriate given the rapidly evolving landscape of disease burden, screening technologies, and health system reforms. In addition, this period aligns with the implementation of the 2015 United Nations SDGs and other contemporary global health frameworks [7,37], enhancing the policy relevance of the findings. Thirdly, only peer-reviewed studies were included. While scoping reviews typically aim to capture a wide range of evidence and do not usually exclude studies based on quality, this approach may have led to the exclusion of relevant grey literature and ongoing interventions. Nevertheless, prioritising peer-reviewed evidence ensured that the included studies met minimum methodological standards, thereby strengthening the reliability of the conclusions for informing policy, practice, and future high-quality research. Finally, the review was limited to databases accessible to the researchers, which may have introduced selection bias by excluding potentially relevant studies indexed elsewhere. Despite this limitation, the review identified a sufficiently large and diverse body of evidence to support robust scientific conclusions and meaningful recommendations.

Conclusion

While numerous interventions have been implemented to improve cancer screening, this review highlights important gaps, including a skewed distribution of empirical evidence,

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limited use of rigorous implementation research methods, and contradictory or inconsistent findings across studies. Findings revealed important gaps in culturally responsiveness and real-world intervention approaches for cancer screening. Future research should prioritise pragmatic, culturally appropriate, and multiple component interventions, supported by sufficiently long follow-up periods to assess sustainability and real-world effectiveness. Multiple component interventions that engage communities in the design and implementations and embedding a quality improvement framework have great potential to address practical and structural challenges and improve screening uptake even across resource-constrained and vulnerable health settings.

Supplementary Information

Search strategy (**Additional File 1)**

Review data (**Additional File 2)**

PRISMA-ScR checklist (**Additional File 3)**

List of abbreviations

CFIR: Consolidated Framework of Implementation Research

COVID-19: Coronavirus Disease 2019

FIT: Faecal Immunochemical Test

GLOBOCAN: Global Cancer Observatory (cancer statistics database)

HDI: Human Development Index

IEC: Information, Education and Communication

LHE: Lay Health Educator

LMICs: Low- and Middle-Income Countries

NCD: Non-Communicable Disease

PCC: Population, Concept, Context

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses

PRISMA-ScR: PRISMA Extension for Scoping Reviews

RE-AIM: Reach, Effectiveness, Adoption, Implementation, Maintenance

SDGs: Sustainable Development Goals

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SMS: Short Message Service

UN: United Nations

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

The study used publicly available, peer-reviewed data which did not require ethics approval. No primary data was collected. However, the review was performed and reported in accordance with the PRSIMA-ScR checklist (**Supplementary File 3**).

Consent for publication

Not applicable.

Availability of data and materials

All data is available as supplementary material for this submission. The protocol is also available from the corresponding author upon a reasonable request inwriting.

Competing interest

The authors declare no competing interests.

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Authors' contributors

EK generated the idea. EK, RB, CH and LM designed the study and reviewed the literature. EK and RB participated in data analysis and writing the original manuscript. RB, CH, GG and LM made critical scientific contributions and reviewed the manuscript. All authors approved the final manuscript.

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