A Systematic Review of Implementation Science Frameworks in Cancer Prevention Interventions: An Exploratory Health Disparities Analysis

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Abstract

Background: A growing number of studies have used implementation science (IS) frameworks, such as RE-AIM, to inform and evaluate the implementation of evidence-based cancer prevention services (e.g., cancer screening); however, the impact of such applications is not well understood, including whether the use of an IS framework can lead to reductions in health disparities. The purpose of this systematic review is to explore how IS frameworks can guide adaptations to cancer prevention services to specifically address health disparities.

Methods: This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and registered with PROSPERO. Searches were conducted in Ovid MEDLINE, PubMed, PsycINFO, CINAHL, and EMBASE. Search strategies used a combination of terms related to implementation science frameworks, cancer prevention, and/or intervention. All searches were conducted between January to May 2020. The QATSDD tool was used to assess the quality of studies included in the review.

Results: A total of 1,025 titles and abstracts were screened, and 84 were deemed eligible for full-text screening. After full-text screening, n=27 articles were included for data abstraction and synthesis. Of the 27 studies that were included, an overwhelming majority (n=19, 70.3%) were based in the United States, utilized mixed-methods (n=12, 44.4%), focused only on a single cancer site (n=21, 81.5%), and took place in a health system (n=18, 66.7%). Approximately half of the studies (n=13, 48.2%) used an IS framework for post-implementation evaluation. Most notably, only one-third of studies (n=9, 33.3%) used an IS framework to address cancer-related health disparities. Of those nine studies, six (66.7%) of them used the Consolidated Framework for Implementation Research (CFIR). Other IS frameworks that were used to inform a health disparities adaptation were Diffusion of Innovations, Knowledge-To-Action, and RE-AIM. Most studies were at moderate risk of bias (n=19, 70.4%).

Conclusion: Across the various cancer prevention studies that have been implemented, CFIR has been the dominant IS framework used to address health disparities. The application of such frameworks, however, has been used in pre-implementation and planning studies. It remains to be seen if IS frameworks used within a health disparities context in cancer prevention interventions can reduce cancer-related outcomes.

Trial registration: PROSPERO CRD42020171970

Contributions To The Literature

- This novel systematic review consolidates the literature on studies that have used implementation science (IS) frameworks to inform and guide the design or delivery of cancer prevention interventions, including addressing cancer-related health disparities.
- These findings support an emergent gap that the uptake and application of IS frameworks remain limited in the field of cancer prevention.
- When IS frameworks were applied to adapt and inform adaptations to an intervention targeted at a population with a documented cancer-related disparity, these adaptations were commonly planned in advance and primarily by the core research team. Potential avenues to engage and expand more stakeholders in the pre-implementation process need to be further explored.

Background

Significant advances in research and healthcare services have been made to curb cancer mortality in the United States; however, population groups from disadvantaged racial/ethnic, sex, gender, age, and socioeconomic backgrounds have minimally benefitted from these advances [1]. Consequently, cancer disparities between more- and less-advantaged population groups have continued to widen. According to the National Cancer Institute Surveillance, Epidemiology and End Results Program, between 2014–2018 African-Americans had the highest cancer death rates across all racial/ethnic groups at 177.5 deaths per 100,000 people compared to 156.3 deaths per 100,000 people in White Americans [2]. Many of these cancers are preventable, yet disadvantaged populations bear a disproportionate burden of cancer deaths. Reducing these cancer inequities will require researchers and healthcare practitioners to prioritize the design and implementation of evidence-based cancer preventions targeting health disparities [3].

Research on cancer prevention has led to the development of numerous evidence-based interventions (EBIs) (e.g., screening practices and programs, vaccination recommendations) [4, 5]. However, many cancer prevention EBIs are never fully implemented or failed to be scaled-up [6, 7]. Challenges associated with implementing these EBIs often include difficulties on the part of researchers and practitioners in understanding and identifying EBIs, limited planning strategies (e.g., use of a pre-implementation theory or framework) to enhance their delivery, and problems adapting existing EBIs for new settings and populations. Recently, researchers within the cancer care continuum have been calling for increased recognition and application of implementation science (IS) to illuminate and address some of these implementation challenges [1].

Theories, models, and frameworks are becomingly recognized as critical instruments to the mission of IS [8]. When selected intently and appropriately, a model or framework can significantly improve an IS study. Models provide a systematic structure for developing, managing, and evaluating implementation efforts, linking study aims, design, measures, and analytic strategies [9, 10]. Implementation frameworks can also help narrow the scope of a study by assisting with the focus of the research question and guiding the selection of constructs to measure. Framing a study within an IS model can also help explain why an EBI works or does not work in its chosen context. In this way, theoretical applications can help on the front-end to organize and understand phenomenon and on the back-end to understand why/how implementation strategies succeed or fail [11, 12].

However, current IS frameworks include little guidance on how to adapt an intervention to different disadvantaged groups to address health disparities [13, 14]. Adaptations, defined as intentional change(s) to the design or delivery of an intervention to facilitate effectiveness or contextual fit [15], may positively impact cancer prevention and implementation outcomes in populations affected by health disparities [3, 16, 17]. For example, as shown in several pilot studies with the Somali community in Minnesota, culturally-tailored cancer-prevention efforts can increase motivation to participate in cancer screening [18,

19]. Yet, little research exists on whether the specific tailoring or adaptations identified and implemented through IS frameworks in cancer prevention EBIs can lead to any significant reduction in cancer-related disparities. Discussions on how IS frameworks can address health inequities have only recently emerged within both national and global health contexts [20]. Central to these conversations is how to appropriately identify and adapt evidence-based practices to the context, culture, and acceptance levels of key stakeholders (implementing organizations, intended program recipients) [14, 21–23]. The primary aim of this review is to characterize the state of how IS frameworks have been used across the implementation continuum within cancer prevention studies globally. The exploratory aim is to examine how a subset of these studies may have used IS frameworks to address or adapt intervention designs to fit within the context of a population(s) experiencing cancer-related health disparities.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [24] (see Supplementary Material Tables 1 and 2 for completed checklists) and registered with PROSPERO (CRD42020171970) [25]. Studies were identified through searches from five bibliographic databases: (1) Ovid MEDLINE; (2) PubMed; (3) PsycINFO; (4) CINAHL; and (5) EMBASE.

Table 1
Characteristics of studies included in this review (n = 27)^a

Study Sample			Study Characteristics						
Author	Age	Race/Ethnicity	Sex	Study Location	Study Design	Study Dates	N	Type of Cancer/ Cancer Site	Intervention Description
Arrossi, 2019 [34]	30–65+	Argentinian	F	Argentina	Retrospective cohort study, Quantitative (EHR)	2012–2014	N = 49,565	Cervical	To increase based testing in Argentina
Arrossi, 2017 [33]	30+ (patient sample)	Argentinian	F	Argentina	Mixed-Methods (self-administered surveys, EHR, & content analysis)	2014–2015	N = 2,983 (patients) N = 368 (CHWs)	Cervical	To scale up testing and testing in Argentina through community health workers home visits
Baldwin, 2020 [66]	NR	NR	NR	US	Qualitative (field notes, interviews)	2017	N = 10	Colorectal	Health plan implemented mailed FIT for Medicaid eligible Medicaid enrollees.
Cole, 2015 [47]	NR	NR	M, F	US	Qualitative (interviews)	2014	13 (2 M, 11 F)	Colorectal	To increase cancer screening rates through a FQHC to centralize health care
Coronado, 2017 [67]	NR	NR	NR	US	Qualitative (interviews)	2015	N = 61	Colorectal	EMR-level automate FIT program to increase colorectal screening community center clinics
DeGroff, 2019 [45]	50–64 (patient sample)	African American/Black American Indian/AN Asian Native Hawaiian/Pacific-Islander White	M, F (patient sample)	US	Mixed-Methods (survey, content analysis, interviews)	2012–2014	N = 443 (patients, quantitative) N = 27 (staff/stakeholders, qualitative)	Colorectal	To provide screening support services through patient navigator

^a N, sample size; ^b Health system-based vs. community-based, or both; NR, not reported; EHR, electronic health record; RCT, randomized controlled trial; EMR, electronic medical record; CHWs, community health workers; SFH, smoke-free home; HPV, human papilloma virus; FIT, fecal immunochemical test; FQHC, federally qualified health center; CDS, clinical decision support; EBPs, evidence-based programs; EBIs, evidence-based interventions; CHA, community health advisor; HCC, hepatocellular carcinoma

Study Sample			Study Characteristics						
Duffy, 2016 [68]	47.9 (patient sample, avg)	African American/Black White Hispanic Non-Hispanic Other	M, F (patient sample)	US	Mixed-methods (EMR, survey, interview), Pre-Post design	2011–2013	N = 1,345 (pre-intervention sample) N = 375 (intervention, control) N = 849 (post-intervention sample) N = 296 (intervention, control) N = 1,720 (total)	Lung	Nurse-advised tobacco cessation program.
Else, 2016 [39]	27–80	South-Asian (Nepali)	M, F	Nepal	Mixed-methods (clinic data, interview, focus groups)	2012–2014	Phase One (Pre): N = 21 (patients, interviews) N = 14 (health workers, focus group) Phase Three (Post): N = 27 (patients, clinic data) N = 5 (health workers, interviews)	Lung	Integration of tobacco cessation support with health promotion
Escoffery, 2019 [69]	NR	NR	NR	US	Qualitative (interviews)	2016	N = 32	Cervical	A multilevel, community-based intervention to increase HPV vaccination rates in FQHCs.
Garbutt, 2018 [70]	11–15 (patient sample)	Provider sample: African American/Black Asian Caucasian	M, F	US	Mixed-methods (interviews, medical records)	2016	N = (16 providers, interviews) N = 4,592 (patients, medical records)	Cervical	Increase in vaccine acceptance and recommendation through primary care providers
Gesthalter, 2017 [71]	NR	NR	NR	US	Qualitative (interviews)	2013–2014	N = 29	Lung	Low-dose screening lung cancer
Harry, 2019 [46]	NR	NR	M, F	US	Qualitative (interviews)	2017	N = 28	Breast, Colorectal, Lung, and Cervical	Integration of prevention services within a cardiovascular management program

^a N, sample size; ^b Health system-based vs. community-based, or both; NR, not reported; EHR, electronic health record; RCT, randomized controlled trial; EMR, electronic medical record; CHWs, community health workers; SFH, smoke-free home; HPV, human papilloma virus; FIT, fecal immunochemical test; FQHC, federally qualified health center; CDS, clinical decision support; EBPs, evidence-based programs; EBIs, evidence-based interventions; CHA, community health advisor; HCC, hepatocellular carcinoma.

Study Sample				Study Characteristics					
Kegler, 2018 [72]	NR	NR	NR	US	Mixed-Methods (interviews, medical records)	NR	N = 33	Colorectal	Evidence-provider oriented to promote cancer screening
King, 2019 [73]	21–64	African American/Black Asian White Not Hispanic Hispanic Other	F	US	Mixed-Methods (survey, interviews)	2016–2017	N = 13 (staff) N = 115 (program participants)	Breast, Cervical and, Colorectal	Community education with a co-format delivered via primary prevention through lifestyle behavior, women to screened cervical, and colorectal
Liang, 2016 [74]	NR	NR	NR	US	Mixed-Methods (program progress reports, interviews)	2013	N = 61	Breast and Colorectal	Implementer (combined patient and provider oriented to increase screening rates through primary prevention systems to cancer diagnosis
Liles, 2015 [75]	NR	NR	NR	US	Qualitative (interviews, focus groups)	2008–2010	N = 55	Colorectal	Population CRC screening outreach utilizing screening centralize campaign
Liu, 2015 [76]	50–74	NR	M, F	US	Quantitative	2013	N = 1,394	Colorectal	Lay health increase cancer screening primary care residency
Lobb, 2013 [43]	18–69 (survey participants)	South Asian	M, F	Canada	Mixed-Methods (focus group, surveys)	2011	N = 53 (focus group) N = 46 (survey)	Breast, Cervical, Colorectal	Identify barriers to implement Canadian systems and community organization intervention
McSherry, 2012 [36]	NR	Irish	M, F	Ireland	Qualitative (interviews)	2007	N = 33	Cervical	Increase health education related clinical behaviors
Oketch, 2019 [77]	25–65	Kenyan	F	Kenya	Qualitative (Interviews)	2016	N = 120	Cervical	A qualitative assess Kenyan women's knowledge with HPV sampling
Santos, 2017 [78]	NR	African American	M, F	US	Cluster RCT, Mixed-Methods (survey & field observations)	NR	N = 8 (traditional classroom training, churches) N = 7 (technology web-based training, churches)	Breast, Prostate, and Colorectal	Web-based technology CHA train limited technical assistance implement evidence-based cancer education intervention
Selove, 2017 [44]	NR	African American Hispanic White Other	M, F	US	Qualitative (interviews)	2009–2010	N = 30	Cervical	Developing education intervention increase health vaccination (non-intervention study).

^a N, sample size; ^b Health system-based vs. community-based, or both; NR, not reported; EHR, electronic health record; RCT, randomized controlled trial; EMR, electronic medical record; CHWs, community health workers; SFH, smoke-free home; HPV, human papilloma virus; FIT, fecal immunochemical test; FQHC, federally qualified health center; CDS, clinical decision support; EBPs, evidence-based programs; EBIs, evidence-based interventions; CHA, community health advisor; HCC, hepatocellular carcinoma

Study Sample				Study Characteristics					
Soi, 2018 [38]	NR	African	NR	Mozambique	Qualitative (interviews)	NR	N = 40	Cervical	School-based delivery n
Thompson, 2019 [48]	NR	NR	NR	US	Mixed-Methods (survey, interviews)	2015–2016	Surveys: N = 120 (before SFH training) N = 101 (after SFH training) N = 79 (after SFH implementation) Interviews: N = 25	Lung	Integration with 2-1-1
Tu, 2014 [42]	50–65+	Asian (Vietnamese)	M, F	US	Quasi-Experimental, Quantitative (survey data)	2009–2011	Baseline: N = 1,016 (604 intervention, 412 control) Post-intervention: N = 1,260 (746 intervention, 514 control)	Colorectal	Adaptatic based edu outreach promote (screening Vietnamese populatio
Turner, 2019 [49]	NR	Hispanic Non-Hispanic	M, F	US	Mixed-Methods (EMR, field notes)	2014–2018	N = 6 (health systems) N = 13,334 (patients)	Liver	The STOP program v designed net prima practices majority-t communi highest bi cirrhosis a the Unitec
VanDevanter, 2017 [40]	NR	Asian (Vietnamese)	NR	Vietnam	Qualitative (interviews)	NR	N = 40	Lung	Implementer tobacco u treatment
^a N, sample size; ^b Health system-based vs. community-based, or both; NR, not reported; EHR, electronic health record; RCT, randomized controlled trial; EMR, electronic medical record; CHWs, community health workers; SFH, smoke-free home; HPV, human papilloma virus; FIT, fecal immunochemical test; FQHC, federally qualified health center; CDS, clinical decision support; EBP, evidence-based programs; EBIs, evidence-based interventions; CHA, community health advisor; HCC, hepatocellular carcinoma									

Table 2

Characteristics of implementation science (IS), health disparities application and magnitude of bias within studies included in exploratory aim (n = 9)

Implementation Science Characteristics				Health Disparities Application				
Author	Evidence-based Cancer Prevention Intervention Implemented	Phase of Implementation ^b	Name of IS Framework	Timing of Adaptation	Decision-makers of Adaptation	Contextual Adaptation	Content Adaptation	Magnitude of Bias
Cole, 2015 [47]	Mailed FIT	All Phase	CFIR ^a	By design	Core researchers and staff	Setting	Tailoring/tweaking/refining	Model
Harry, 2019 [46]	Clinical decision support (CDS) - EHR reminders and decision aids	Pre-Implementation	CFIR ^a	By design	Core researchers and staff	Setting	NR	Low
Lobb, 2013 [43]	Use of EBIs (mammograms, Pap tests, and FOBTs)	Pre-Implementation	KTA ^a	By design	Core researchers and community members	Setting	Tailoring/tweaking/refining	Low
Selove, 2017 [44]	HPV vaccine	Pre-Implementation	CFIR ^a	By design	Core researchers and community members (this was a CBPR study)	Setting	Tailoring/tweaking/refining	Model
Soi, 2018 [38]	HPV vaccine	Post-Implementation	CFIR ^a	By design	Core researchers	Setting Personnel	Tailoring/tweaking/refining	Model
Thompson, 2019 [48]	Smoke-Free Homes (SFH) Program entails: (1) screening 2-1-1 callers for eligibility; (2) enrolling eligible callers, who completed an initial assessment; (3) mailing printed intervention materials at three time points; (4) delivering one telephone coaching call; and (5) administering a telephone survey (for evaluation purposes) after the intervention had been delivered	All-Phase	CFIR ^a	By happenstance	Core researchers and staff	Format Setting Personnel	Tailoring/tweaking/refining Adding elements Removing elements	Model
Tu, 2014 [42]	Clinic-based educational program to promote CRC screening in Chinese immigrants using small media, CHWs, and provision of FOBT kits	All-Phase	Diffusion of Innovations ^a	By design	Core researchers and staff	Format Personnel	Tailoring/tweaking/refining Removing elements	Model

^a IS framework was used/applied to address health disparities (n = 9); ^b pre, post or all-phase; HPV, human papilloma virus; CHA, community health advisor; FIT, fecal immunochemical test; CRC, colorectal cancer; EBIs, evidence based interventions; FOBT, fecal occult blood test; CHWs, community health workers; USPSTF, United States Preventative Task Force; HCV, hepatitis C virus; NR, not reported; CFIR, consolidated framework for implementation research; PRISM, practical robust implementation and sustainability model; RE-AIM, reach effectiveness adoption implementation maintenance; PARIS, promoting action on research implementation in health services; KTA, knowledge to action; TDF, theoretical domains framework

Implementation Science Characteristics				Health Disparities Application				
Turner, 2019 [49]	USPSTF HCV screening recommendation for baby boomers	All-Phase	RE-AIM ^a	By design	Core researchers and staff	Format Personnel	Tailoring/tweaking/refining Adding elements	Model
VanDevanter, 2017 [40]	Tobacco cessation (screening and counseling)	Pre-Implementation	CFIR ^a	By design	Core researchers and staff	Personnel	NR	Model

^a IS framework was used/applied to address health disparities (n = 9); ^b pre, post or all-phase; HPV, human papilloma virus; CHA, community health advisor; F, fecal immunochemical test; CRC, colorectal cancer; EBIs, evidence based interventions; FOBT, fecal occult blood test; CHWs, community health workers; USPS, United States Preventative Task Force; HCV, hepatitis C virus; NR, not reported; CFIR, consolidated framework for implantation research; PRISM, practical robust implementation and sustainability model; RE-AIM, reach effectiveness adoption implementation maintenance; PARIS, promoting action on research implementation in health services; KTA, knowledge to action; TDF, theoretical domains framework

Search Strategy

Search strategies used a combination of search terms related to implementation science frameworks, cancer prevention and/or intervention, and all search algorithms were validated by a public health librarian (see Supplemental Material Table 3). Additional studies were identified by checking the bibliographies of included studies. BioMed Central (BMC) Implementation Science was also hand-searched for relevant articles. All searches were conducted between January to May 2020 and managed with Covidence [26].

Screening and Study Selection

Inclusion criteria for studies included: any type of study design (including randomized controlled trials (RCTs), non-RCTs, intervention and non-intervention studies, qualitative, quantitative, and mixed-methods); published in peer-reviewed journals with full-text available; English-only publications; published between 2001–2020; and explicitly used an IS framework. Geographic limitations were not applied in order to capture implementation science applications across global health initiatives (i.e., as some IS frameworks have been developed in non-US contexts). Studies were excluded if they were: pilot/formative studies leading to the development of an IS framework; case studies; systematic reviews or meta-analyses of cancer prevention interventions; did not address cancer prevention and/or detection; included the prevention or relapse of subsequent cancer tumors (i.e., cancer survivorship); did not use an IS framework; and were not empirical studies (involving primary data collection) or research protocols.

Data Extraction and Analysis

Two reviewers (SX, HIA) performed title and abstract screening for inclusion and exclusion criteria. All conflicts were resolved by a third reviewer (RP). *Kappa* statistics were calculated to assess inter-rater reliability agreement for both inclusion and exclusion processes. Both reviewers performed full-text screening for inclusion and exclusion criteria, and the same third reviewer also resolved conflicts. Consensus coding and resolution of disputes were conducted between the two reviewers, with the third reviewer arbitrating.

Study Outcomes

Specific outcomes collected for each study included: (1) author name and year of publication; (2) study sample (age, race/ethnicity, sex); (3) study characteristics (study design, study dates, analytic sample, type of cancer/cancer site, intervention description); and (4) implementation science characteristics (phase of implementation, use of IS framework – verified with the Dissemination & Implementation Models in Health Research & Practice hub [27], name of IS framework) and (5) magnitude of bias.

Study Characteristics

For each included study, the following characteristics were collected: (1) Study design, which referred to the type of design employed in the study. Four coding options were available for this indicator: “Quantitative” was coded for any study that employed quantitative data (e.g., EMR, survey). “Qualitative” was coded for any study that used qualitative methods (e.g., focus groups, interviews). “Mixed-Methods” was coded for any study that used a combination of quantitative and qualitative methods (e.g., survey & focus groups; claims data & interview). Finally, “RCT” was coded for any study that employed a randomized controlled trial design. (2) Study dates referred to the year(s) in which data collection for the study took place (e.g., 2009–2010). (3) Analytic sample was defined as the sample size used to analyze cancer-related outcomes. (4) Type of Cancer/Cancer Site referred to the type of cancer(s)/cancer site(s) the intervention or study targeted. (5) Study/Intervention Description reflected a short description of the study/intervention. For example, “a patient navigation cancer screening program” or a “mobile-based tobacco cessation program.”

IS Characteristics

The IS characteristics coded for each study included the phase of implementation and the name of the IS framework used in the study. Phase of Implementation referred to the stage in which the implementation science framework was employed and included three coding options. “Pre-Implementation” was coded for any study that used an IS framework to inform the implementation of an intervention (i.e., before implementation of EBI). “Post-Implementation” was coded for any study that used an IS framework to evaluate the implementation of an intervention. “All Phase” was coded for any study that incorporated an IS framework throughout all phases (pre and post) of implementation. Name of IS Framework referred to the IS framework(s) used in the study and was verified with the D&I Models in Health Research & Practice hub [27].

Exploratory Aim Outcomes

When applicable, each study was assessed for whether it targeted a known or documented population impacted by cancer-related health disparities as defined by the National Institutes of Health [28]. This definition was also applied to global health contexts, where there are known and ongoing health disparities in low- and middle-income countries [29]. Information on this outcome was abstracted from the background context in each study (e.g., explicit statement that this intervention is aimed at increasing screening rates within the Hispanic/Latino population), and was either coded as “Yes” if the study met this criterion or “No” if the study did not meet this criterion. If the implementation of a cancer prevention EBI was adapted to meet the needs of a health disparities population, this health disparities application was further categorized according to when, for whom, and how the adaptation(s) occurred. The Timing of Adaptation referred to when the adaptation(s) of an EBI took place and can be coded as either “by happenstance” (as the implementation was ongoing) or “by design” (if the adaptations were incorporated as part of the design of the study). In addition to capturing when the adaptation(s) were considered and implemented, who initiated and decided on the adaptation(s) was also abstracted (Decision-Makers of Adaptation). The decision to modify an intervention with adaptations was classified either as by “the core research team” or by a “team of researchers and community members” (e.g., community-engaged studies). The type of adaptations was coded as either contextual or content modifications using the coding scheme adapted by Stirman and colleagues [30]. For any study, it was possible to have both contextual and content modifications. A narrative highlighting the study overview and findings are also presented for all studies included within this exploratory aim.

Study Quality Assessment

The Quality Assessment Tool for Studies with Diverse Designs (QATSD) tool established and validated by Sirriyeh and colleagues was used to assess the quality of studies included in the review [31]. The QATSD tool consists of 16 items (with some items only applicable to quantitative and qualitative studies), scored on a Likert scale from 0 = “high risk of bias” to 3 = “minimal risk of bias”, and has strong reliability and validity in scoring studies with various (mixed) designs [32]. A QATSD overall percentage score was calculated for each included study. A study with “low risk of bias” has an overall QATSD percentage score greater than or equal to 75%. A study at “moderate risk of bias” has an overall QATSD percentage score between 50–74%, meanwhile a study with “high risk of bias” has an overall QATSD score between 0–49% [31].

Results

A total of 1,025 article titles and abstracts were screened, and 84 were deemed eligible for full-text screening (Figure). After full-text screening, $n = 27$ articles were included for data abstraction and synthesis (Table 1). Inter-rater reliability was moderate to strong between both reviewers during inclusion and exclusion screening processes ($K = 0.728$, $K = 0.866$, respectively). Of the 27 included studies in the final sample, more than half of them ($n = 19$, 70.3%) were based in the US. Two studies were based in Argentina and conducted by the same research team [33, 34]. The remaining individual studies were implemented in the following countries: Canada [35], Ireland [36], Kenya [37], Mozambique [38], Nepal [39], and Vietnam [40]. Overall, most studies ($n = 19$, 70.4%) were at moderate risk of bias as appraised with the QATSD rubric.

Study Design, Cancer Types, & Study Settings

Most studies utilized mixed-methods ($n = 12$, 44.4%) or qualitative methods ($n = 12$, 44.4%) to conduct their data collection and analyses. Only three studies exclusively used quantitative data, which were heavily drawn from electronic medical records (EMR) [34, 41, 42]. More than 80% of the studies ($n = 21$, 81.5%) focused on a single cancer site, with cervical ($n = 8$, 29.6%) and colorectal ($n = 8$, 29.6%) being the most targeted cancer types. Most studies implemented a cancer screening intervention; only two studies were non-intervention or pre-planning studies [43, 44]. Of the 27 studies, 66.7% ($n = 18$) took place in a health system, 22.2% took place in a community setting, and three studies were implemented in both contexts [34, 43, 45].

Implementation Science (IS) Frameworks & Characteristics

Nine studies used an IS framework for all phases of implementation, meanwhile half of the studies ($n = 13$, 48.2%) used an IS framework for post-implementation evaluation [36, 40, 43, 44, 46]. The most common IS framework used across studies was the Consolidated Framework for Implementation Research (CFIR) ($n = 13$, 48.2%) followed by the Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) framework ($n = 7$, 25.9%). Less common IS frameworks utilized included the Capability, Opportunity, Motivation, Behaviour (COM-B) Model, Diffusion of Innovations, Health System Framework (HSF), Knowledge-To-Action (KTA), Normalization Process Theory (NPT), Promoting Action on Research Implementation in Health Services (PARIHS), A Practical, Robust Implementation and Sustainability Model (PRISM), and Theoretical Domains Framework (TDF).

Exploratory Findings

Only one-third of studies ($n = 9$, 33.3%) used an IS framework to address cancer-related health disparities (Table 2) [38, 40, 42–44, 46–49], of which six were based in the US. Of the nine studies, six (66.7%) of them used the CFIR to guide, inform, and adapt the implementation of a cancer prevention intervention to target health disparities [38, 40, 44, 46–48]. Other IS frameworks that were used to inform a health disparities adaptation were Diffusion of Innovations [42], KTA [43], and RE-AIM [49].

Exploratory Findings – CFIR Studies

When the CFIR was used to guide a health disparities adaptation, it was used comparably by studies to inform both contextual and content adaptations. The contextual adaptation most commonly informed by the CFIR and used across five studies was setting. Only one study used the CFIR to guide a format adaptation [48], while three studies used the framework to inform personnel adaptation [38, 40, 48]. [38, 40, 46–48]. Regarding content adaptations, the CFIR was most commonly used by studies to inform the tailoring/tweaking/refining (e.g., language translation) of the existing components of an intervention. Only one study used this framework to inform both the addition and removal of components in an intervention [48].

VanDevanter et al., 2017

In a qualitative study conducted by VanDevanter and colleagues [40], the CFIR was used to identify barriers, facilitators, and modifications to implementing a tobacco cessation program. As a formative evaluation (non-intervention study), VanDevanter and colleagues were interested in how to translate an existing tobacco use treatment program created and tested in a high-income developed country (HIDC) to the local context of a low-income developed country (LIDC) in this case Vietnam. The original intervention included training patients and providers with a toolkit, and a reminder system to prompt providers to identify eligible patients for screening and brief counseling. The adaptation of the intervention to the Vietnamese context was to include a village health worker (VHW), who would provide patients with more intensive cessation counseling. Before implementing this adapted intervention, VanDevanter and colleagues wanted to examine if any barriers and facilitators may exist and if further adaptations were needed.

They identified four potential facilitators within the following CFIR domains: (1) a greater advantage of the intervention compared to existing practice (intervention characteristics), (2) a need to address the burden of tobacco use in the population (outer setting), (3) a demand to increase training, skill-building and leadership engagement (inner setting), (4) and a strong collective efficacy to provide services for tobacco cessation (individual characteristics). Conversely, the following CFIR barriers were uncovered: the perception that the intervention was complex (intervention characteristic) and not necessarily compatible with current workflows (inner setting); and that the Ministry of Health (MOH) has not historically prioritized tobacco cessation and control, and therefore, external resources were lacking (outer setting). VanDevanter and colleagues also identified additional modifications to the intervention, including: (1) lengthening the initial training session with providers and VHWs, and adding a booster session to provide opportunities for these personnels to continually reflect and build capacity; (2) training VHWs as a team rather than individually; and (3) creating an external advisory board consisting of members from the MOH to plan for the sustainability of the intervention.

Cole et al., 2015 & Harry et al., 2019

In qualitative studies conducted by Cole et al. [47] and Harry et al. [46], the CFIR was used to identify domain-specific (e.g., outer setting, inner setting) barriers and facilitators of cancer prevention implementation interventions. Cole and colleagues [47] adapted Systems of Support (SOS), a proactive, mail-based colorectal screening program into U.S.-based federally qualified health centers (FQHCs). The facilitators they identified included the FQHCs' significant previous quality improvement experience (outer); and previously developed process for pilot testing and evaluating new programs (inner). The barriers they identified included: limited personnel resources (inner); diverse patient population with low health literacy, limited English proficiency, and primary language other than English (inner); communication challenges in the organization and within teams (inner); and large geographic distance between the research team and the FQHC organization leadership staff. Factors that were identified as both barriers and facilitators included FQHC organization reporting requirements. Finally, identified barriers were used to plan adaptations to the original SOS program such as: (1) streamlining FQHC reporting requirements; (2) creating graphically based brochures for patient populations with low literacy or limited English skills, implementation strategies for leadership teams and staff; and (3) creating detailed workflow and implementation plans.

Harry and colleagues [46] identified pre-implementation barriers and facilitators of a clinical decision support (CDS) for cancer prevention. They identified the following outer and inner setting barriers – outer setting included patients' needs and resources (e.g., limited health insurance coverage, high deductibles), meanwhile inner setting barriers included primary care provider time limitations, electronic medical record alert fatigue, and compatibility of CDS Facilitators included: (1) an increased number of patients seen by PCPs per day (outer); (2) improved patient education (outer); (3) improved patient control of their own health (outer); and (4) CDS would improve cancer prevention and screening quality metrics. Overall, both studies identified multilevel barriers and facilitators to the potential implementation of their respective cancer prevention interventions.

Exploratory Findings – Diffusion of Innovations

In a clinic-based educational program to promote colorectal cancer screening, Tu and colleagues [42] used the Diffusion of Innovations to adapt the intervention, designed initially for a Chinese audience, to a Vietnamese population. The original intervention consisted of a culturally and linguistically appropriate clinic-based educational program to promote CRC screening among Chinese immigrants using small media, a bicultural and trilingual (English, Cantonese, and Mandarin) Chinese health educator, and provision of fecal occult blood test (FOBT) kits. After implementation, the EBI was shown to have a strong effect (adjusted OR = 5.91; 95% CI = 3.25, 10.75). The Diffusion of Innovations was used by Tu and colleagues to guide the contextual adaptations (format and personnel) and content adaptations (tailoring/tweaking/refining, removal elements) of this EBI to a Vietnamese patient population, and was used throughout all implementation phases.

Tu and colleagues adapted the original EBI with: Medical assistants (MAs) serving as the intervention agents instead of a health educator (personnel adaptation); no FOBT kits provided by the MAs as consistent with International Community Health Services procedures (removal of element); and a series of 10–15 minute in-service presentations to the MAs (format). Over two years (2009–2011), the researchers conducted a total of 15 presentations to MAs and two with the staff at the intervention clinic.

Tu and colleagues collected and analyzed pre- and post-measures of CRC screening adherence (for three modalities - FOBT, Sigmoidoscopy, Colonoscopy) at the intervention and control clinics. Both intervention and control clinics had similar overall CRC screening adherence rates at baseline. At post-implementation, the intervention clinic reported a 3% increase whereas the control clinic reported no change in overall adherence rate. During the study period both sites reported decreases in FOBT rates. The intervention clinic also saw an increase in Colonoscopy compared to the control clinic, but this difference was not statistically significant. A subgroup analysis of nonadherent patients at baseline also showed a moderate and significant increase in overall CRC screening adherence (adjusted OR = 1.70; 95% CI 1.05, 2.75) within the intervention arm compared to control arm. Findings from this study highlight that IS-informed adaptations can increase overall CRC screening rates among adherent and non-adherent patients.

Exploratory Findings – Other IS frameworks (KTA, RE-AIM)

In 2011, Lobb and colleagues [43] used the KTA framework to help inform barriers to implementing cancer EBIs (e.g., FOBTs, mammograms, Pap tests) in Canadian health systems and community organizations. Overall, 45 unique barriers to use of mammograms, Pap tests, and FOBTs were identified with limited knowledge among residents; etho-cultural discordance; and health education programs ranked highest for all surveys. Barriers related to cost, patient beliefs, fears, and lack of social support.

Turner and colleagues [49] used the RE-AIM framework to guide and evaluate the implementation of STOP HCC (Screen, Treat, Or Prevent HCC) – a health system-based program designed to promote Hepatitis C Virus (HCV) screening in safety-net primary care practices with large populations of Hispanic patients. STOP HCC was adapted from an intervention that included built-in EMR reminders, posters and handouts about HCV screening, reflex HCV RNA testing, and in-person counseling by a community health worker (CHW) about HCV and follow-up care. STOP HCC adopted the majority of these components with some modifications.

Turner and colleagues used the RE-AIM framework to consider contextual (format, personnel) and content (tailoring/tweaking/refining, adding elements) adaptations for STOP HCC. In STOP HCC, the format was adapted by having CHWs provide remote navigation to patients instead of in-person. In addition to CHWs, STOP HCC had other personnel to assist patients, including nurses, pharmacists, and social services workers. Regarding content adaptations, HCV screening materials were translated in Spanish (tailoring/tweaking/refining), and a mobile application was created and added to educate patients about HCV, HCV-associated stigma and risk factors, and curative options.

STOP HCC was implemented in six health systems (n = 13,334 patients) and instituted for 43 months (October 2014 to May 2018). All practices implemented HCV screening; however, not all contextual and content adaptations were applicable or applied across all health systems (i.e., some health systems exclusively relied on nurses because they did not have CHWs). Pre- and post-measures on HCV screening were reported for all health systems. In the year before STOP HCC implementation, data from four health systems showed that 110 of 13,216 baby boomers (0.8%) had been screened for HCV (pre-intervention). After 29 to 43 months of STOP HCC (depending on site), 13,334 of 27,700 eligible baby boomers (48.1%) were screened, varying by health systems from 19.8–71.3%. By comparison, only 8.3% of 60,722 patients in a national study of community health centers were screened for HCV from 2010 to 2013, and 17.3% of baby boomers were screened nationally in 2017 according to the National Health Interview Survey.

Discussion

This is the first review that employed a mixed-methods synthesis to examine how IS frameworks have been used in cancer prevention studies, with an exploratory aim of how some of these frameworks have been applied in the context of health disparities. Cancer prevention studies using IS frameworks were uncovered across both high-income developed countries (HIDC) (e.g., Canada) and low-income developed countries (LIDC) (e.g., Vietnam). A resounding number of these IS studies were based within health systems in the US, which may reflect the growing trend and value of developing learning health systems in this country [50]. The sizeable amount of LIDC-based studies also demonstrate a promising expanse and application of implementation science within the international context. However, the number of non-US studies remains disproportionate to US-based studies, affirming the concern raised in Rabin and colleagues' 2012 IS harmonization campaign that outreach to and engagement with the international IS research community is limited [51]. To continue advancing IS, cross-fertilization and collaboration with the global research community will be needed to maintain the standardization and rigor of the field.

Our review also found that IS frameworks were applied with variable frequency in cancer prevention studies, with the CFIR most commonly used. The high prevalence of CFIR use may be a function of its earlier establishment, advancements, and ubiquitous applications compared to other frameworks [52]. Across all of these studies, most researchers employed IS frameworks within either the pre-implementation phase or the post-implementation phase. As a corollary of this, many of these studies were not designed to assess, measure, and report implementation outcomes, prohibiting any empirical assessment of whether applications of IS frameworks can influence these outcomes. The limited number of studies that used an IS framework throughout the implementation continuum also suggest that these frameworks continue to be applied prescriptively, either as a determinant framework or an evaluation framework [12]. This prescriptive nature highlights two potential implications: 1) that current IS frameworks may be limited in their ability to incorporate the dynamic and cyclical nature of implementation, and 2) that IS researchers and practitioners may need to incorporate IS frameworks throughout the implementation continuum. Although new frameworks, such as the Dynamic Sustainability Framework, are emerging, they are yet to be widely used and tested within the context of cancer prevention [53]. Given the deluge of available IS frameworks, selecting an appropriate framework also continues to be a challenge for IS researchers [54, 55]. Although several decision tools have been created to support IS researchers [8, 54], a growing appreciation and application of these tools within the cancer prevention field may facilitate greater transparency and standardization around the identification, purpose, and elucidation of how an IS framework may mechanistically influence implementation outcomes.

Exploratory Aim Implications

Within the exploratory aim, very few studies purposely used IS frameworks to tackle cancer-related health disparities. While it is unclear why this is, we surmise several possible explanations. First, the application of a health equity lens within the field of IS is still relatively new [3, 56]. Discussion of this topic at organizations like the National Cancer Institute's Implementation Science Consortium in Cancer (ISCC) [57] and National Implementation Research Network [58] only materialized in the late 2010s and may have not yet entered into the radar of cancer prevention IS researchers. Secondly, as this subfield of IS has only been recently recognized, myriad opportunities exist to further advance it, including developing and refining IS models and frameworks that intentionally integrate a health equity lens [3]. Finally, as this subfield continues to grow, we anticipate future cancer prevention EBIs will employ IS frameworks to explicitly address health disparities.

Within this subset of studies, CFIR remained the predominantly applied framework. Mirroring the primary findings, IS studies on health disparities also primarily employed IS frameworks for pre-implementation, as an analytical framework to identify potential facilitators and barriers (i.e., adaptations) pertinent

to a health disparities population. When applied in a pre-implementation context, CFIR was most commonly used to describe “organizational” barriers and facilitators to implementation, which then informed content and contextual adaptations of the intervention of interest. Therefore, the domains of most interest within these studies were the inner setting, outer setting, and individuals involved. Only two studies employed the CFIR throughout the implementation continuum, using it to identify pre-implementation adaptations and to characterize additional and future adaptations post-implementation [47, 48]. Furthermore, all but one study [48] identified adaptations by design or during pre-implementation, and most adaptations were exclusively identified by the core research team and implementation staff. These adaptation processes highlight two significant implications. First, the identification and tracking of adaptations are occurring systematically at the beginning of studies (i.e., proactively and planned) and are primarily driven by researchers. Second, the reporting of reactive (i.e., unplanned) adaptations and the consideration of adaptations driven by input from stakeholders outside the research team are almost non-existent. This finding points to a critical need to employ community-engaged research approaches to democratize the adaptation process in implementation studies [59, 60]. Community members outside of the research team must be involved with the implementation process so that they can provide any potential adaptations to optimize the intervention's fit and acceptability. Encouraging and activating more participatory research approaches, therefore, is necessary to achieve the growing call for more equitable IS [61].

As illustrated in the primary findings, implementation outcomes were also not measured, assessed, and reported in this exploratory subset. However, two health disparities studies did note how the application of an IS framework led to the identification and implementation of adaptations, and how those framework-informed adaptations influenced patient-reported outcomes [42, 49]. In both studies, the application of an IS framework led to a small but significant increase in recipient-level outcomes, such as increased cancer screening rates within the targeted health disparities populations. These modest findings suggest that IS frameworks infused with a health equity lens can potentially reduce cancer-related disparities. Conversely, more empirical research is needed, to evaluate and elucidate how the varying components of an IS framework may influence patient-reported outcomes and link to different implementation outcomes.

Strengths and Limitations

This review had several strengths. First, we included studies with diverse designs (e.g., mixed-methods), searched multiple databases with additional hand-searching, and considered studies in all locations. Despite our vast search strategies, we still observed little regional diversity. Most studies were conducted in the US combined with a few studies coming from other HIDs (e.g., Canada) and some LIDs (e.g., Vietnam). Further research should seek to capture country-specific vernacular around implementation science and include studies published in other languages. Secondly, with the interplay between cancer sites and complex interventions, various outcomes were assessed and reported in the included studies. As a result, we could not perform a meta-analysis due to the sparse effect estimates available for a random-effects model. A more comprehensive systematic review and meta-analysis of the use of implementation science frameworks across various public health interventions may be valuable for discerning the effect of applying IS frameworks and its impact on implementation- and patient-reported outcomes. We also did not include cultural adaptation models as part of the search strategy for IS frameworks. This limitation may be an artifact of the Nilsen taxonomy of IS frameworks, which currently does not account for cultural adaptation models as explicit IS frameworks [12]. Consequently, many studies that have used cultural adaptation models to inform the implementation of a cancer prevention EBI to address a specific health disparity may not have been included our review.

Conclusion

This study suggests that the application of IS frameworks to cancer prevention studies is still in an embryonic stage. Recent clarion calls about infusing more equity within the practice of IS highlight that cancer prevention researchers must do more to intentionally design interventions that center health equity at the core. While no specific health equity IS frameworks were identified in any cancer prevention studies in this review, there is promising growth and development of novel theories and models that infuse a health equity lens within cancer treatment and other disciplines. One notable framework includes Woodward and colleagues’ “Health Equity Implementation Framework”, which draws on two conceptual frameworks – the Health Care Disparities Framework and the i-PARIHS – that explicitly highlights health determinant factors within a healthcare delivery system that may influence disparate health outcomes (i.e., clinical encounter) [62]. A recent addition to this work by Woodward also highlighted some core domains to consider when addressing implementation-related disparities, such as 1) cultural factors of recipients, 2) clinical encounter, or patient-provider interaction, and 3) societal context (including but not limited to social determinants of health). [63] However, health equity frameworks are not just limited those mentioned earlier; an expanse of IS frameworks, specifically, cultural adaptation frameworks and models exists and are currently being refined to fit within specific health and implementation disparities contexts [64]. Exciting developments, such as the Transcreation framework [65], is aiming to create more equitable and participatory approaches within implementation science to address health disparities. Since its inception a decade ago, the field of IS has grown tremendously. Along with this growth comes a wide variety of tools and frameworks that are now available to practitioners of the field to take up and explicitly address health inequities. It is incumbent upon IS researchers, including cancer prevention scientists, to implement more equitable interventions that will ultimately reduce cancer disparities.

Abbreviations

BMC: BioMed Central; CFIR: Consolidated Framework for Implementation Research; CHW: Community Health Worker; CDS: Clinical Decision Support; EBI: Evidence-Based Intervention; FOBT: Fecal Occult Blood Test; EMR: Electronic Medical Record; FRAME: Framework for Modification and Adaptations; FQHC: Federally-Qualified Health Center; HCC: Hepatocellular Carcinoma; HCV: Hepatitis C Virus; HIDC: High-Income Developed Countries; HSF: Health System Framework; i-PARIHS: integrated Promoting Action on Research Implementation in Health Services; IS: Implementation Science; ISCC: Implementation Science Consortium in Cancer; KTA: Knowledge-To-Action; LIDC: Low-Income Developed Countries; MA: Medical Assistant; MOH: Ministry of Health; NPT: Normalization Process Theory; OR: Odds Ratio; PARIHS: Promoting Action on Research Implementation in Health Services; PRISM: A Practical, Robust Implementation and Sustainability Model; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PROSPERO: The International Prospective Register of Systematic Reviews; QATSDD: Quality Assessment Tool for Studies with Diverse Designs; RCT: Randomized Controlled Trial; RE-AIM:

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

All authors have indicated they have no potential conflicts of interest to disclose.

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Authors' contributions

RP conceived of the idea for the review and oversaw the project. SX, HIA, RG, SK, DL, SM, and RP constructed and refined the search strategies. SX conducted, acquired, and managed the data. SX and HIA were involved in the screening of studies, data extraction, coding and analysis. SX drafted, refined, and revised the manuscript, and is the guarantor of this paper. All authors, edited, read, and approved the final manuscript.

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Figures

Figure 1

PRISMA Flowchart

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