

REVIEW

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How does integrated knowledge translation work? A realist review

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Abstract

Background Integrated knowledge translation (IKT), or research co-production, is a research approach where researchers and knowledge users carry out a study as equal partners. A growing evidence base demonstrates that IKT produces research findings that are useful, usable and used. Despite knowing how IKT works, we have yet to ascertain how it operates. We conducted a realist review to examine the key mechanisms thought to explain how IKT approaches work in relation to the generation of research in the healthcare sector.

Methods The research question was the following: what are the necessary conditions (context) and key mechanisms that explain the success of IKT in the healthcare sector? We conducted the review in two phases. During phase 1, we collaborated with knowledge users and scoped the literature to develop preliminary program theories. In phase 2, we inductively tested the preliminary program theories against the literature. We searched OVID Medline, Embase, PsycINFO, the Cumulative Index of Nursing and Allied Health Literature, Social Sciences Abstracts, and ABI Inform for empirical articles published between 2002 and 2017. An updated search included Embase and OVID Medline articles published between 2017 and 2020. The review includes 84 papers. We included articles written in English that focused on the health sector; encompassed the co-generation of research with researchers, policy-makers, administrators and/or practitioners; and evaluated the IKT approach. In analysing the retained articles, we produced three program theories by looking for common patterns and challenging and refining these theories.

Results We postulate three program theories about how teams of researchers and knowledge users work to generate research. We identified three important conditions: infrastructure, role clarity and power sharing. Under particular infrastructure arrangements, effective partnerships are mechanisms that lead to the production of research findings relevant to knowledge users. Role clarity also triggers effective partnerships. With power sharing, synergy is a mechanism that leads to the use of findings.

Conclusions We identified different conditions (contextual factors), including infrastructure, role clarity and power sharing, in which IKT produces research findings that are of relevance to knowledge users and used in health settings. Effective partnerships are necessary but an insufficient mechanism for actual use of research findings, and must occur before the mechanism of partnership synergy. This work contributes to our understanding of how to enhance the uptake of evidence by presenting three program theories and a consolidated, mid-range theory of IKT.

Keywords Integrated knowledge translation, Knowledge translation, Research co-production, Partnered research, Realist review, Power, Infrastructure, Role clarity

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Background

Integrated knowledge translation (IKT) is a partnered approach to the generation and application of research findings. Those using the approach may include a combination of team members in the research process, including administrators, policy-makers, funders, clinicians, community members or persons with lived experience of certain conditions. More formally, IKT is defined as a “model of collaborative research, where researchers work with knowledge users who identify a problem and have the authority to implement the research recommendations” (p. 299) [1]. IKT applies to the entire knowledge production process, from the generation of research questions to the development of context- and knowledge-user-appropriate strategies to put co-generated knowledge to use. IKT evolved from the premise that the underutilization of research findings in practice, programs and policy is a result of research questions that do not align with the needs of knowledge users. Because knowledge users are not involved in the production of research, they have no stake in the implementation of the findings. By working together, however, researchers and knowledge users can generate and address relevant research questions, resulting in findings that are useful to knowledge users and used in health settings. Those who are interested in or affected by the research (stakeholders) are distinct from knowledge users or partners working alongside researchers in the research process [2]. In sum, IKT is “a model of collaborative research that explicitly responds to knowledge user needs in order to produce research findings that are useful, useable, and used” (p.2). [2] In this work, we consider IKT to be equivalent to research co-production.

A number of reviews about IKT and research co-production have generated useful insights about the process [3–11]. Scholars have reported barriers to and facilitators of IKT, and often, the barriers are the converse of the facilitators. Communication within the partnership has been identified as a predominant factor, which is closely aligned with clear expectations (e.g. about time commitments). Researchers have also identified the importance of shared goals and objectives for IKT. Relatedly, also critical to IKT work is a shared governance structure with clear decision-making mechanisms [7]. Other consistently identified factors have been dedicated resources (e.g. logistical support) and funding for the partnership, which in turn increase capacity for IKT, such as through the provision of training in research skills [5]. Researchers have also proposed that the IKT process needs to be flexible and tailored and that it needs to involve frequent contact among team members. Studies have recognized that IKT requires time from partners, and that staff

turnover among knowledge user partners proves to be a challenge when a relationship has already been established. These reviews have also reported that collaborations with knowledge users work better when they begin in the early stages of research, such as setting the research agenda and formulating the research question.

While the list of barriers and facilitators generated by traditional systematic reviews is helpful, such a list only starts to uncover the complexities inherent in planning, executing or evaluating an IKT process. There is little information about the mechanisms that explain more fully how aspects of IKT interact to result in a successful IKT approach. While some barriers and facilitators relate to individual attributes, such as commitment, others appear to occur at a higher project level or even at the system level (e.g. funding). While there is a lot of information about barriers and facilitators, the list provides limited insight into how an IKT approach works to produce research that is relevant to knowledge users and findings that are used. In the face of these gaps, we pose the following question: How does being part of an IKT research process influence the IKT team members’ responses or decision-making? We do not know much about IKT mechanisms, which are the focus of this paper. Taking a realist review approach to the primary literature allowed us to direct attention to understanding how team partners contributed to IKT outcomes, i.e. what happens when researchers and knowledge users work together.

Using a realist review approach [12], our aim was to identify and then test the core mechanisms supporting IKT by understanding how organizational conditions stimulate team processes to achieve promising IKT outcomes. The findings may assist research teams and funders as they try to incentivize or establish mechanisms and/or conditions for productive interactions. Realist reviews are theory-driven; they start with a rough or preliminary program theory that is iteratively tested and developed to produce a refined program theory. The refined program theory is situated at the middle-range level such that hypotheses can be extracted for subsequent testing in different programs or situations [12]. We used an IKT approach to conduct this review. We brought together a team of researchers, research funders and health professional association members to develop the research question, and the expertise of the team was incorporated iteratively throughout the work. This realist review sought to develop a program theory regarding how IKT works, in what contexts and why. Our guiding research question was the following: What are necessary conditions (context) and key mechanisms that explain the success of IKT in the healthcare sector?

Methods

Realist reviews are based on a realist philosophy of science, which supports identifying and testing underlying generative mechanisms [12, 13]. These mechanisms, which are situated in particular conditions, provide strong explanatory power to understand a phenomenon [14]. Realism, which sits between empiricist and constructivist accounts of phenomena [13], supports the stance that what we know is an interpretive reality of social actors, that social actors evaluate their reality and that causal explanations are achievable [15].

Rationale for conducting a realist review

By using a realist lens, we are trying to understand how social processes – researchers and knowledge users working together – bring about change. The standard realist approach is to generate context–mechanism–outcome (CMO) configurations to understand the so-called black box of how IKT works. Context refers to the relevant dimensions of the setting, the circumstances or the groups; in this paper, we use the term “conditions”. Mechanisms are the social processes reflected in how the IKT team responds to the partnership approach. Mechanisms cause outcomes, but only under certain conditions. Put differently, certain conditions trigger, activate or accommodate IKT mechanisms to lead to outcomes. This generative view of causation challenges the idea that an IKT approach independently produces outcomes; rather, the idea of mechanisms flags the importance of social forces under conditions that generate outcomes [12, 16, 17].

We used a two-stage process in this review. The purpose of phase 1 was to define the scope of the review [18]. First, through collaboration with knowledge users, including T.H. and C.M., as well as other knowledge users who are no longer part of our team, we identified the research question and clarified the purpose of the review. Then, we developed preliminary program theories of IKT. We were interested in IKT research activities for the health sector that comprised or promoted collaboration, which we refer to collectively as approaches, but, in the absence of a universally accepted taxonomy, may also be referred to as strategies, mechanisms, methods, activities, or processes. The preliminary hypotheses proposed which conditions (the characteristics of the space or place within which the IKT approach is situated) triggered or supported particular mechanisms to produce certain outcomes. This phase helped us disentangle the levels at which mechanisms could be found, thereby further focusing our inquiry. Preliminary theories can be developed through stakeholder interviews, consideration of extant research, related theories and documents [19]. Our preliminary IKT program theories were based on the empirical and nonempirical published literature,

along with iterative team meetings for discussion and revisions.

The preliminary program theories were tested in phase 2 of the review. This involved working with a librarian to search the literature, followed by systematic screening and data extraction of selected articles. A key step here was to assess an article for methodological rigour and relevance to the preliminary program theories. Articles that were deemed relevant were synthesized to refine the preliminary program theories related to IKT. Knowledge users on the team, including T.H., C.M., and other knowledge users who are no longer members of the project, were involved in multiple discussions throughout the iteratively developing work to develop specific, refined theories of IKT.

The review was registered with the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42018107832), and the Realist And Meta-narrative Evidence Syntheses: Evolving Standards (RAMSES) publication standards [12] guided our reporting.

Phase 1 approach: scoping the literature for theory development

All project team members (i.e. authors and other knowledge users who are no longer project members), themselves experts in IKT, nominated relevant articles that contained details about the IKT process. A total of 16 articles identified by at least two members were used to develop the initial program theory (Supplementary File 1). Drawing on guidelines by Booth et al. [20], these articles were read by four team members to develop hypotheses in the form of “if–then” statements (Supplementary File 1), which were then discussed by the entire research team. Next, a set of 100 empirical and conceptual articles consisting of the nominated articles, our personal files, and rapid, informal database searches were used to further develop the if–then statements. The statements were clustered and labelled in a concept map (Fig. 1).

In virtual meetings, the team undertook a process of analysis through which one of the main aims was to determine the major outcomes of IKT. This analysis included not only reference to the cluster map and the if–then statements but also our experiences of working in IKT, which we discussed through a process of identifying shared experiences and analyses of the texts, seeking contrary examples, and linking these findings to produce a hypothesis [21]. The team agreed that IKT is motivated by two major outcomes: the production of research findings relevant to knowledge users and the use of those research findings in decision-making. Our reflections and experiences suggest the following. (1) Relevant research findings come about because researchers and knowledge users come together to share their expertise.



Fig. 1 Concept map of if-then statements hypothesizing barriers to and facilitators of IKT research

Researchers bring methodological expertise, while knowledge users bring their understanding of the implementation setting, the organization, the sector and other political issues. Both knowledge users and researchers understand the topic from their own perspective. By working together, research questions are selected and framed in relevant ways for knowledge users, and data interpretation and recommendations are generated with an application lens. Research findings are expected to be relevant and feasible for implementation. (2) Our understanding of the second outcome, use of research, relies on Weiss’s classic categorization of conceptual, instrumental and symbolic research/knowledge use [22]. Implementation (instrumental use) of research findings is desirable, but considering and discussing research findings were seen by the team as positive IKT outcomes and likely preceded instrumental use of findings. Symbolic use, where research is used to support a predetermined decision, was also acknowledged as a type of research use outcome.

Through iterative team meetings, we were able to further focus our preliminary emerging theory. We chose to work with variables that were amenable to change and restrict the theory building to the organization level (to the exclusion of extra-organizational/policy). We were interested in the health sector, and we agreed that we would limit our focus to studies where the IKT approach led to some generation of research or knowledge and not just implementation of a previously developed program or intervention. We limited our focus to studies involving knowledge users to those who are policy-makers, administrators and practitioners (persons with lived or living

experience were excluded). Our rationale was that it is precisely these decision-makers in the healthcare setting who can use research generated through IKT partnerships to influence health system change. We believe that IKT motivations and responses are different for those with lived experiences of certain conditions, and they do not tend to make decisions about the health system. Finally, we were especially interested in papers by teams that evaluated their IKT approach.

With this focused lens, the entire team interrogated the relationships in the concept map to develop the preliminary theories with key mechanisms (Fig. 2). We were attuned to major concepts that emerged in the literature about how IKT works, but we also noted subtleties in the literature about concepts that might be important or that showed contradictory findings. Our preliminary explanations for mechanisms underlying successful IKT were the following.

- (1) **Effective partnerships:** Effective partnerships are characterized by trust, authenticity and openness among partners. These social processes come together to form an effective partnership when conditions related to infrastructure, role clarity, power sharing and pre-existing relationships are in place. An effective partnership leads to the production of research findings relevant to knowledge users.
- (2) **Synergies:** Synergies, which include and go beyond effective partnerships, speak to something extra that allows for accomplishments that could not have happened without the partnership rela-

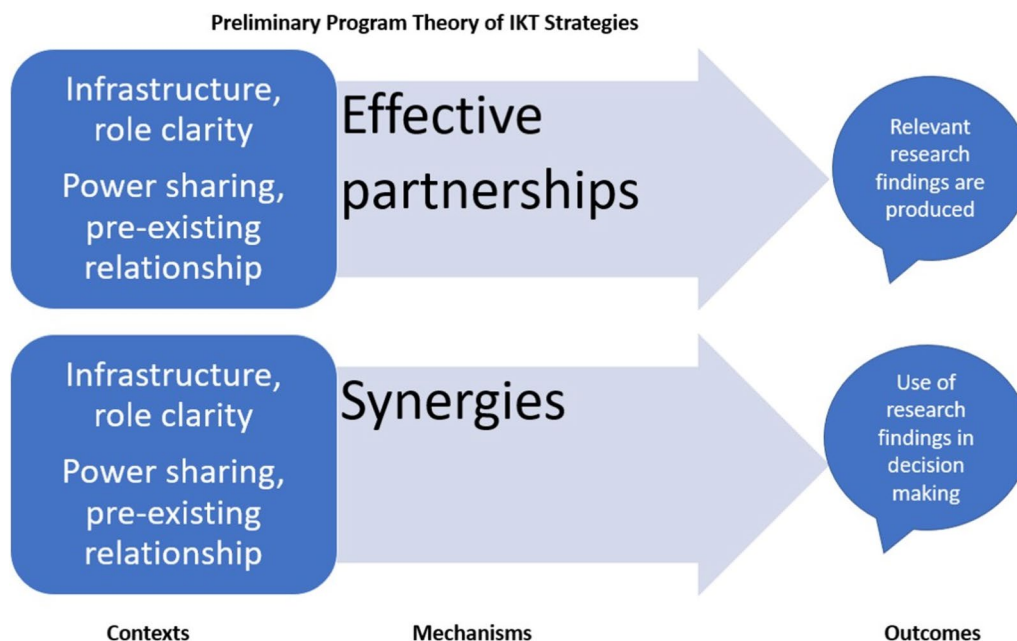


Fig. 2 Preliminary program theory of key mechanisms influencing IKT

tionship. Synergies are accomplished through high-quality, meaningful relationships among partners, with increased collaboration (collaborative action) and sustainability of the relationships. Synergies can flourish under conditions related to infrastructure, role clarity, power sharing and pre-existing relationships, and they lead to the use of research findings in decision-making.

Phase 2 approach: screening and testing of program theories

Search process

We tested our preliminary program theories during the second phase of our review using published IKT articles that report IKT approaches and outcomes. A health sciences library scientist experienced in systematic review searching developed and executed the search strategy in collaboration with a team member. The search strategy sought to identify empirical research studies in a healthcare setting using IKT or where there was collaboration between those who produce research and those who use it. The search strategy was broad in scope owing to the inconsistency in indexing of the IKT literature [23, 24]. An initial search strategy was tested and adjusted to ensure that it was sensitive enough to retrieve 15 highly relevant articles identified by the research team. The final OVID Medline search strategy is shown in Supplementary File 2. The search strategy was executed in six relevant databases (OVID Medline,

Embase, PsycINFO, the Cumulative Index of Nursing and Allied Health Literature, Social Sciences Abstracts, and ABI Inform). We first searched the databases on 3 March 2017, and we included citations published between 2002 and 2017. We determined that a 15-year timespan was likely to capture most of the relevant literature, as IKT is a relatively new phenomenon in the healthcare sector [25].

A second search was performed using the Embase and OVID Medline databases on 15 September 2020; for feasibility reasons, we limited the update to these two highest-yield databases. The reference lists of all selected articles were reviewed for possible relevant articles. We limited this review to research conducted prior to the coronavirus disease 2019 (COVID-19) pandemic, as significant changes in working conditions and processes were prompted by public health measures and continue to persist, including the increased prevalence of virtual and remote work [26, 27]. To this end, we included articles published in 2020 that reported on research conducted prior to the implementation of public health measures (approximately March 2020, following the declaration by the World Health Organization that COVID-19 was a global pandemic). As such, further research is needed to investigate conditions, mechanisms and outcomes that shape IKT in consideration of these significant shifts in research processes and conditions. See Fig. 3 for a Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) diagram depicting the inclusion and screening process.

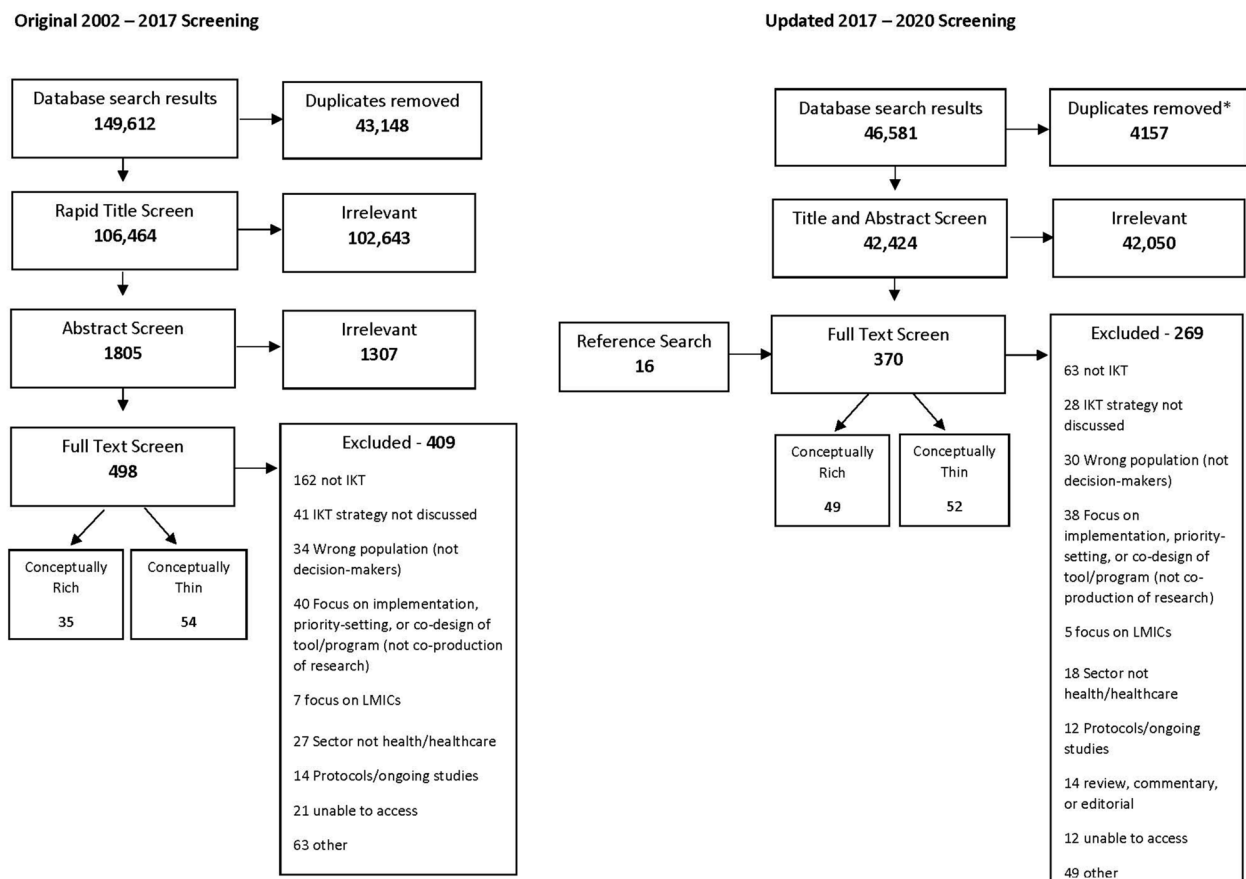


Fig. 3 Prisma diagram of screening process for Phase 2

Selection and appraisal

Titles and abstracts were screened for conceptual relevance by trained research assistants, and selected articles went on to full-text review by two authors (either A.K., T.S. or S.L.S.). We included articles written in English that focused on the health sector, encompassed the co-generation of research with researchers, policy-makers, administrators, and/or practitioners, and evaluated the IKT approach. Requiring articles to have evaluated the IKT approach was an inclusion criterion added after protocol registration with PROSPERO. We excluded articles that reported on implementation only (without the co-production of knowledge to be implemented) and those set in low- or middle-income countries, which we argue represent a different socioeconomic setting than high-income countries. We excluded action research or other community-based participatory approaches, practice-based quality improvement initiatives, and research conducted by practice-based research networks (groups of clinicians or institutions that jointly deliver patient care), inter-organizational networks, and quality improvement collaboratives that disseminate knowledge

to point-of-care providers or that improve service delivery and outcomes but do not undertake research – these exclusion criteria were added after protocol registration with PROSPERO. These were excluded given key differences between these approaches and IKT related to their onto-epistemologies and aims; for instance, unlike community-based participatory research, the aim of IKT is to collaborate with decision-makers to achieve implementation goals, rather than other aims of empowerment and participation. Likewise, the power dynamics shaping the work of practice-based research networks may differ in important ways from those in IKT given that IKT is uniquely characterized by collaboration between researchers and knowledge users. The reference lists of eligible articles were scanned for possible primary studies.

Drawing on Pearson et al., we critically appraised the selected articles along two dimensions [28]. First, each article was subjected to methodological appraisal using a tool suitable for qualitative and quantitative studies [29]. Articles were appraised in relation to the clarity of the research question, the theoretical perspective,

the study design, the context in which the study took place, sampling, data collection, data analysis, reflexivity and generalizability (Supplementary File 3). Second, as is characteristic of realist methods, each article was assessed for its potential to contribute to the development of our preliminary theory. Articles were classified as either rich or thin in terms of conceptual relevance [28] and depth of description. Thin articles provide minimal insights regarding relevance and few descriptive details [28]. In rich articles, the theoretical concepts (and relationships between/among them) are grounded in the literature, described in depth, and understandable, and conditions, goals versus actual outcomes, and strengths and weaknesses are discussed in detail. Our aim was to test our preliminary theories regarding the mechanisms that support successful IKT based on empirical articles that were conceptually relevant. Rich articles were selected purposively for data extraction as they had the most to offer in terms of understanding conditions and mechanisms in support of IKT outcomes (Table 1).

Data extraction and synthesis

A data extraction form was developed, tested and refined with critical input from the entire research team. Characteristics of the included studies were extracted, including the IKT approach being evaluated, the geographical location, the sub-sector related to the IKT approach, the partner type and the research methods. In line with realist synthesis methodology, the analysis proceeded through an iterative and interpretive process of theory refinement, as CMO configurations were developed through cross-case comparison, pattern recognition and discussion of conflicting findings [21]. Rather than aiming for numerical aggregation, we assessed the explanatory power of findings across studies, asking how, why and in what circumstances particular outcomes occurred. Specifically, with the assistance of NVivo software, the studies were analysed using the two preliminary theories generated in phase 1 by two authors (A.K., S.L.S. and research assistants); we coded and looked for common patterns related to the preliminary context–mechanism–outcomes to develop them through challenge or refinement. The findings were discussed and refined through meetings with the larger research team and re-reading of the papers; furthermore, preliminary results were discussed at seven international conferences for iterative feedback and discussion. This process was guided by abductive reasoning and retroductive inference, as outlined by Rycroft-Malone et al. [21], with particular

attention paid to the explanatory depth of each paper [21].

Results

Document characteristics

A total of 84 international sources that focused on IKT in the healthcare sector were used to develop middle-range theories detailing the conditions under which certain social processes among a research team resulted in successful IKT outcomes. The majority of the sources were from studies set in Canada ($n=31$; 37%), the United States ($n=21$; 25%), and the United Kingdom ($n=20$; 24%) (Supplementary File 4). Overall, 66 sources utilized a qualitative methodology (79%) (Supplementary File 3). The studies were conducted across a range of sectors. The most common setting was public health ($n=29$; 34%), followed by primary care ($n=15$; 18%) and acute care settings ($n=15$; 18%). The most common partner types included clinicians and healthcare practitioners ($n=46$; 55%), management/administrators ($n=31$; 37%), policy-makers and government ($n=29$; 34%), and patients ($n=14$; 17%). Outcomes were diverse and included closing the gap between research and practice, capacity building, knowledge translation and dissemination, practice and policy changes, and relationship building (Supplementary File 4).

Main realist findings

In phase 2, we tested and developed our preliminary theories using the empirical literature and repeated team discussions. Our sensemaking resulted in three IKT CMOs, labelled 1a, 1b, and 2, that we propose explain how an IKT approach leads to positive and applied outcomes via two different mechanisms – effective partnerships and synergy – identified in the work from phase 1. When research teams use an IKT approach intentionally to conduct research, team members will ideally respond by enacting an effective partnership. This can occur under two different conditions. The first condition is related to appropriate infrastructure to support the research process. The second condition speaks to the actions related to ongoing role clarity. We posit that a second mechanism, synergy, is another type of response by the research team to an IKT approach. This response can flourish within a context of authentic and equitable power sharing among team members. In what follows, we synthesize the three CMOs into an overarching mid-range theory of IKT. It is important to note that CMOs 1a and/or 1b – the conditions of infrastructure and role clarity, which trigger effective partnerships that lead to knowledge-user-relevant and useful research findings – must occur before CMO 2, the condition of power sharing, which triggers synergy and leads to the use of

Table 1 Rich articles selected for data extraction and which elements of the program theories they contributed to

	Role clarity as context	Power sharing as context	Infrastructure as context	Effective partnerships as a mechanism	Synergy as a mechanism
Alexander et al. [30]	X	X	X	X	X
AuYoung et al. [31]			X	X	
Baumbusch et al. [32]				X	X
Beckett et al. [33]	X	X	X	X	X
Beddingham and Whitehead [34]	X	X	X	X	
Bergman et al. [35]	X			X	X
Bowen et al. [36]	X		X	X	X
Bowen et al. [37]	X		X	X	
Bullock et al. [38]				X	
Bullock et al. [39]	X		X	X	X
Calmbach et al., [40]			X		
Krieger et al. [41]		X	X	X	X
Cramer et al. [42]	X	X	X	X	
D'Andreta et al. [43]	X	X	X	X	
Daykin et al. [44]		X		X	X
Denis et al. [45]			X	X	
Drahota et al. [46]				X	X
Dipankui [47]	X	X	X	X	
El-Masri et al. [48]			X	X	
Eriksson et al. [49]				X	X
Evans and Scarbrough [50]	X			X	X
Farmer et al. [51]			X	X	
Ferlie and Wood [52]			X		X
Filipe et al. [53]		X		X	X
Fitzgerald and Harvey [54]			X	X	X
Forsythe et al. [55]		X		X	X
Fortin et al. [56]	X			X	X
Franco-Trigo et al. [57]				X	
Gagliardi and Dobrow [25]			X	X	
Gagliardi et al. [58]				X	X
Gagliardi et al. [59]	X			X	
Goering et al. [60]	X		X	X	
Goodman et al. [61]		X		X	
Graham et al. [62]				X	
Greenhalgh et al. [63]	X	X	X	X	
Harris et al. [64]				X	X
Harvey et al. [65]	X				X
Hayes and Burge [66]			X	X	
Haynes et al. [67]	X		X	X	X
Heaton et al. [68]				X	
Heaton et al. [69]	X	X	X	X	
Henderson et al. [70]			X	X	
Huang et al. [71]		X	X	X	
Hunt et al. [72]				X	
Jansson et al. [73]	X		X	X	
King et al. [74]			X	X	
Kothari et al. [75]	X		X	X	X
Kothari and Wathen [76]				X	X
Kothari and Wathen [77]					X

Table 1 (continued)

	Role clarity as context	Power sharing as context	Infrastructure as context	Effective partnerships as a mechanism	Synergy as a mechanism
Kwak et al. [78]	X	X	X	X	
Mackie et al. [79]	X	X	X	X	X
Manns et al. [80]				X	
Martin et al. [81]		X	X	X	
McCloughen and O'Brien [82]		X		X	
Morris et al. [83]					
Nguyen et al. [84]		X	X	X	
Oborn et al. [85]		X	X	X	X
O'Brien et al. [86]	X		X	X	
Pinto [87]		X	X	X	X
Poger et al. [88]	X	X		X	X
Provan et al. [89]		X	X	X	X
Ramanadhan et al. [90]			X	X	
Redwood et al. [91]			X	X	X
Roberge-Dao et al. [92]	X	X	X	X	X
Rodgers et al. [93]	X	X	X		
Rowlands et al. [94]	X				
Rubin et al. [95]		X		X	
Rycroft-Malone et al. [96]			X	X	
Rycroft-Malone et al. [19]			X	X	X
San Martín-Rodríguez et al. [97]		X	X	X	
Scarinci et al. [98]			X		X
Shaw et al. [99]	X		X	X	X
Sibbald et al. [100]	X		X	X	
Solberg et al. [101]			X	X	
Springer et al. [102]	X		X	X	X
Treiman et al. [103]		X	X	X	X
van Raak et al. [104]			X		
Vangen and Huxham [105]	X	X			X
Williamson et al. [106]	X	X	X	X	X
Willis et al. [107]				X	X
Winterbauer et al. [108]	X	X	X	X	X
Witteman et al. [109]	X	X	X	X	X
Wutzke et al. [110]			X	X	
Zych et al. [111]	X		X	X	X

research findings in decision-making. We describe these CMOs in detail below.

CMOs 1a and 1b: effective partnerships generate research findings relevant to knowledge users

The conditions: infrastructure and role clarity

Our review identified two different conditions (or contexts) that trigger the mechanism – effective partnerships – and thus lead to knowledge-user-relevant and useful research findings.

(1a) Infrastructure, as a condition, activates and then supports effective partnerships through the provision

of the structures and processes necessary for collaboration. Specifically, the optimal infrastructure involves (i) resources, (ii) leadership and (iii) resource allocation, where resources and leadership intersect. On the basis of the findings of our review of the literature, these elements of infrastructure are hypothesized to trigger an effective partnership response within an IKT team such that the generated research is more likely to respond to knowledge user partners' needs.

Resource infrastructure relates to the commitment of tangible and intangible resources. Rycroft-Malone et al. [19], for instance, note that physical proximity was

a key condition for collaborative implementation processes between research users (end users) and producers (researchers), highlighting the importance of physically embedding team members within the service context [19]. They propose that governance structures that support physical (face to face), social and intellectual connectivity between researchers and research users are more likely to lead to productive outcomes. Likewise, in reviewing the infrastructure that supported a knowledge translation program in stroke thrombolysis and other projects, Heaton et al. [69] found that the partnership was fostered by conditions that allowed for knowledge translation by implementing, for example, processes through which a stroke consultant was able to submit questions for prioritization, funding to support the lead clinician's time to work on the project and funding to enable members of the stroke team to visit other centres to promote the methodology [69].

Gagliardi and Dobrow [25] similarly cite a lack of infrastructure to support collaboration between researchers and research users as a barrier to IKT [25]. Some of the limitations they describe include a lack of mechanisms to foster interactions, the need for IT systems that work in tandem, and limited mechanisms to share data among researchers and research users. Bowen et al. [37] reference concerns raised by research users who had declined requests to partner with researchers because they did not have the necessary resources to engage in research [37]. Budgetary stress resulted in a failure to provide the organizational infrastructure necessary to support partnerships. On a structural level, the requirements of research funding bodies, limited inter-regional supports for research partnerships and loss of funder support were identified as barriers to nurturing the conditions in which research findings relevant to knowledge users can be produced.

To generate relevant research findings, infrastructure also includes leadership to manage the relational aspects of the IKT partnership (e.g. shared decision-making), which in turn supports a shared vision. Committed leadership is drawn from organizations with a positive orientation towards research, where research and collaboration are valued. Forms of leadership identified throughout the literature included committees of researchers and research users [81, 98], shared leadership between two or more team members [40] and senior-level leadership within organizations. [30, 37, 43, 67, 98].

Greenhalgh et al. [63] suggest that differing leadership styles may have a significant impact on knowledge co-creation [63]. Democratic leaders, for instance, may promote structures and facilitation techniques that allow for transparency, deliberation and the inclusion of a diversity of end users. On the other hand, Oborn et al. [85] note

that non-hierarchical leadership may present challenges related to accountability mechanisms and loosely defined governance processes [85]. Rycroft-Malone et al. [19] distinguish distributed, informal leadership that provides opportunities for engagement at various levels of the organization from centralized, so-called command and control leadership that may be more practical but risks siloing people into tight networks that are difficult to penetrate [19]. The authors propose that a more distributed leadership style might better support collaboration and a shared vision around implementation.

Effective resource allocation sits at the intersection between resources and leadership, supporting purposeful collective action and effective knowledge exchange [19]. Among the characteristics of strong leadership, including a clear vision, visibility and ongoing reflection, Rycroft-Malone et al. [19] include strategic allocation of resources [19]. They suggest that thoughtful allocation of resources by leaders, combined with a distributed approach to leadership, facilitate collaboration. According to Gagliardi and Dobrow [25], resources to be carefully allocated within teams include leadership, coordinators, space, forums and information systems [25]. Funding was also identified in the literature as a resource to be carefully allocated. El-Masri et al. [48], for instance, suggest that while it can be difficult to anticipate costs as research and dissemination activities change, IKT leadership should remain flexible in budgeting, and changes should be communicated to the rest of the team in a timely manner so as to support newly identified efforts [48]. Martin et al. [81] note that decisions around resource allocation often depend on the priorities of certain individuals or groups over others; they found that resources, including funding, were often allocated to activities led by established academic researchers [81]. Time also emerged as another important resource to be allocated. Bowen et al. [36] indicate the importance of allocating sufficient time to activities and to make these decisions on the basis of participants' experiences and feedback, including allocating more time for team discussions, the development of dissemination plans and site visits [36].

(1b) Role clarity relates to transparency among members with respect to the roles and responsibilities of all research team members, establishing role parameters (e.g. availability, frequency of tasks and time investment), and discussing expectations and the identification of leadership roles/facilitators. This includes clear articulation of expectations around time investment, along with the objectives and goals related to the partnership and the project. Several authors proposed that clear articulation of roles and shared understandings of objectives, goals and expectations are crucial to project success [42, 73, 88, 100, 105, 109]. As Sibbald et al. [100] found, lack

of role clarity led to frustration and negative experiences, while partnerships with greater role clarity seemed to be part of long-term or existing partnerships that were nurtured and maintained [100].

Role clarity also refers to describing the scope of the partnership (what it is and what it is not) and establishing that within this scope, researchers and knowledge users have different roles but equitable partnership arrangements [111]. Knowledge users want to know what is expected of them, including what tasks they will be invited to take on. Upfront conversations make clear what resources and expertise knowledge users' organizations and researchers can bring to the table. Vangen and Huxham [105] suggest that in many instances, there is ambiguity around who the partners are and their roles [105]. Likewise, Cramer et al. [42] found that members of a rural community advisory board desired more consistent clarity and expectations to understand their responsibilities within the partnership [42]. Sibbald et al. [100] propose that it is important for partners to share definitions of individual roles within larger partnerships, particularly in instances where knowledge users want to be engaged beyond an advisory role [100]. Furthermore, team members need to be explicit about what they need from the partnership; in particular, different partners may have varying agendas to disclose. For Cramer et al. [42], to ensure success, all partners in a project should be able to see how their personal agendas could be advanced by the collective impact of the project [42]. These upfront expectations can be explicitly written out in a reference document or a memorandum to guide the work as it moves forward. [73]

A particularly interesting aspect of role clarity to emerge from this review was the insight that defining roles and maintaining role clarity are iterative, ongoing processes. Winterbauer et al. [108] argue that ensuring role clarity on an ongoing basis can support equitable resource sharing and build trust, which can consequently improve knowledge co-production [108]. They recommend regularly acknowledging where and how team members will participate, designating who will lead each study phase, and indicating the level of effort expected from each team member. Likewise, Witteman et al. [109] note that individual and project goals should not only be explicitly stated but also periodically reviewed to ascertain the extent to which these goals are being achieved [109]. Haynes et al. [67] found that while roles and aims might be clear at the start of a project, over time, team members might face confusion regarding the project's progress and what their contribution ought to be [67]. They found that team members desired a long-term vision, updates and a clear understanding of what would be expected of them. Mackie et al. [79] also highlight the

reality that roles might shift throughout the research process; new roles may arise, for example, owing to knowledge users' multiple identities, their evolving interests and their perceptions of the study's needs [79]. On the basis of participants' experiences, they suggest that team members' roles should be restated and reconsidered over the course of a project.

These conditions – infrastructure and role clarity – are necessary for researchers and knowledge users to manifest the IKT arrangement as an effective IKT partnership leading to research findings that are relevant to knowledge users. Future studies should be designed to disentangle whether both conditions are required or whether one of them is sufficient, a nuance we were unable to shed light on. Clarity around the goals of a project and mutual objectives shared by research partners also foster conditions in which relevant research findings can be produced [93]. Mackie et al. [79] frame clarity as a question of honesty, including honest depictions at the outset of a project of its goals and possible roles for knowledge users, reporting the roles and rules of governance, and recognition that individuals' roles might shift throughout the research process [79].

The mechanism: effective IKT partnerships

As a mechanism, effective IKT partnerships comprise the ways in which the IKT team responds to the partnership. This social process is characterized by the intensity of involvement at different phases of the research and increased frequency and length of involvement in research activities [64, 67, 93]. The ways in which knowledge users are involved in the research will differ depending on the expertise and time available. Some knowledge users might provide strategic input, while others will be more involved with the methodological details, e.g. providing valuable contextual insight about possible gatekeepers (to access study sites), sharing how to entice possible study participants or providing input on data collection tools and data collection and analysis processes. Some knowledge users may have research backgrounds and/or may be responsible for other aspects of the research, such as implementing an intervention or creating research outputs and dissemination activities [53, 86].

Another characteristic of an effective partnership is a diversity of perspectives, both in terms of organizational backgrounds and administrative/point-of-care experiences for broad research applicability and acceptability. This plurality brings multiple skills sets, connections and worldviews to the research and the dissemination process. Nguyen et al. [84] point to the importance of creating environments in which diverse perspectives, including conflicts, are integrated [84]. Greenhalgh et al.

[63] highlight the value of more democratic forms of governance that create space for a diversity of knowledge users [63]. In addition, in bringing to the table diverse perspectives, Mackie et al. [79] identify the importance of recognizing various dynamics at play in partnerships with diverse knowledge users [79].

In terms of operational details, regular team meetings using a combination of modalities (web conferencing, in person) are essential. Project updates support the momentum between meetings. In effective IKT partnerships, knowledge users are contributing rather than simply responding to researchers' requests. As such, regular, clear meetings are important for supporting timelines and maintaining relationships; this includes incorporating multiple opportunities for involvement and accommodating knowledge user scheduling requirements [47, 67, 73, 75, 88]. Effective partnerships also reflect a particular relationship profile. Knowledge users and researchers trust each other, which in turn supports deeper engagement [108]. Mutual respect and valuing each other's contributions are also exhibited. This involves understanding each other's expertise and needs. As such, effective partnerships are relationships that are committed to equitable interactions. Developing this relational profile requires time and face-to-face interaction. [19, 111]

The outcome: producing research findings relevant to knowledge users

Producing research findings relevant to knowledge users as an outcome is dependent on an effective IKT partnership. Knowledge-user-relevant research findings come from research that is responsive, feasible and focused on areas of priority for policy and practice. To obtain research findings relevant to knowledge users, the research must address meaningful research questions for knowledge users who can influence the research process [32, 33]. Project outputs also need to be timely and produced in ways that are accessible to users [110].

In summary, we hypothesize that an IKT team can produce research relevant to knowledge users if an effective IKT partnership, as described above, is achieved under the conditions of specific infrastructure and/or role clarity (Fig. 4).

CMO 2: Synergy

The condition: power sharing

Power sharing is a condition or feature of the context that is necessary to trigger the mechanism of synergy, as described below. While the articles reviewed did not present an explicit definition of power, most mobilized Weberian understandings of power as the capacity of an actor to carry out their will despite resistance [112].



Fig. 4 Conditions–mechanisms–outcomes 1a and 1b: infrastructure and role clarity (the conditions or contexts) trigger the core mechanisms (effective partnerships) and lead to the outcome (research finding relevant to knowledge users)

In this sense, authors saw power sharing as reflected in partners' ability to influence and enact a collaborative agenda or a long-term vision. According to Winterbauer et al. [108], power sharing and power dynamics can emerge within many areas of the research process, including control of the research process, resource sharing and the dissemination of results [108]. Power imbalances can undermine the development and maintenance of the trusting environment necessary for collaboration, as can the domination of some groups and the alienation of others, which may lead to the alienated groups returning to their institutional silos, where strong relationships already exist [85]. Power imbalances and weak links between knowledge user groups can also undermine and negatively impact the development and maintenance of previously established trusting environments required for research collaboration and synergy [51, 58]. However, sharing power and working towards more equitable power dynamics can lead to greater engagement in the research process by all involved [53, 100], as well as enhanced trust building, increased relevance of the research findings and greater translational impact, improved co-production of knowledge [108], the inclusion of diverse perspectives, and the establishment of collective priorities [84].

Power is a dynamic concept, and power imbalances might surface in a number of ways. Dipankui [47], for instance, points to office designs that allow for informal meetings between team members working in the same building versus team members located elsewhere, which may contribute to unequal access to information [47], while Roberge-Dao et al. [92] suggest that knowledge users may struggle with power sharing in relation to principal investigators, particularly if they have no prior research experience or they need support to understand the research and their role in the process [92]. Williamson et al. [106] identify the unequal power dynamics that might ensue if researchers take over the project and offer little opportunity for policy-makers to shape the research agenda or if researchers do not

share credit for the work accomplished [106]. Furthermore, project partners may perceive power imbalances related to hidden agendas, territory control, the structure of the collaboration, agenda setting, and dynamics between so-called principal and subsidiary members [105]. This may be particularly true for those representing smaller organizations. Social factors, including gender and disparities in social status, are also potential sources of power differences among team members [97].

Acknowledging and re-balancing traditional power dynamics enables more structured and supported IKT research [93]. Within the literature, numerous strategies for more equitable power sharing are presented. For instance, according to Greenhalgh [63], power distribution needs to be transparent to team members through clear communication about the process for decision-making and the decisions made [63]. D'Andreta et al. [43] describe a collaborative process in which members held equal positions in the knowledge network irrespective of management positions and through which knowledge could be translated along multiple pathways without needing to pass through a network core [43]. A mixed composition of core actors and a decentralized knowledge network in which members had equal access to and control over knowledge were key. Rodgers et al. [93] highlight the potential of a model through which community-based organizations were directly funded and provided with partnership support, which allowed for shared power among partners [93]. Beckett et al. [33] call for greater reflexivity concerning one's own values and social position as a strategy for facilitating more equal relationships between knowledge users, as well as shared ownership and control over the study design, aims and outcomes [33]. Likewise, Poger et al. [88] offer practical advice for avoiding power differentials, including emphasizing at the beginning of meetings that each voice holds equal weight, that questions and clarifications are welcome and that the meeting will not move forward until consensus is achieved; using meetings to demonstrate how stakeholder and partner feedback, expertise and voices were applied to study activities; and engaging in check-ins facilitated by a community engagement coordinator uninvolved in the study to provide feedback in a non-threatening environment [88].

The mechanism: synergy

In our program theory, synergy constitutes the social process (i.e. the mechanism) through which the IKT team responds to the partnership. Synergy within the team reflects a sense of collaborative value, where what is achievable outweighs the costs of partnered research. This social process exhibits a heightened sense of

responsiveness, cooperation and acknowledgement of everyone's contributions to the team. Zych et al. [111] conceptualize synergy as encompassing shared goals among the researchers and the research users (or their organizations) that include shared interests and passion for the subject matter [111]. Synergy promotes critical thinking, high levels of collaboration and inclusiveness, thus leading to deeper research results and understandings that increase the quality of outcomes [53, 69, 85]. Rycroft-Malone et al. [19] leverage the language of alignment to describe synergies that emerge over time [19]. Their focus on alignment draws attention to the importance of learning and evaluating as the project adapts. Furthermore, tensions within implementation systems may act as catalysts for actions that minimize the potential for entrenchment and habit.

Synergy embraces complexity and allows for research that is continually adapting to dynamic circumstances. While Oborn et al. [85] acknowledge the complexity of navigating the unique contexts of various organizations and the particular dynamics of each research team, they also point to the value of brokering boundaries between these domains so as to develop ways of developing knowledge translation processes that are more locally suitable [85]. By organically embedding activities within providers' concerns, genuine engagement becomes possible between providers and researchers, as neither can carry out the networked activities without engagement from the other. Similarly, Springer et al. [102] highlight the importance of allowing relationships to grow between team members rather than focusing too much on any one project; in this way, new, unexpected projects may arise, which will further contribute to team members' empowerment [102]. Beckett et al. [33] echo the value of relationships that will lead to further collaborative work between researchers and practice partners [33]. The authors underscore how research co-production can engender changes within, during and beyond the research project as a result of multiple processes and productive interactions. In this sense, research becomes dynamic and cyclical rather than finite and linear. These changes may lead to transformative synergy at a broader scale that allows for the emergence of new ideas, wider policy or practice priorities, and knowledge that is ultimately greater than the sum of its parts.

The benefits of synergistic IKT partnerships also include enhanced access to resources, unanticipated capacity development and enhanced relationships. As Eriksson et al. [49] found, partnership synergy in one project led to a second partnership agreement through which a project was extended for another three years [49]. This partnership also generated new, unanticipated projects and activities, including joint activities that

received funding. The authors also note that cumulative partnership synergy increased the quality of outputs and outcomes over time and increased the sustainability of the project goals beyond the funded time frames. In this way, synergy is a foundation for strengthened partnerships, expanded networks and long-term sustainability. Synergy can be achieved only after effective partnerships have been established; synergy represents a levelling up of effective partnerships.

The outcome: the use of research findings in decision-making

While research findings relevant to knowledge users are important and necessary, an ultimate outcome of interest is the use of research findings in decision-making. IKT approaches can lead to variable configurations of use of research findings by knowledge users. For example, knowledge user partners might use the research to activate multiple networks and encourage research application at distal locations [46, 64]. A different aspect of use is when research findings or the methodology from one project are used to influence other research projects (so-called spin-off research) [33]. This might include increased capacity for research, added impetus for the development of research and support for joint clinical/research careers. Furthermore, there might be less application of research at the specific, local level but broad uptake from wide dissemination efforts [33, 34].

A classic view of use – the incorporation of research evidence in health organizational decision-making – can be difficult to ascertain given the specificity of research goals and the length of the research process. Overall, moderate changes in practice, policy and health improvements arising from IKT partnerships were reported in the reviewed literature. These changes included the introduction of health quality equity indicators used by health units to evaluate their own health equity work [33]; the inclusion of older people's aspirations in agencies' foci [113]; the practical enactment of organization-level knowledge translation capacities to link research and practice at the local level [43]; enabling a clinical agency to amend policy development and revision [102]; and the development of effective working relationships between health policy centres and a provincial health agency [37]. As Jenkins et al. [114] suggest, rather than focusing on increasing the uptake of specific interventions, enhanced capacity for collaboratively identifying and creating change within a setting has been shown to influence health outcomes, particularly given evidence from the literature that specific practices may need to continually shift in response to changes in context [114].

In summary, we hypothesize that an IKT team can achieve the use of research findings in decision-making if synergy, as described above, is realized under the

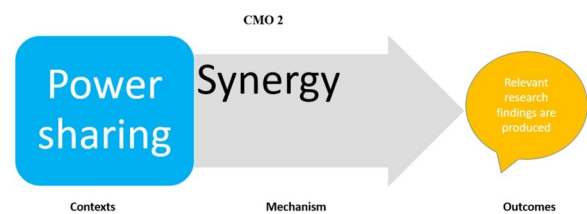


Fig. 5 Conditions–mechanisms–outcome 2: power sharing (the conditions or context) triggers synergy (the mechanisms) and leads to the use of research finding in decision-making as an outcome

condition of balanced power among team members (Fig. 5).

Discussion

In this realist review, we drew on relevant and rich articles to develop and test a preliminary, mid-range theory about how integrated knowledge translation works. Using 84 articles in total, the analysis resulted in three mid-range theories of the conditions (infrastructure, role clarity and power) that trigger mechanisms (effective partnerships and partnership synergy) to produce two outcomes: the production of research findings relevant to knowledge users and the use of research findings in decision-making. To the best of our knowledge, no other realist review has examined how IKT works when policy-makers, administrators and/or practitioners are knowledge users; it is precisely these decision-makers in the healthcare setting who can use research, generated through the partnership, to influence health system change. We have consolidated the three mid-range CMOs into an overall mid-range IKT theory. However, before doing so, we make some observations about role clarity, the longitudinal nature of partnerships and the importance of achieving synergy through attention to power imbalances.

The importance of regularly attending to role clarity throughout a partnership was a particularly interesting finding of our review. Our analysis accentuated the dynamic nature of IKT partnerships. The literature tends to outline IKT approaches as static endeavours when, in fact, external as well as internal influences within the partnership, such as staff turnover, can affect a partnership's functioning. The roles of team members are among the most dynamic aspects of an IKT project; these roles may change in response to changes in available time and resources, the project's goals and team members' shifting interests over time. Thus, in addition to being clear about all members' roles in a project, it is equally important to regularly revisit these roles to ensure that they continue to align with team members' capacity and interests and evolving project goals. This important finding ought to

be easy for IKT team members to implement into their own processes.

Some of the IKT characteristics emerging from this realist review were not surprising, such as the need to establish trust or a common vision, but our analytical process resulted in an element worthy of spotlighting. The longitudinal nature of partnerships, with the result that they must be nurtured over time, has received less attention as a topic of interest in the previous IKT literature but surfaced strongly in this review. Expectations, goals and roles are dynamic throughout an IKT partnership, and they require explicit, ongoing discussion. Trust and power distribution need to be continuously addressed as they also change during the research life-cycle. We also note that knowledge users are involved to varying degrees throughout the research process owing to interest, time and availability, among other factors. This finding implies that IKT researchers ought to consider features of commitments, relationships and activities that vary over time when examining any processes or outcomes related to IKT arrangements.

Synergy was positioned as an elevated mechanism that could lead to implementation. The analysis showed that the relational dynamic in an IKT team went beyond “let’s do this collaborative job well” (an effective partnership) to an understanding of working as one to achieve collective efficacy (synergy). An important avenue of future inquiry is understanding exactly how synergy is fostered and how to create or incentivize this mechanism. While synergy may take time to develop, this is energy well-spent, as the studies included in this review showed that synergy within a context of power sharing in IKT teams led not only to the production of research findings but also to the application of these findings. In our review of the literature, we found that power sharing is reflected in team members’ abilities to enact a collaborative agenda or a long-term vision. More equitable power relations within a team can lead to greater engagement in the research process, enhance trust, increase the relevance of research findings and their translational impact, improve the co-production of knowledge, and support the inclusion of diverse perspectives and collective priorities. Strategies for attending to power dynamics include clear communication about decision-making, knowledge translation across multiple pathways through a decentralized network, novel funding arrangements through which community-based organizations directly receive funding and emphasizing consensus in decision-making. The identification of synergy and its relationship to power dynamics is a novel contribution to the IKT literature.

In Fig. 6, we consolidate the three CMOs described in the findings into an overarching middle-range theory of IKT for the generation of research relevant to knowledge

users that can be used in health decision-making. Our resulting hypotheses are the following.

- If particular infrastructure arrangements related to resources, leadership, and resource allocation and/or role clarity are in place, these conditions can support teams to enact effective partnerships such that research findings relevant to knowledge users are produced.
- If power is shared among team members, synergy can emerge and flourish within teams, leading to research findings that are more likely to be useful, useable and used for decision-making.
- If effective partnerships are in place, the mechanism of synergy is possible when power is shared across the IKT team.

The sequential nature of the first two CMOs is important to highlight here. While the conditions of infrastructure and/or role clarity trigger the mechanism of effective partnerships to produce the outcome of research findings relevant to knowledge users, there is a distinction between the production of findings and the actual application of these findings. The condition of power sharing triggers the mechanism of synergy, which leads to the use of research findings in decision-making. Thus, the second CMO cannot occur before the first; research findings must be produced before they are actuated. Likewise, synergy emerges through effective partnerships and cannot exist prior to the establishment of effective partnerships as social processes. Equally important is our description of the conditions of CMO 1 as comprising infrastructure and/or role clarity, as, based on this review, we cannot determine whether the conditions required for effective partnerships must include both infrastructure and role clarity or if only one of these conditions is necessary. This distinction represents an important area of future research.

The consolidated, mid-range theory features one view of IKT, but future studies might shift to examine other aspects of IKT approaches. For example, our theory centre on two important outcomes that are foundational to why researchers use IKT approaches (to produce research findings relevant to knowledge users and to support the use of research findings). Other researchers might decide to focus on alternative outcomes associated with IKT, such as identifying new professional contacts, capacity development for engaging in IKT, building individual-level knowledge and skills, enhancing connections between previously isolated research fields, etc. Furthermore, we made choices that another research team might have positioned differently; for example, we identified leadership

HOW DOES INTEGRATED KNOWLEDGE TRANSLATION WORK?

A Theory Based on a Realist Review

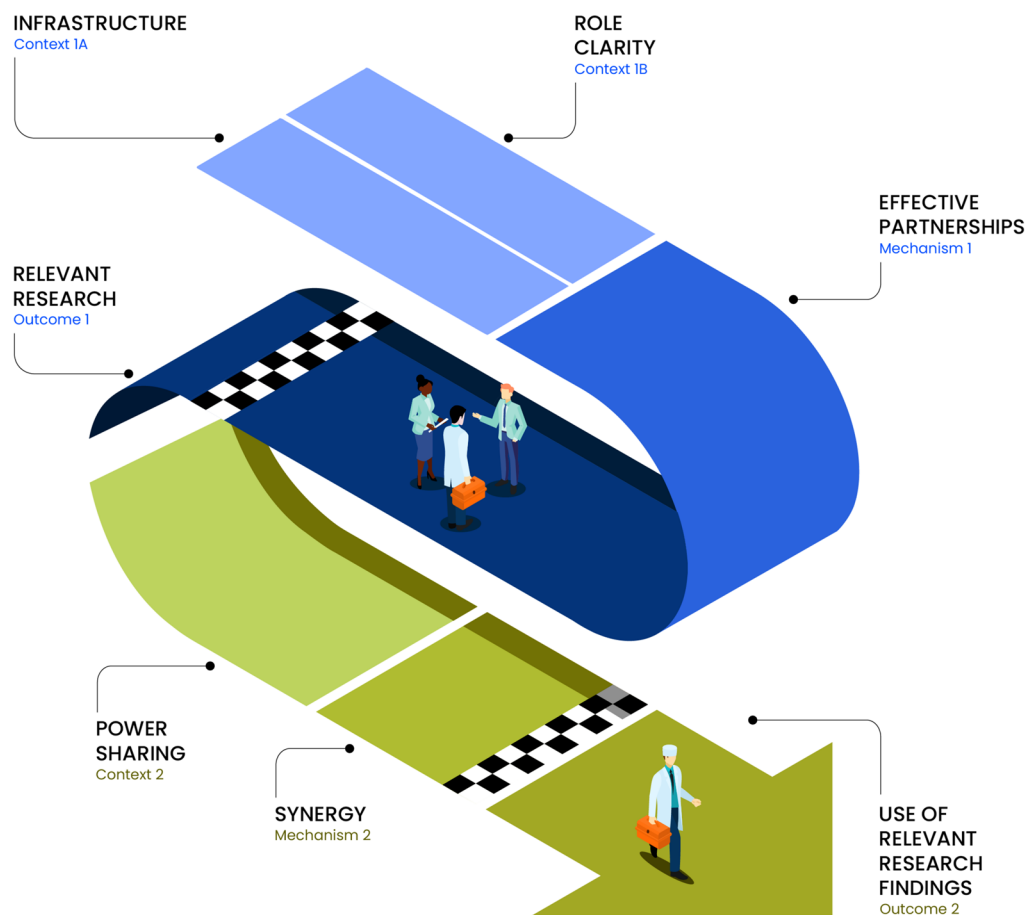


Fig. 6 A consolidated, mid-range theory of integrated knowledge translation

as a feature of infrastructure on the grounds that leadership and commitment are intertwined with resource allocation, but other scholars might conceptualize leadership in another way. Nevertheless, our view of IKT is helpful for researchers, funders and health system leaders who might want to use the theories to think about

maintaining and sustaining effective IKT relationships. A greater understanding of the conditions and mechanisms outlined in this review offers the opportunity to cultivate research practices, processes and forms of organization that lead to the production of research findings relevant to knowledge users that are then taken up in decision-making and other forms of intervention.

Limitations and strengths

In terms of study strengths, the research team included knowledge users and researchers who used an IKT approach to collaboratively design, execute and interpret the study findings, thereby keeping the work rigorous and focused on useful parameters. For example, the decision to narrow in on IKT-related organizational elements rather than individual attributes was based on knowledge users' suggestions to understand where it was possible to support future IKT efforts with the greatest reach. The implication, however, is that we are presenting a partial view of underlying mechanisms supporting IKT. Our findings represent a theoretical synthesis that produced three IKT program theories developed for pragmatic purposes. In future studies, these theories and their consolidation should be tested in different settings to determine what works. Furthermore, in a realist paradigm, personal reflections are perceived as a strength for theory building. We included reflections and descriptions, as they often captured detailed accounts of conditions, mechanisms and/or outcomes.

As each study in the articles retained for analysis sampled partnerships to best suit their research objectives, some purposefully selected partnerships that exemplified successful IKT or included individuals experienced in IKT [33, 51, 52, 69, 77] or IKT-absent organizations [25]. As a result, the identification of barriers, facilitators and relationships may not be transferrable to struggling or unsuccessful IKT partnerships, because, for the purpose of this realist review, our theory testing focused on processes within successful IKT partnerships.

A realist review is a theory-based approach to synthesis, grounded in generative inference to explain phenomena. Our review, which included 84 rich and eligible articles, provided sufficient data to develop trustworthy and plausible mid-range CMOs about how IKT works [116]. We reached a point of theoretical saturation, where additional evidence neither enhanced nor contradicted our findings, indicating a modest level of theoretical generalizability (Booth, Wright, & Briscoe, 2018) [115]. The review was limited to studies conducted prior to the implementation of COVID-19-related public health measures, owing to both project timelines and resource constraints. As such, the program theories developed do not account for the substantial and ongoing changes to research practices, such as the increased prevalence of remote and virtual work, prompted by the pandemic. In line with realist methodology, which views theory development as iterative and open to refinement, we are now conducting a follow-up qualitative study with IKT experts to assess whether these contextual shifts or new evidence warrant updates to the original theories or whether they remain relevant and accurate. [116]

Conclusions

Our work has produced three IKT theories and a consolidated mid-range IKT theory that extends previous lists of barriers to and facilitators of successful IKT. Our theories spotlight several important concepts, reveal social processes or mechanisms associated with the concepts, and then describe the relationship among the concepts. Future studies should be designed around the hypotheses arising from the theories, and subsequent findings can be used for theory refinement. These theories do not represent a definitive approach to successful IKT, as theory development is iterative and ongoing, but they do bring conceptual clarity to some key concepts and processes. These concepts and processes can be empirically investigated in future studies.

Supplementary Information

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Additional file 1.

Additional file 2.

Additional file 3.

Additional file 4.

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Author contributions

A.K., S.L.S., C.M., W.B., R.U., T.H. and I.D.G. contributed to the design of the study as it was iteratively developed. A.K. and S.L.S. contributed to data collection. A.K., I.D.G., S.L.S. and C.M. conducted data analysis and interpretation. A.K. and S.L.S. produced the first draft of the manuscript and then worked with L.C. on subsequent versions with input from all authors. C.M. and T.H. acted as knowledge users in this study and therefore provided constructive comments in that capacity. All authors (A.K., S.L.S., C.M., W.B., R.U., T.H., L.C. and I.D.G.) critically revised the article and approved the final version for submission for publication.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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