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SYSTEMATIC REVIEW

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Combined use of the integrated-Promoting Action on Research Implementation in Health Services (i-PARIHS) framework with other implementation frameworks: a systematic review

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Abstract

Background Appropriately and comprehensive applying implementation frameworks is one of the key challenges in implementation science resulting in increased use of multiple implementation frameworks within projects. This is particularly true for frameworks such as PARIHS/i-PARIHS. Therefore, this systematic review aimed to examine if and why the PARIHS/i-PARIHS framework has been applied in research with other implementation frameworks.

Methods We searched six databases from 2016 (the year following i-PARIHS' publication) to April 2024 and supplemented this with a citation search of the seminal i-PARIHS paper. We included studies that 1) were peer-reviewed with a protocol or empirical study design, 2) have applied the PARIHS or i-PARIHS framework for implementation planning, delivery, analysis, or evaluation and 3) also used at least one other implementation framework. Descriptive statistics were conducted to report on study characteristics and frequency for each implementation framework used with PARIHS/i-PARIHS. A qualitative, content analysis was used to analyse the answers to open-ended extraction questions.

Results Thirty-six articles met criteria for inclusion and included 16 protocols and 20 empirical articles (twelve intervention and eight cross-sectional studies). Thirty-four of the studies used one additional implementation framework and two studies used two additional implementation frameworks. In total, nine implementation frameworks were applied with PARIHS/i-PARIHS, including: 1) RE-AIM, 2) CFIR, 3) NPT, 4) REP, 5) TDF, 6), DSF, 7) KTA, 8) Stetler's Model, and 9) SIF. Thirty-four reported a rationale for using PARIHS/i-PARIHS and 34 reported a rationale for using the other implementation framework. Only eleven reported a rationale for using more than one implementation framework. Only three reported strengths of combining implementation frameworks.

Conclusions Overall, this review identified that implementation researchers are using PARIHS/i-PARIHS in combination with other implementation frameworks and providing little to no rationale for why. Use of multiple implementation frameworks without detailed rationales compromises our ability to evaluate mechanisms of effectiveness.

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Implementation researchers and practitioners need to be more explicit about their framework selection, detailing the complementary strengths of the frameworks that are being used in combination, including why using one is not sufficient.

Trial registration This systematic review was registered with PROSPERO: ID: 392147.

Keywords PARIHS, i-PARIHS, Implementation frameworks, Systematic review

Contributions to the literature

- This is the first review to systematically examine what implementation frameworks have been applied in combination with PARIHS/i-PARIHS, which illustrates the limitations and implications of combined framework use.
- This review provides evidence that combined use of implementation frameworks is an emerging trend within the field of implementation science and one that warrants examination.
- The review highlights the need for researchers and practitioners to provide clear rationales when combining implementation frameworks, emphasizing that without explicit justification, the combined use can obscure understanding and potentially undermine scientific integrity.

Background

Implementation science aims to offer evidence-informed approaches in the form of frameworks, models, and theories (from here on termed 'implementation frameworks') to support the adoption of research into policy and practice. There are more than 100 published implementation frameworks [1] that can differ in their purpose due to their underpinning theories and the conceptual level on which they focus. Implementation frameworks offer support to 1) predict or guide the implementation process, 2) organise, understand, or explain factors that influence implementation, and 3) evaluate the implementation success (or failure) [1–3].

Implementation frameworks can be further classified into five categories: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks [1]. Examples of commonly used implementation frameworks, as described in the *Implementation Science Handbook* [4], include Consolidated Framework for Implementation Research (CFIR) [5], Knowledge to Action (KTA) [6], Normalisation Process Theory (NPT) [7], Reach, Effectiveness, Adoption, Implementation and Maintenance (RE-AIM) [8], Stetler's Model [9], Theoretical Domains Framework (TDF) [10, 11], and Promoting Action on Research Implementation in Health Services (PARIHS) [12].

PARIHS is a determinant framework signifying that successful implementation of evidence into practice is a function of the quality and type of evidence, the characteristics of the setting or context, and how the evidence was introduced or facilitated into practice [12]. Through iterative work where PARIHS was applied and tested, it was subsequently refined in 2015 and the integrated-PARIHS (i-PARIHS) framework was introduced [13]. The i-PARIHS framework positions facilitation as the active ingredient, conceptualised as both a role ('being' a facilitator) and actions ('doing' facilitation) [13, 14]. i-PARIHS posits that facilitating a new way of working (i.e., uptake of the *innovation*) with the different target groups (i.e., *recipients* who need to adopt the innovation and those impacted by its uptake) within their *context* leads to successful implementation [13].

i-PARIHS' emphasis of facilitation reflects its view of implementation as a complex and non-linear process. Facilitation thus functions as a meta-strategy to guide teams through the implementation process and facilitators can draw on additional implementation strategies to navigate barriers and embrace enablers [14]. With this characterisation of facilitation, the framework becomes flexible in its application and allows for context-responsive actions and iterative tailoring to dynamic contexts with multiple and varying recipients.

However, this context-responsive and iterative approach to implementation can make the framework complex to apply in practice, particularly for first-time or novice users. Successfully harnessing the flexibility of i-PARIHS requires an understanding of the framework. A recent citation analysis of the original PARIHS framework identified, from a total of 367 published articles, that only a few used the framework to comprehensively guide multiple aspects of their implementation effort [15]. This parallels reviews of other implementation frameworks, such as CFIR [16] and KTA [17], which have identified that they have seldom been used as intended.

Appropriately selecting and applying implementation frameworks is not a new issue and is one of the key challenges researchers and clinicians face when planning and conducting implementation efforts [1, 2, 18]. This is largely due to not knowing which implementation framework to select or how to select from the increasing number being published [1, 2, 18].

This uncertainty can contribute to or exacerbate difficulties in applying an implementation framework. Additionally, doubt on the appropriateness of a single implementation framework is leading to an increasing number of teams selecting more than one implementation framework. There seems to be limited understanding in the field of implementation science on when and how to apply more than one implementation framework to an implementation effort, and whether combined use enhances implementation success.

For many implementation efforts, one implementation framework may be sufficient to address all the aims and scope of the effort [19]. However, given the complexities of implementation, multiple implementation frameworks may support answering different research questions—for example, using the determinant framework i-PARIHS to plan, guide, and deliver an implementation project, while supplementing with the RE-AIM framework [8], an evaluation framework. In this example, the two implementation frameworks vary in their purpose *and* theoretical underpinning and therefore applying them in different stages of the implementation effort ensures the theoretical integrity of each framework. This serves as an example of how applying more than one implementation framework may be useful and has the potential to strengthen implementation efforts. However, there are potential risks and complexities of applying multiple implementation efforts—for example, applying i-PARIHS with CFIR [5] to plan, guide, deliver, and/or evaluate an implementation project. In this example, these implementation frameworks have similarities in their purpose *and* theoretical underpinning. While each framework independently has been shown to lead to successful implementation, combining them may introduce unforeseen complexities and risks, as well as undermine their implementation effectiveness. Additionally, applying both may also create unnecessary duplication and redundant effort.

To date, no literature has systematically assessed how the PARIHS/i-PARIHS framework has been applied with other implementation frameworks in research and practice. It is currently not known what implementation frameworks are being applied with PARIHS/i-PARIHS and why. This presents a risk to the integrity of the field of implementation science as we do not know if combined use is theoretically justified. Therefore, this systematic review aims to examine if and why the PARIHS/i-PARIHS framework has been applied in research with other implementation frameworks (inclusive of all implementation theories, models, and/or frameworks).

Research questions

1. What implementation frameworks have been applied with the PARIHS/i-PARIHS framework?
2. How has PARIHS/i-PARIHS been applied with other implementation frameworks?
3. What are the reported rationales for applying PARIHS/i-PARIHS and other implementation frameworks?
4. What are the reported strengths and limitations of applying other implementation frameworks with PARIHS/i-PARIHS?

Methods

This study used systematic review methodology and followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for conducting and reporting on the review's steps. The review team consisted of multidisciplinary researchers closely acquainted with the PARIHS/i-PARIHS framework who were invited for collaboration in the design and execution of this study. The protocol for this study is registered on Prospero (ID: 392147).

Search strategy

This study used a systematic search that consisted of a primary search in multiple databases and a supplementary search to capture all relevant scientific articles utilising the PARIHS/i-PARIHS framework. The supplementary search was conducted in support of reducing bias and increasing confidence of capturing all relevant articles [20].

Primary search

The primary search method used a systematic search in databases of multiple disciplines, including Scopus, Web of Science, PsycInfo, PubMed, CINAHL, and JSTOR. The search strategy used key terms that reflected the use of the i-PARIHS framework as well as terms for the original PARIHS framework, including "iparihs", "i-parihs", "parihs" and "promoting action on research implementation in health services". Preliminary searches were run to pilot the search terms and ensure their fit for purpose. (The search term "PARIHS" was to ensure inclusion of peer-reviewed articles that may interchangeably use the terms PARIHS and i-PARIHS, consistent with a published review looking at how the i-PARIHS framework has been used [21]. In addition, the inclusion of the original framework term enabled us to determine if there is continued use of the

original PARIHS framework, following the publication of the revised i-PARIHS.)

The search was restricted to publications from January 1st 2016 (the year following i-PARIHS' publication) to April 3rd 2024.

Two independent reviewers (SH and SM) double screened all retrieved titles and abstracts, followed by full-text screening. Screening adhered to the inclusion and exclusion criteria (see below Study selection, and Supplementary File 1) and was completed in Covidence [22]. Conflicts were discussed by the reviewers to reach consensus.

Supplementary search

Citation searching was done as a supplementary search method using a seminal i-PARIHS article [13] that introduced the integrated version of the framework. This method of supplementary searching was chosen over other search strategies due to the nature of the review (that is, looking for studies that have applied this framework). The citations were searched using two databases (Web of Science and Scopus). Articles were screened by two independent reviewers (SH and SM) in EndNote [23], following the same inclusion and exclusion criteria (see Supplementary File 1). Relevant articles were imported into Covidence for extraction.

Study selection

Studies were included if they: 1) were peer-reviewed articles with a protocol or empirical study design 2) have applied the PARIHS or i-PARIHS framework for implementation planning, delivery, analysis, or evaluation and 3) also used at least one other implementation framework. Studies were excluded if 1) they were non-English, 2) their full text was unavailable, 3) or the frameworks were mentioned or referenced only in the study without any description of application. Detailed inclusion and exclusion criteria can be found in Supplementary File 1.

Data extraction

Articles meeting the study selection criteria were double-extracted by seven independent reviewers (SH, SM, BK, AB, AE, ACE, and LW) using Covidence [22] – i.e., extraction for each included article was conducted by a pair of reviewers from among the seven independent reviewers. The data extraction form was adapted from Bergström et al. [15] to reflect the objectives of this study (i.e., allowing extraction for PARIHS/i-PARIHS and other implementation frameworks). The data extraction form was developed and piloted by all members of the research team and revised based on feedback prior to starting the data extraction.

The data extraction form collected information about the study characteristics, including authors, year of publication, country, setting and article type. Further, the form included questions on how PARIHS/i-PARIHS was applied, including one or more of the following ways: 1) in planning or designing the implementation approach, 2) in conducting implementation or delivering the intervention, 3) in analysing any of the data collected, and 4) in evaluating intervention or implementation effectiveness. Each question was followed by an open-ended response field for extracting the relevant information where reviewers could copy and paste sections of the article that were relevant to the review query. The form also collected the same information for each implementation framework used with PARIHS/i-PARIHS, including any reported rationale for choosing the frameworks, and information on the context for how they were applied as above. The form collected any reported strengths and limitations of the implementation frameworks.

A data extraction guide containing examples of extractions from an included article that were conducted through the piloting process, and a decision-making matrix, were developed to aid in extraction, provide transparency, and reduce errors.

Any conflicts in the extraction were discussed among the reviewer pairs completing extraction to reach a consensus. Regular meetings occurred among the research team members to consolidate findings and review the data extraction process.

Quality appraisal

All studies that satisfied the inclusion criteria were included in this review. As this is a systematic review focused on the application of theoretical implementation science approaches (but not on the results or outcomes of the included studies), a formal critical appraisal tool was not used. This is consistent with a previous systematic review (a critical interpretive synthesis of the PARIHS and i-PARIHS frameworks) [21]. Also, consistent with the systematic review on CFIR [16], this review assessed the quality and depth of application of the PARIHS/i-PARIHS framework and other theoretical implementation science approaches by:

(1) the inclusion criteria of our systematic review (i.e., applied PARIHS/i-PARIHS and at least one other implementation framework, not just mention the frameworks without application), and;
(2) the research questions, focusing on the rationale and context for applying other implementation frameworks, and the strengths and limitations of doing so.

This quality assessment was intended exclusively to evaluate the quality of the application of i-PARIHS with other theoretical implementation science approaches (and not the quality of any other aspects of the studies described in the included articles).

Data analysis

The extracted data were exported from Covidence [22] and downloaded as an Excel spreadsheet. Descriptive statistics was used to analyse the categorical data for the study characteristics. The frequency for each implementation framework used with PARIHS/i-PARIHS was determined. The answers to open-ended extraction questions for how PARIHS/i-PARIHS and other frameworks were used were analysed qualitatively, applying a content analysis approach [24]. For each question, the qualitative extracts were read and re-read for familiarisation and then openly coded [24]. Following coding, categories were developed to provide an overall summary of the rationales and strengths for each implementation framework and their combined application.

Results

Study selection

The primary search of the databases identified 1,057 articles, and after removing duplicates ($n=554$), 503 underwent title and abstract screening. Of these, 316 articles underwent full-text screening, and 26 remained for inclusion from the primary search. From the supplementary search, 834 articles were identified. After removing duplicates ($n=372$), 462 articles were screened, resulting in 10 articles remaining for inclusion. Thus, in total, 36 articles were included in the review. The flow of articles included in the study are shown in Fig. 1.

Study characteristics

In total, the 36 articles consisted of 16 protocols [25–40]. A further 20 articles reported empirical studies; twelve were intervention studies [41–52] and eight were cross sectional studies [53–60].

All 36 articles conducted research within the health system. Two spanned both the health and education system [37, 60] and one spanned both the health and social care system [41].

Ten of the articles conducted research within primary care [25, 32, 35, 36, 38, 40, 48, 49, 55, 58], eight within the community [29, 37, 41, 43, 54, 56, 57, 60], nine within

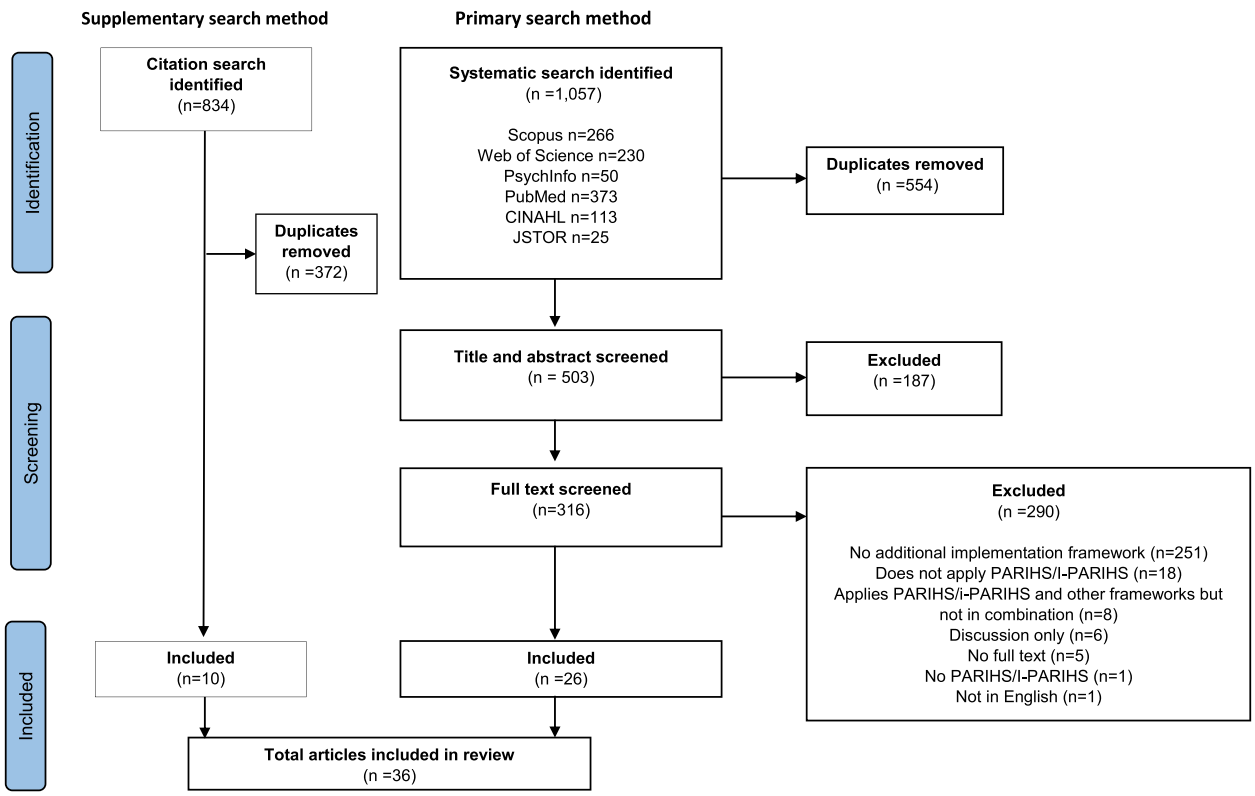

Fig. 1 Flow diagram of included studies

hospital settings [33, 39, 44–47, 50, 52, 59], seven spanning hospital and primary care [26–28, 30, 34, 42, 53], one spanning community and primary care [31], and one spanning community and hospital [51].

Of the 36 articles, 19 were derived from research in the USA [25–31, 34, 35, 37–39, 42, 48, 49, 52, 53, 58, 60], eight from Australia [32, 33, 44, 45, 47, 50, 51, 54], three from Sweden [36, 46, 56], two from the UK [41, 55], one from Canada [57], one from China [59], one from Eswatini [43], and one from Nigeria [40].

Table 1 provides a summary of the study characteristics.

Application of i-PARIHS and other implementation frameworks

In total, 31 studies applied the i-PARIHS framework [25–28, 30–53, 55, 58] and five of the studies applied the original PARIHS framework [29, 54, 57, 59, 60].

Thirty-four of the studies used one additional implementation framework. However, two studies used two additional implementation frameworks [35, 36]. In total,

Table 1 Study characteristics

Reference details	Country	Type of article	Study Design		System	Setting
			Intervention	Cross Sectional		
Aifah et al. 2023 [40]	Nigeria	Protocol	X		Health	Primary care
Almeida et al. 2020 [25]	USA	Protocol	X		Health	Primary care
Alt Murphy et al 2021 [46]	Sweden	Empirical	X		Health	Hospital
Amador et al. 2021 [41]	UK	Empirical	X		Health/Social	Community
Bahraini et al. 2020 [26]	USA	Protocol	X		Health	Hospital/Primary care
Connolly et al. 2020 [53]	USA	Empirical		X	Health	Hospital/Primary care
Damush et al. 2020 [42]	USA	Empirical	X		Health	Hospital/Primary care
Edelman et al. 2021 [27]	USA	Protocol	X		Health	Hospital/Primary care
Felker et al. 2022 [60]	USA	Empirical		X	Health/Education	Community
Gordon et al. 2018 [28]	USA	Protocol	X		Health	Hospital/Primary care
Hill et al. 2021 [29]	UAS	Protocol	X		Health	Community
Iverson et al. 2020 [30]	USA	Protocol	X		Health	Hospital/Primary care
Levin et al. 2022 [31]	USA	Protocol	X		Health	Community/Primary care
Lewis et al. 2018 [54]	AUS	Empirical		X	Health	Community
McClatchey et al. 2022 [55]	UK	Empirical		X	Health	Primary care
Meloncelli et al. 2020 [44]	AUS	Empirical	X		Health	Hospital
Merlo et al. 2022 [45]	AUS	Empirical	X		Health	Hospital
Michaud et al. 2020 [32]	AUS	Protocol	X		Health	Primary care
Mudge et al. 2017 [33]	AUS	Protocol	X		Health	Hospital
Niemeyer Hulstrand et al. 2020 [43]	Eswatini	Empirical	X		Health	Community
Nygardh et al. 2016 [56]	Sweden	Empirical		X	Health	Community
Owen et al. 2019 [34]	USA	Protocol	X		Health	Hospital/Primary care
Pang et al. 2023 [51]	AUS	Empirical	X		Health	Hospital/Community
Peel et al. 2021 [47]	AUS	Empirical	X		Health	Hospital
Ruest et al. 2022 [57]	Canada	Empirical		X	Health	Community
Sabesan et al. 2021 [50]	AUS	Empirical	X		Health	Hospital
Sideris et al. 2024 [52]	USA	Empirical	X		Health	Hospital
Singh et al. 2022 [35]	USA	Protocol	X		Health	Primary care
Smith et al. 2018 [49]	USA	Empirical	X		Health	Primary care
Smith et al. 2021 [48]	USA	Empirical	X		Health	Primary care
Strid et al. 2022 [36]	Sweden	Protocol	X		Health	Primary care
Swindle et al. 2017 [37]	USA	Protocol	X		Health/Education	Community
Szymczak et al. 2024 [39]	USA	Protocol	X		Health	Hospital
Tuepker et al. 2018 [58]	USA	Empirical		X	Health	Primary care
Wray et al. 2018 [38]	USA	Protocol	X		Health	Primary care
Yue et al. 2022 [59]	China	Empirical		X	Health	Hospital

nine implementation frameworks were applied with PARIHS/i-PARIHS. These included:

- Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) [8]: $n=16$ [25–27, 29–32, 34, 35, 37, 38, 40, 47, 48, 52, 60]
- The Consolidated Framework for Implementation Research (CFIR) [5]: $n=9$ [28, 36, 39, 41, 42, 45, 57–59]
- Normalisation Process Theory (NPT) [7]: $n=5$ [33, 36, 43, 44, 54]
- Replicating Effective Programs (REP) [61]: $n=2$ [49, 53]
- Theoretical Domains Framework (TDF) [10, 11]: $n=2$ [51, 55]
- Dynamic Sustainability Framework (DSF) [62]: $n=1$ [35]
- Knowledge to Action (KTA) [6]: $n=1$ [46]
- Stetler's Model [9]: $n=1$ [56]
- Strategic Implementation Framework (SIF) [63]: $n=1$ [50]

The way in which PARIHS/i-PARIHS and other implementation frameworks were used varied significantly. Table 2 summarises how each included study applied i-PARIHS and other implementation frameworks across the different phases of an implementation project (planning, delivery, analysis, and evaluation). Meanwhile, Fig. 2 provides an overall quantitative summary of which frameworks were used within the phases.

Of the 36 articles, PARIHS/i-PARIHS was used in 31 to plan or design the implementation approach [25–31, 33–42, 44–50, 52–58, 60], in 19 to conduct implementation or deliver an intervention [26, 33, 34, 36–42, 44, 46, 48–50, 53–56, 60], in 22 to analyse data collected [25, 28–32, 34, 35, 37–39, 41, 43, 45, 48, 50–53, 57–59] and in 15 to evaluate intervention or implementation effectiveness [25, 27–33, 39, 43, 44, 48, 53, 57, 59].

Overall, only three articles used i-PARIHS in all four phases of the study design [39, 48, 53] and only one of the articles used another implementation framework (CFIR) in all four phases of the study design [42]. The majority of the articles combined their use of PARIHS/i-PARIHS and other implementation framework within one (or more) of the study design phases [25–33, 35, 36, 38, 39, 41–53, 55–58, 60]. Whereas five of the articles used PARIHS/i-PARIHS and another implementation framework in separate study design phases [34, 37, 40, 54, 59].

Rationale for i-PARIHS and other implementation frameworks

The articles varied in detail, depth, and quality in terms of descriptions of why they selected more than one implementation framework. Of the 36 articles, 34 reported a rationale for using PARIHS/i-PARIHS [25–53, 56–60] and 34 reported a rationale for using the other implementation framework [25, 27–42, 45–60]. Supplementary File 2 provides a summary.

Rationale for i-PARIHS

Of the 34 articles that reported a rationale for using PARIHS/i-PARIHS, 22 reported using PARIHS/i-PARIHS to guide the implementation process and to use facilitation [26, 28, 33–39, 41, 42, 44, 46–50, 56–60] and 13 reported using PARIHS/i-PARIHS to identify barriers and enablers to implementation and evaluation of implementation outcomes [25, 27, 29–32, 38, 40, 43–45, 51–53, 58].

Rationale for other implementation framework

Of the 16 articles that used RE-AIM, all consistently reported using RE-AIM to evaluate implementation outcomes [25–27, 29–32, 34, 35, 37, 38, 40, 47, 48, 52, 60]. Six of the nine articles that used CFIR reported using CFIR to evaluate the implementation process [28, 36, 39, 41, 45, 58] and four reported using CFIR to guide or inform the implementation process [28, 42, 57, 59]. Two of the four articles that used NPT reported a rationale. One reported using NPT to guide a realist evaluation and [54] and the other reported using NPT to survey participants [33]. One of the two articles that used REP reported using it to structure the implementation stages and guide the facilitation process [53] and the other reported using REP to structure the implementation process and guide analysis [49]. Of the two articles that used TDF, both reported a rationale. One reported to use TDF to develop a behaviour change intervention [55] and one reported using TDF to inform interview questions to evaluate pilot implementation for future scale-up [51]. Stetler's Model was reported to be used to support the facilitation process [56], and SIF was reported to be used for a mixed methods evaluation [50].

Rationale for multiple implementation frameworks

Whilst many of the studies reported a rationale for each individual implementation framework, only eleven reported an explicit rationale for using multiple [25, 28, 35, 37, 40, 47, 48, 51, 57–59].

The following rationales were provided for combining approaches:

- i-PARIHS and RE-AIM:
  - Allowed for testing of efficacy and feasibility of delivering the intervention at scale [25]

Table 2 Summary of how PARIHS/i-PARIHS and other implementation frameworks have been applied ($n = 36$)

Study	Frameworks used							
	Planning		Delivering		Analysis		Evaluation	
RE-AIM								
Aifah et al. [40]	i-PARIHS		i-PARIHS					RE-AIM
Almeida et al. [25]	i-PARIHS	RE-AIM			i-PARIHS		i-PARIHS	RE-AIM
Bahraini et al. [26]	i-PARIHS	RE-AIM	i-PARIHS					RE-AIM
Edelman et al. [27]	PARIHS						PARIHS	RE-AIM
Felker et al. [60]	PARIHS	RE-AIM	PARIHS					RE-AIM
Hill et al. [29]	PARIHS	RE-AIM			PARIHS	RE-AIM	PARIHS	RE-AIM
Iverson et al. [30]	i-PARIHS	RE-AIM			i-PARIHS	RE-AIM	i-PARIHS	RE-AIM
Levin et al. [31]	i-PARIHS				i-PARIHS	RE-AIM	i-PARIHS	RE-AIM
Michaud et al. [32]					i-PARIHS		i-PARIHS	RE-AIM
Owen et al. [34]	i-PARIHS		i-PARIHS		i-PARIHS			RE-AIM
Peel et al. [47]	i-PARIHS	RE-AIM						RE-AIM
Sideris et al. [52]	i-PARIHS	RE-AIM			i-PARIHS			RE-AIM
Singh et al. [35]	i-PARIHS	DSF	i-PARIHS		i-PARIHS	DSF		RE-AIM
Smith et al. [48]	i-PARIHS	RE-AIM	i-PARIHS		i-PARIHS		i-PARIHS	RE-AIM
Swindle et al. [37]	i-PARIHS		i-PARIHS		i-PARIHS			RE-AIM
Wray et al. [38]	i-PARIHS	RE-AIM	i-PARIHS		i-PARIHS			RE-AIM
CFIR								
Amador et al. [41]	i-PARIHS	CFIR	i-PARIHS		i-PARIHS			
Damush et al. [42]	i-PARIHS	CFIR	i-PARIHS	CFIR		CFIR		CFIR
Gordon et al. [28]	i-PARIHS	CFIR			i-PARIHS	CFIR	i-PARIHS	CFIR
Merlo et al. [45]	i-PARIHS	CFIR			i-PARIHS	CFIR		
Ruest et al. [57]	PARIHS	CFIR			PARIHS	CFIR	PARIHS	CFIR
Strid et al. [36]	i-PARIHS	CFIR	i-PARIHS			CFIR		NPT
Szymczak et al. [39]	i-PARIHS		i-PARIHS		i-PARHS	CFIR	i-PARIHS	CFIR
Tuepker et al. [58]	i-PARIHS	CFIR			i-PARIHS	CFIR		
Yue et al. [59]		CFIR			PARIHS		PARIHS	
NPT								
Lewis et al. [54]	PARIHS		PARIHS			NPT		NPT
Meloncelli et al. [44]	i-PARIHS		i-PARIHS			NPT	i-PARIHS	NPT
Mudge et al. [33]	i-PARIHS		i-PARIHS				i-PARIHS	NPT
Niemeyer Hulstrand et al. [43]					i-PARIHS	NPT	i-PARIHS	NPT
REP								
Connolly et al. [53]	i-PARIHS	REP	i-PARIHS	REP	i-PARIHS		i-PARIHS	
Smith et al. [49]	i-PARIHS		i-PARIHS	REP				
TDF								
Pang et al. [51]		TDF			i-PARIHS	TDF		
McClatchey et al. [55]	i-PARIHS	TDF	i-PARIHS			TDF		
Other								
Alt Murphy et al. [46]	PARIHS	KTA	PARIHS	KTA				
Nygardh et al. [56]			PARIHS	Stetler's				
Sabesan et al. [50]	i-PARIHS	SIF		SIF	i-PARIHS			SIF

PARIHS Promoting Action on Research Implementation in Health Service, *i-PARIHS* integrated-Promoting Action on Research Implementation in Health Service, *RE-AIM-Reach* Effectiveness, Adoption, Implementation, Maintenance, *CFIR* Consolidated Framework for Implementation Research, *NPT* Normalisation Process Theory, *REP* Replicating Effective Programs, *TDF* Theoretical Domains Framework, *KTA* Knowledge to Action, Stetler's-Stetler's Model, *SIF* Strategic Implementation Framework, *DSF* Dynamic Sustainability Framework

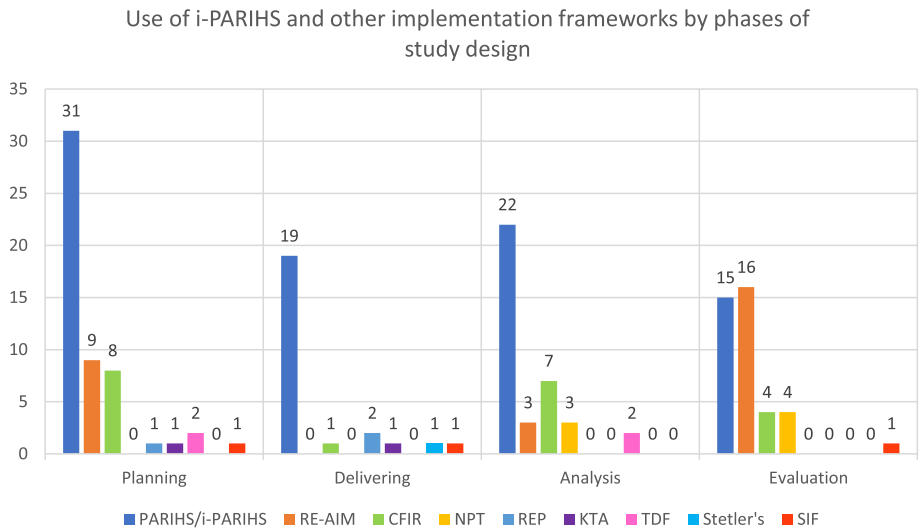

Fig. 2 Use of i-PARIHS and other implementation frameworks by phases of study design

- Provided a more systematic approach to evaluation [47]
- Allowed for a focus on longitudinal facilitation [35]
- A conceptual framework was developed outlining how the two approaches worked together to design and evaluate implementation [38, 40]

- PARIHS/i-PARIHS and CFIR:
  - Allowed for a more comprehensive approach to implementation supported by facilitation [28]
  - To complement one another and identify all characteristics of relevant contextual factors [57]
  - Allowed for documentation of effectiveness and how facilitation was used to navigate barriers and enablers [38, 58]
  - Existing frameworks were not sufficient as a single approach [59]

- i-PARIHS and REP:
  - To test the combined use of approaches [49]
- i-PARIHS and TDF:
  - As i-PARIHS builds on the other implementation framework [51]

Strengths and limitations of i-PARIHS and other implementation frameworks

Only three of the 36 articles reported strengths of combining implementation frameworks [38, 46, 59]. One of the articles combined i-PARIHS and RE-AIM and reported that use of both allowed for clear documentation of effectiveness as well as how facilitation was used to overcome barriers and harness enablers [38]. One of the articles combined PARIHS and CFIR and reported that using both allowed for sufficient guidance to support the implementation process [59]. The third article combined PARIHS and KTA and reported that using facilitation to engage clinicians in the knowledge creation and action cycles to tailor and adapt the intervention content was key to implementation success [46]. None of the articles explicitly reported limitations of combining implementation frameworks.

There was also a limited description of strengths and limitations regarding the individual use of PARIHS/i-PARIHS and other implementation frameworks. Of the 36 articles, only nine reported strengths of using PARIHS/i-PARIHS [26, 28, 33, 38, 43, 44, 46, 51, 60]. Four of the eight articles reported facilitation as a strength of using PARIHS/i-PARIHS [26, 28, 33, 46], and three reported its strength in the planning phase to assess factors that may influence implementation [38, 44, 51]. Further, one reported its strength in supporting structured reporting of implementation processes [43], and one reported its strength in organising the overall project and supporting communication with stakeholders [60].

Of the 36 articles, only four reported strengths of using the other implementation frameworks [28, 38, 39, 59]. Two reported strengths for CFIR, specifically, as being more comprehensive than other frameworks [28] and for providing practical tools [59]. Two reported strengths for RE-AIM, specifically, as being able to evaluate implementation in a real-world setting [38] and for offering a systematic guide for collecting and analysing data [40]. None of the articles explicitly reported limitations regarding

the individual use of PARIHS/i-PARIHS or other implementation frameworks.

Discussion

This is the first review to systematically examine what implementation frameworks have been applied with PARIHS/i-PARIHS in the literature. Thirty-six studies were included in the review and nine different implementation frameworks were identified as being applied with PARIHS/i-PARIHS. This provides evidence that combined use of implementation frameworks is an emerging trend within the field of implementation science and one that warrants examination. This is especially true given that this review identified how varied the articles are in the detail, depth, and quality in terms of descriptions of why they used more than one implementation framework.

Despite identifying nine frameworks used alongside PARIHS/i-PARIHS, two are clearly the most commonly used: Reach, Effectiveness, Adoption, Implementation, Maintenance (RE-AIM) [8] and the Consolidated Framework for Implementation Research (CFIR) [5]. An interesting finding was that five of the 36 included articles used the original PARIHS framework, despite the revised i-PARIHS framework being published and available. Only one article [59] provided a rationale stating that the PARIHS was a better fit due to its clearly defined constructs, sub elements, and rating criteria. However, this may suggest a lack of recognition of the revised i-PARIHS framework, as it was specifically developed to provide clearer theoretical underpinnings and support for operationalising the framework [4, 13].

Despite PARIHS/i-PARIHS being a determinant framework that can be used across all phases of implementation research [4], we identified that many researchers are not using it in this way. Only three studies reported use of PARIHS/i-PARIHS in all four phases [39, 48, 53]. This indicates that implementation researchers see a need to supplement PARIHS/i-PARIHS with another implementation framework. The most common phase in which PARIHS/i-PARIHS was used was planning or delivery, which may reflect the utility of the flexible and context-tailorable facilitation (both the role and the actions) represented by i-PARIHS. This is supported by the most common reported rationale for using PARIHS/i-PARIHS being due to the framework's facilitation construct.

The most common way in which RE-AIM was used in combination with PARIHS/i-PARIHS was in evaluation. This combination makes sense given the differences in purpose and theoretical underpinning of each framework. This is supported by the most common reported rationale for using RE-AIM being to evaluate implementation outcomes, which is to be expected as it is an evaluation framework [4]. Similarly, of the few articles that reported strengths of combined use, those that did confirm that combining PARIHS/i-PARIHS with RE-AIM provides a strong implementation (facilitation) and evaluation approach. This combination indicates that implementation researchers may see shortcomings in PARIHS/i-PARIHS to evaluate implementation efforts and this can be supplemented with the RE-AIM framework.

However, it gets interesting when interpreting the use of PARIHS/i-PARIHS with CFIR. The use of CFIR does not appear to support other phases; rather, it appears to supplement PARIHS/i-PARIHS within one (or more) of the phases. The conceptual similarities between PARIHS/i-PARIHS and CFIR, and the reported rationales for each, leave an unanswered question of why users are combining similar implementation frameworks. The similarities and no reported relative advantage beg the question of whether we are seeing unnecessary duplication with the risk of theoretical conflict. The most commonly reported rationale for using CFIR was to guide and evaluate the implementation process. However, i-PARIHS and CFIR were equally used within the evaluation phase, undermining the reported additional utility of CFIR for evaluation. One possibility may be that given the similarities, the two frameworks are viewed as theoretically compatible, and the distinct benefit of each may be facilitation for PARIHS/i-PARIHS and the available tools and resources for CFIR.

Despite all included studies combining use of implementation frameworks, unfortunately, we have learnt very little about why multiple frameworks have been used, with only a very few studies reporting an explicit rationale for selecting more than one framework. Most reported a rationale for using PARIHS/i-PARIHS as well as the other implementation framework, however the detail, depth, and quality of descriptions varied significantly. Overall, this supports previous research proposing that implementation frameworks are not used to their full capacity [15]. The citation analysis on PARIHS by Bergström et al. [15] found that only 23% of included studies used the framework in a substantial way. These findings are similar to reviews conducted on other implementation frameworks. Specifically, a review on CFIR found that less than 10% of included studies used the framework in a meaningful way [19]. The field of implementation science has repeatedly made clear that underuse, superficial use, or misuse of implementation frameworks can undermine methodological rigour and can impact health and clinical outcomes [15, 18]. If the field of implementation science was already in a situation where individual frameworks are not being comprehensively applied, we are now

facing combined use of frameworks without clear justification. This presents a critical issue for the science of implementation science. If implementation frameworks are combined within research studies without clear rationale and explanation, this can obscure our ability to understand mechanisms of effect and may undermine scientific integrity. Ultimately, it muddies the water.

In the context of this review, the lack of consideration for the theoretical underpinnings and lack of clear rationales for combining frameworks of the same or different theoretical underpinnings, makes it difficult to conclude what combinations may be effective or useful for various purposes. This finding builds on a recent review that explored the selection and application of implementation frameworks from the five categories: process models, determinant frameworks, classic theories, implementation theories, and evaluation frameworks [1]. The review found that studies did not discuss or justify why they selected implementation frameworks from a particular category, indicating no consideration for theoretical underpinnings [64]. Like our investigation, the review identified four studies that used more than one implementation framework, which often belonged to different categories. The review concluded however, that despite it making sense intuitively to combine frameworks from different categories (e.g. combining a determinant framework with a process model) the lack of reported detail makes it difficult to draw conclusions around the merit and effectiveness of combined uses [64].

As outlined, this review presents significant implications for the field of implementation science, primarily for its researchers and practitioners. Firstly, when planning and designing an implementation project, researchers and practitioners need to consider the purpose and theoretical underpinnings of implementation frameworks, as this will not only support comprehensive use of one framework but will aid in deciding if it theoretically and practically makes sense to use more than one. Secondly, if a decision is made to use more than one implementation framework, there needs to be an explicit rationale that is articulated and reported. It is not sufficient to simply report what frameworks were used nor is it sufficient to replicate the study design of a prior publication. We propose that good reporting should include 1) a clear rationale for multiple implementation framework selection, including risks of not combining, 2) how the decision was made to use multiple frameworks, 3) ways in which all the elements of each implementation framework were used or not used, and 4) acknowledgement of the strengths and limitations of using multiple implementation frameworks. Reporting this detail will be critical to ensuring that combined use of frameworks can be evaluated for effectiveness.

Limitations

This study was a systematic review specifically on the use of PARIHS/i-PARIHS in combination with other implementation frameworks thus further exploration is warranted to understand the combined use of implementation frameworks more broadly. In addition, we cannot say with certainty that the included studies did not have rationales for why they selected the implementation frameworks they did, and why they decided to use more than one. It is worth acknowledging that the exclusion of this methodological detail may be influenced by publishing biases as health journals have historically prioritised trial methodology and clinical outcomes over implementation methodology and implementation outcomes [15]. This may have resulted in many of the authors not fully detailing or reporting their selection and application of implementation frameworks. Additionally, as we did not include articles that were not written in English, we may have limited insights into the selection and application of implementation frameworks published in other languages.

Conclusion

Implementation science is a field that aims to offer evidence-informed approaches in the form of implementation frameworks, to support the adoption of research into policy and practice. Utilising these implementation frameworks is intended to maximise the chances of successful implementation and also provides critical insights into, and explanations of, implementation processes and outcomes. This systematic review on the use of the i-PARIHS framework in combination with other implementation frameworks shows that, as a field, we are potentially moving away from being able to offer evidence-informed approaches to support the adoption of research into policy and practice. The findings highlight that implementation researchers are using more than one implementation framework within an implementation effort and are providing very little to no rationale for why. This makes it difficult, if not impossible, to determine what is the impact of the frameworks on implementation success or failure. There are significant risks that combining implementation frameworks may undermine the theoretical integrity of each individual framework if such rationale is missing. The advancement of the field of implementation science is reliant on framework users to be more explicit about their framework selection,

detailing the complementary strengths of the frameworks that are being used in combination, including why one is not sufficient. Further, we support prior calls for the development and adoption of reporting guidelines on how frameworks are used in implementation studies. This will ultimately strengthen the ability to assess whether combining implementation frameworks leads to better, or hinders, implementation and clinical outcomes.

Abbreviations

CFIR	Consolidated Framework for Implementation Research
DSF	Dynamic Sustainability Framework
i-PARIHS	Integrated-Promoting Action on Research Implementation in Health Services
KTA	Knowledge to Action
NPT	Normalisation Process Theory
PARIHS	Promoting Action on Research Implementation in Health Services
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RE-AIM	Reach, Effectiveness, Adoption, Implementation and Maintenance
REP	Replicating Effective Programs
SIF	Strategic Implementation Framework
TDF	Theoretical Domains Framework

Supplementary Information

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Supplementary Material 1.

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ALK is one of the developers of the PARIHS and i-PARIHS frameworks. AB is part of the Editorial Board for Implementation Science Communications. All other authors declare that they have no competing interests.

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