Understanding the Broker Role of Clinician–Scientists: A Realist Review on How They Link Research and Practice

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Abstract

Purpose

Clinician–scientists are said to be well placed to connect research and practice, but their broker role has been underexplored. This review sought to gain an understanding of the broker role of clinician–scientists.

Method

The authors conducted a realist review to describe context–mechanism–outcome (CMO) configurations associated with the broker role of clinician–scientists. CINAHL, PubMed, PsycINFO, Web of Science, and Embase were searched between May and August 2017. Data were analyzed qualitatively; data synthesis focused on assembling CMO configurations.

Results

Of an initial 2,241 articles, 9 were included in the final review. Included papers show that clinician–scientists, in their broker role, achieve 2 organizational-level outcomes: an increased volume of clinically relevant, research, and increased evidence application to improve care. They also achieve the individual-level outcome of professional development as a researcher, clinician, and broker. Multidimensional skills and management support are necessary context factors. Mechanisms that contribute to outcomes include balancing economic and scientific interests and performing boundary-crossing activities. Four CMO configurations by which clinician–scientists achieve outcomes in brokering a connection between research and practice were identified. Useful program theories for explaining these are boundary crossing, social network, communities of practice, and diffusion of innovation theory.

Conclusions

The mechanisms found may provide insight for interventions aiming to support clinician–scientists in their broker role. The authors expect that if more attention is paid to learning multidimensional skills and management support for the broker role is strengthened, stronger links between research and practice could be forged.

Health care is a knowledge-intensive industry.[1] The knowledge used by health care professionals to treat patients is derived from the best available research evidence, and there is an understanding that best practices rely on research evidence.[2] However, despite its importance, the link between knowledge generation (research) and knowledge application (practice) has been described as tenuous.[3,4] The need to strengthen this link has been addressed through various knowledge transfer initiatives that facilitate the flow of information from research findings into practice.[5] Some examples include translational research efforts that focus on translating discoveries generated during basic and clinical research to the practice setting,[6] as well as researchers publishing in relevant journals and guideline developers using research to formulate guidelines for practice. Practitioners work according to these guidelines and might establish journal clubs to assist in the interpretation and application of research knowledge to their own practice.[7] To ensure clinical relevance, the reverse flow—from practice to research—is also important.[6] For example, there have been recent insights into the importance of including clinicians[5,8] and the patient voice[9–11] in research projects.

Past efforts to strengthen the link between research and practice have varied in nature and degree of interaction between the 2 worlds but frequently conceptualize the link between them as linear and unidirectional.[2] More recently, the research–practice gap has been reconceptualized as occurring on various levels, with discontinuities between research and practice occurring as a result of epistemic, professional, and organizational issues.[2,12] This complexity suggests that creating a viable link between research and practice requires a more dynamic, bidirectional approach.[13] Attempts from both sides are necessary to lower the boundaries between 2 distinctly different sociocultural domains.[5] One manner of linking research and practice bilaterally is through brokers: professionals who have legitimate access to both settings[14] and engage in knowledge management, capacity building, and linkage and exchange activities.[15] (In this review, we chose to use the term brokers rather than knowledge broker to showcase the breadth of activities [e.g., organizing continuing professional development workshops, maintaining an extensive network] that such a role encompasses.[16])

In terms of linking research and practice, clinician–scientists are considered to be ideally placed to fulfill the broker role. Their importance was flagged in the early 1900s, with Meltzer advocating for medical professionals (clinicians) who are competent in conducting scientific research rather than relying on external

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researchers to set the research agenda.[17] To date, titles such as physician–scientist, clinician–scientist, and nurse–scientist are used to describe doctors, allied health professionals, and nurses working simultaneously in clinical and research contexts, respectively. Many publications exist that highlight the importance of brokers in health care.[14] Issues such as the dwindling numbers of clinician–scientists despite their importance,[18] the importance of good research mentoring for clinician–scientists,[19] and the difficulty of securing research funding[20] are discussed in these publications. However, the broker role of clinician–scientists is not explicated as a separate task in these publications. Clinician–scientists' potential to link bench to bedside is assumed, and their brokering tasks are not described or considered to be separate from their clinical- and research-related work.[21] Thus, limited attention has been given to the nature of the broker role. In this review, we sought to answer the question: Which contextual factors and mechanisms contribute to the outcomes achieved by clinician–scientists in linking research and practice?

To provide insight into how clinician–scientists connect research and practice, we first analyzed which outcomes they achieved. We then looked in detail at which context factors influence the execution of the broker role and which mechanisms are induced within these contexts that contribute to the outcomes. We subsequently considered program theories that might assist in the understanding of why contexts and mechanisms yield certain outcomes.

Method

We conducted a realist review, which is a type of review that is well suited to study complex social phenomena by answering questions such as "What works for whom?" "How does it work?" and "In what circumstances does it work?"[22] A realist review unpacks context–mechanism–outcome (CMO) configurations, which are chains of reasoning that detail which contexts facilitate the activation of certain mechanisms that contribute to certain outcomes. We judged this to be an adequate method to answer our research question about how clinician–scientists connect research and practice. For the context, we focused on inner and outer context factors.[23] Inner context factors refer to characteristics of individuals, such as beliefs about science, and outer context factors refer to situational factors at the organizational level, such as management support. Mechanisms are defined as people's underlying responses, processes, or manners of reasoning that "operate in particular contexts to generate outcomes of interest."[24(p368)] We classified outcomes as individual level or organizational level.

We developed 2 search strings iteratively. The search strings consisted of a combination of the search term *clinician–scientist* or *broker* and their synonyms. These terms and their synonyms were also truncated in different ways to assist in finding relevant articles (see Supplemental Digital Appendix 1 at http://links.lww.com/ACADMED/A692 for the full search strings). The first search string was designed to identify articles about professionals who have a title such as clinician–scientist. The second search string was designed to identify articles about professionals who may not have an official title signifying a dual role but who perform both clinical- and research-related tasks. Both search strings were applied to the CINAHL, Embase, Web of Science, PubMed, and PsycINFO databases on 4 separate dates from May to August 2017.

In 2 discussion rounds with all authors, the list of inclusion and exclusion criteria was applied to a selection of 48 articles to calibrate the criteria. Subsequently, titles and abstracts were screened by 2 authors (M.B. and E.d.G.) and discussed. When in doubt about whether a paper should be included or if there was disagreement, the full text was screened and the other authors were consulted. The main objective of the criteria was to identify publications that described the broker activities of clinician–scientists in a manner that was detailed enough to be able to identify the contexts, mechanisms, and outcomes of these—regardless of whether the professionals had the formal title of clinician–scientist. List 1 presents the final inclusion and exclusion criteria.

Data extraction

An overview of all included articles was compiled to provide insight into variations between the articles' participant populations, study contexts, methods, and study aims related to bridging the research–practice divide. The title and country of publication were listed, as were the level of qualification (e.g., PhD, master's, bachelor's) and profession (e.g., nurse, physician) of the clinician–scientists in the study. For each study, the aim, research method, sample size, and our assessment of its rigor were documented. Two authors—one an experienced quantitative researcher (M.-L.E.L.B.) and one an experienced qualitative researcher (N.S.)—assessed the studies using the Joanna Briggs Foundation guidelines.[25] They judged the methodological quality of each study and the extent to which bias was addressed using the appropriate critical appraisal checklist. To enhance credibility, we included only empirical studies. Relevance and rigor were not treated as absolute criteria but, rather, as dimensions of fitness for the purposes of this review.[26] As is usual for realist reviews, we did not exclude or rank publications based on our assessment of the rigor.[26]

Data analysis and synthesis

A 3-step approach was taken during the data analysis process.

Step 1. The full text of the articles was read, reread, and discussed by 2 members of the author team (E.d.G. and M.B.) to obtain a comprehensive understanding of the data.

Step 2. E.d.G. and M.B. coded the entire dataset using NVivo 11 (QSR International, Doncaster, Victoria, Australia). To assist in understanding inner and outer context factors, we coded for individual and situational barriers and facilitators. To assist in the identification of mechanisms, we coded for brokering role descriptions and brokering activity descriptions. To assist in gaining an understanding of outcomes, we coded for outcomes of brokering activities. The coding began with codes derived from sensitizing concepts and with the aim of a realist review in mind. We added codes iteratively during the data analysis. We did not use the codes or themes presented in the original research of included qualitative studies.

Step 3. E.d.G. and M.B. discussed the initial coding and subsequently refined the coding by making a distinction between context factors that pertained exclusively to the broker role and

List 1
Final Inclusion and Exclusion Criteria for a 2017 Realist Review Examining How Clinician–Scientists Connect Research and Practice

Inclusion criteria

- In the study, both clinical researchers and academic professionals with a clinical role are involved or titles such as clinician–scientist, nurse–scientist, or physician–scientist are used.
- Studies that contribute to the understanding of professional roles and activities that span the academic (research) and clinical field of function (that is, studies that aim to describe the role and work activities of a broker).
- Studies are conducted in a medical professional context: professionals[a] or professionals in PhD-level training within the medical context, such as physicians, surgeons, physicists, pharmacists, dentists, nurses, allied health professionals, clinician–scientists, and nurse–scientists. (Residents are included.)
- Unit of analysis should be the individual clinician–scientist and his/her work context.
- Studies with a focus on cultural or psychological elements.
- Studies that clarify factors that facilitate fulfilling the role of broker.
- Studies that present empirical data (i.e., primary research data).
- Studies focusing on the collaboration between researchers and clinicians will be included to ascertain potential broker activities.
- Studies that address the role of mentor to a broker and also reference the broker role of the mentee.
- Studies that were peer-reviewed.
- Studies from any date (the oldest included publication was from 1961 and the newest was from 2017).

Exclusion criteria

- Unit of analysis on the level of a team or organization (indicated by statements such as "teams should" or "organizations could better"). A team is not able to act as a broker.
- When the word "facilitator" or "moderator" is used in studies about a specific research design (e.g., focus groups). Studies are about a different topic, but the word "facilitator" or "moderator" is included in the abstract.
- Studies about professionals who are appointed to be brokers, it is their formal job, and who do not have the same background as professionals from one of the "sides of the boundary." Probably called a "liaison."
- Conceptual or theoretical papers, opinion pieces, position papers, commentaries, obituaries, or literature reviews.
- Language of the full article is not English.
- Studies conducted in contexts related to but distinctly separate from the medical context, such as complementary medicine, psychology, psychotherapy, music therapy, art therapy, social work, and social sciences.
- Studies researching training and mentoring of medical, nursing, and allied health students at the bachelor's or master's level who are not employed as clinician–scientists (e.g., teaching students research skills to be able to perform a clinician–scientist role).
- Studies focusing on training and mentoring without a clear link to the clinician–scientist role (e.g., training to increase research productivity).

[a]Professionals are individuals who have a position as a clinician–scientist, which includes individuals who are employed as clinician–scientists and hold a bachelor-level qualification or higher.

those that related to either research- or practice-based activities only, with no element linking the two. Contextual factors that were not exclusively relevant to the broker role (e.g., research funding availability) were excluded from our CMO configurations.

The data synthesis was initially conducted by E.d.G. and M.B. and was subsequently discussed with the full author team. The data synthesis focused on assembling findings into CMO configurations, which a realist review typically seeks to unpack.[22] First, we focused on outcomes of interest and then identified mechanisms associated with each outcome.[27] The descriptions of brokering activity provided a starting point for this process. We then examined data to determine the relationship between contexts, mechanisms, and outcomes to derive CMO configurations. Next, we clustered mechanisms to identify program theories that are useful in explaining clinician–scientists' broker role. Program theories are useful in describing why certain outcomes were achieved.[28] Thus, these theories provide a diversity of lenses through which the broker role of clinician–scientists can be viewed to gain an understanding of how it functions and how it could be supported.

Finally, we tested the plausibility of each CMO configuration by rereading the full text of the included articles and discussing the configurations among the entire author team.

Results

After duplicates were removed, our initial searches yielded 1,445 articles for the first search string and 796 for the second string (n = 2,241). After title and abstract screening and applying inclusion and exclusion criteria (see List 1), 52 articles remained for full-text review. After full-text review (M.B. and E.d.G.), 41 articles were excluded for assuming the broker role of clinician–scientists and focusing on clinical and/or research activities of clinician–scientists without providing a description of the broker role, and 2 were excluded for their focus on research mentoring rather than brokering. The results and stages of the selection process are presented in the PRISMA[29] flowchart in Figure 1. Nine articles were included in the final full-text review.[2,30–37]

Of the 9 included articles, the nursing profession is represented in 3 of them,[30,31,33] whereas physicians are represented in 1.[34] The remaining papers represent multiprofessional groups.[2,32,35–37] A summary of the characteristics of all of the included articles is presented in Table 1.

Outcomes of brokering

Three outcomes of brokering activities were identified—2 at the organizational level and 1 at the individual level (Chart 1).

The first outcome was a perceived growth in clinically relevant and practically applicable research results.[2,31,32,34–36] However, 1 article indicated that practically applicable research still remained sparse.[35] The second outcome was a perceived increase in evidence application to improve care.[30–32,34–37] These were the organizational-level outcomes.

The individual-level outcome of brokering activity was the professional development of the clinician–scientist in

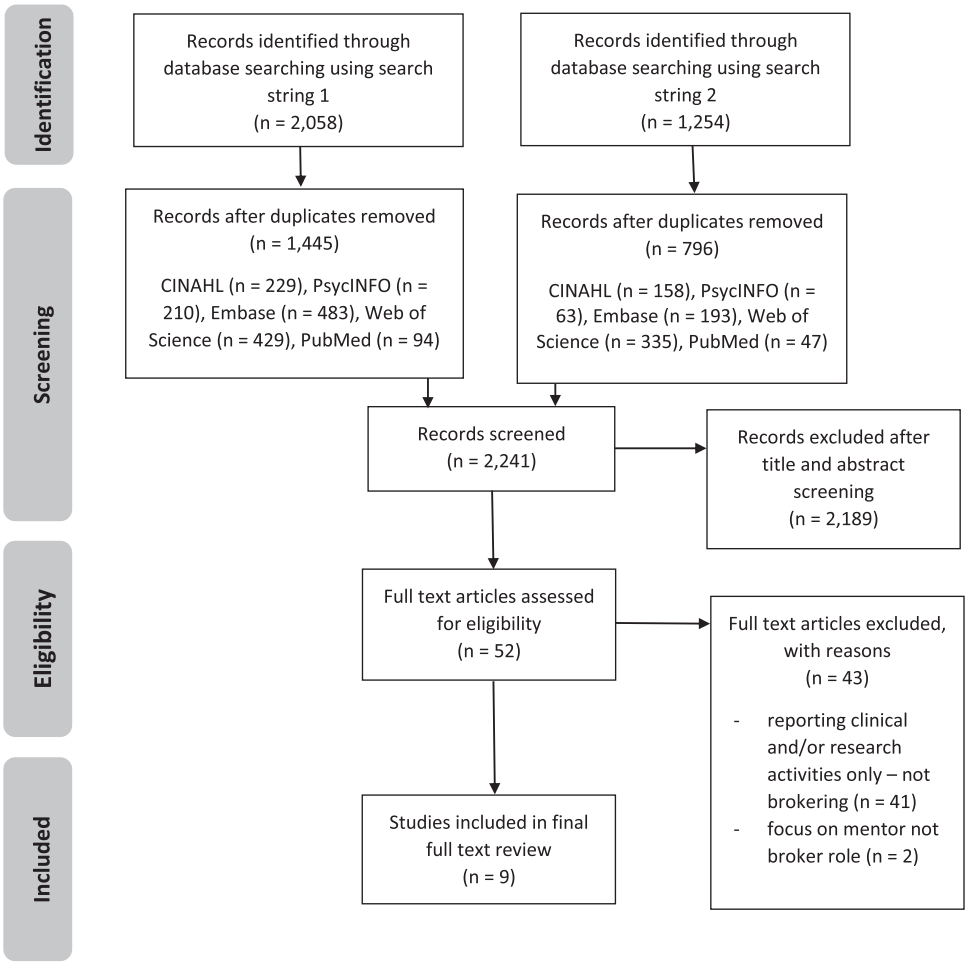

Figure 1 Flow diagram of the selection process used in a 2017 realist review examining how clinician–scientists connect research and practice.

their capacity as a researcher, clinician, and broker.[2,30,32,34,36]

One article identified an individual-level outcome that does not fall under professional development—that is, a participant reported that he/she perceived his/her relationship with colleagues had changed since becoming a clinician–scientist.[32] As a clinician–scientist, he/she felt that he/she no longer belonged to the community of clinicians or to the community of researchers.

Contexts

We found a number of inner and outer context factors that play a role in harnessing mechanisms to achieve organizational-level outcomes. Of these, some inner context factors reflect the necessity of brokers having multidimensional skills, including networking,[32,36] innovation,[32] and change management skills.[35,37] In addition, clinician–scientists require the ability to prioritize tasks to maintain a career across both fields.[35] Necessary outer context factors included management support[30,35,36] as well as epistemological and cultural alignment between scientific and clinical work contexts[2,31,32,34–36] (Chart 1).

In contrast to organizational-level outcomes, the individual-level outcome requires relatively few inner and outer context factors to activate the mechanisms necessary to achieve the outcome. Inner context factors required to achieve the individual outcome were a strong interest in the research results of others[30] and a high level of motivation and capacity to read relevant scientific literature.[30] Similar to organizational outcomes, an outer context factor that yields the individual outcome is management support.[30,35,36] Yet, in contrast, we did not find that an alignment between the scientific and clinical contexts was required to achieve individual-level outcomes of brokering (Chart 1).

Mechanisms

Further, we set out to understand the ways in which context factors would result in outcomes by focusing on supporting mechanisms. Understanding these might provide insight into the specific elements required for interventions that seek to capitalize on the value of brokering for bridging the gap between research and practice. Mechanisms that contribute to the achievement of organizational-level outcomes include the extent to which brokers align their own goals or values with organizational goals,[36] balancing economic and scientific interests,[34] direct involvement in key decision making in research activity,[31,32,35] and direct involvement in key decision making in evidence-based change projects[35,37] (Chart 1).

The mechanisms for the individual-level outcome include engaging in reflective practice[32,35] and associating habitually with the clinical care

Table 1

Summary of Characteristics of the 9 Included Articles in a 2017 Realist Review Examining How Clinician–Scientists Connect Research and Practice

Author, year[ref]	Country	Level of qualification[a]	Profession[a]	Aim of the study	Research method	Sample size	Quality and bias assessment[b]
Lander, 2016[2]	Canada	BSc, MSc, PhD, and MD	Multiprofessional group	To explore how individuals affiliated with academic health care organizations negotiate institutional logics related to science and care	Qualitative, interview study	24	Good
Adamsen et al, 2003[30]	Denmark	Not reported	Nurses	To examine whether there was a difference between clinical nurses who were research-active and clinical nurses who were not research-active in terms of use of research	Quantitative, exploratory and descriptive structured interview research	79	Moderate to good
Logsdon et al, 2017[31]	US	MSc and PhD	Nurses	To describe the role, activities, and outcomes of nurse–scientists	Quantitative, cross-sectional descriptive study	23 (of 55)	Moderate
Kluijtmans et al, 2017[32]	The Netherlands	MSc	Nurses and physiotherapists	To explore perception of professional identity and the experience of crossing the boundary between care and research	Qualitative, semistructured interview study	14 (10 nurses, 4 physio-therapists)	Very good
Kelly et al, 2013[33]	US	PhD, MSc, and BSc	Nurses	To describe the facilitators and hindrances associated with the conduct of registered nurse-led research in U.S. hospitals	Qualitative, open-ended survey	152 (of 160)	Moderate
Wilson-Kovacs and Hauskeller, 2012[34]	UK (Exeter)	PhD	Physicians	To analyze the experience and self-rationalization of clinician–scientists and the ways in which these professionals portray, explain, and justify their role	Qualitative, case study	32	Moderate
Hoeijmakers et al, 2013[35]	The Netherlands	Not reported	Multiprofessional group	To evaluate the extent to which the Academic Collaborative Centre Limburg links policy, research, and practice	Mixed methods, action research, and case study	Not reported	Moderate
Long et al, 2016[36]	Australia	Not reported	Multiprofessional group	To evaluate a translational research network's performance over the 4 years of its operation in terms of translational research planning, projects, outputs, and dissemination	Quantitative, survey research and social network analysis	171	Good
Ritchie et al, 2017[37]	US	Not reported	Multiprofessional group	To evaluate a facilitation strategy to help clinical sites likely to experience challenges implement evidence-based primary care–mental health integration	Qualitative, descriptive interview study	16	Good

Abbreviations: US indicates United States; UK, United Kingdom.

[a]Of clinician–scientists in the study.

[b]Assessments of the methodological quality of each study and the extent to which bias was addressed were made by 2 authors—one an experienced quantitative researcher and one an experienced qualitative researcher—using the Joanna Briggs Foundation guidelines.[25]

Chart 1

Contexts and Mechanisms for Organizational- and Individual-Level Outcomes of Brokering Activities, From a 2017 Realist Review Examining How Clinician–Scientists Connect Research and Practice

Contexts	Mechanisms[a]	Outcomes
Organizational-level outcomes		
Individual (inner): – a professional identity of a clinician and a researcher and/or an integrated identity[32] – resilience in maintaining career across both fields[34] – ability to prioritize diverse work tasks across contexts[35] – networking skills[32,36] – a mindset of openness in allowing practice and policy to inform research[2,35] – expertise in clinical practice[32,34,35] – a suitable level of research ability and training[2,32,33,35] – facilitating beliefs about science and the benefit of good research[2,34,35] **Situational (outer):** – a boundary-spanning professional jurisdiction[34–36] – close geographic proximity, preferably colocation, of clinical and scientific work contexts[2,36] – access to a network of collaborators[2,36] – management support[30,35,36] – epistemological and cultural alignment between the scientific and clinical work contexts[2,31,32,34–36]	**Boundary crossing:** – performance of boundary-crossing activities[35,36] **Social network:** – involvement of clinical staff in research[31,35] – collaboration between clinicians and researchers in writing research proposals[35] – strengthening network relationships between researchers, clinicians, and policymakers[36] **Community of practice:** – direct involvement in key decision making in research activity[31,32,35] – catalyzing the formulation and conduct of care-informed research[31,32] **Diffusion of innovation:** – critical reflection on public health issues and the patient perspective[32,35] – balancing economic and scientific interests[34] – focus on translation and practical applicability of research results[32]	**Research related:** – increase in volume of practically applicable, clinically relevant research results[2,31,32,34–36]
Individual (inner): – skills in change management and implementation facilitation[35,37] – networking skills[32,36] – demonstrating insight into daily clinical work[32] – ability to generate new ideas and evidence-based innovations[32] – ability to lead evidence-based practice projects[31] – ability to communicate research results in practice, education, and marketing settings in appropriate ways[32,35] – ability to prioritize tasks to maintain career across both fields[35] – ability to delineate professional jurisdiction[34] – a mindset of belief in the relevance of science or research to practice[35] – a mindset of openness in allowing practice and policy to inform research[2,35] **Situational (outer):** – consumer involvement[36] – management support[30,35,36] – organizational priorities allowing brokering between clinical and research fields[35] – possibility for collaboration (between practitioners and researchers)[32,36] – being viewed by clinicians as a plausible or competent clinician[34] – epistemological and cultural alignment between the scientific and clinical work contexts[2,31,32,34–36]	**Boundary crossing:** – performance of boundary-crossing activities[35,36] **Social network:** – strategic focus on networking activities[36] – involvement and enablement of key stakeholders[31,37] **Community of practice:** – direct involvement in key decision making in evidence-based change projects[35,37] **Diffusion of innovation:** – leadership opportunities in implementing research results in practice[31] – balancing economic and scientific interests[34] – alignment of own goals or values with organizational goals[36] – sensitivity and responsiveness to local context[37]	**Practice related:** – increased evidence application to improve care[30–32,34–37]

(*Chart continues*)

Chart 1
(Continued)

Contexts	Mechanisms[a]	Outcomes
Individual-level outcome		
Individual (inner): – high level of motivation and capacity to read relevant scientific literature[30] – strong interest in the research results of others[30] – sense of ownership and involvement in research, policy, and practice[30,35] **Situational (outer):** – management support[30,35,36] – access to boundary-spanning structures for collaboration[34,36] – networking opportunities[36] – shared understanding of purpose in collaborative networks[36]	– strategic focus on networking activities[36] – engagement in translational collaborations that transcend silos[2,35] – resourcefulness in overcoming organizational barriers[30] – engaging in reflective practice[32,35] – habitual association with the clinical care setting[2] – execution of high-quality, practice-focused research[34] – performance of boundary-crossing activities[35,36]	**Professional development of the clinician–scientist:** *As a researcher:* – becoming more skilled as a scientist[32] – more practice-focused view on research[2] – increased access to research opportunities[36] *As a clinician:* – having a higher degree of orientation toward international research results of relevance to own department[30] – increased use of evidence-based knowledge[30,32] – increased knowledge and skill[36] – broader perspective on patient care[32] – having a more critical evidence-seeking attitude[32] – having a higher awareness of the limitations of care[32] – more reasoned views of developments in own field of health care[32] – increased pride in own health care profession[32] *As a broker:* – broader perspective on organization of care[32] – increased networking opportunities and collaborative ties[36] – increased career opportunities[36] – reinforced position or status at the intersection between traditional medical care, scientific research, and academic medicine[34] – changed relationship with former colleagues[32]

[a]For the organizational-level outcomes, the mechanisms are clustered by program theories.

setting[2] (Chart 1). The mechanisms that feature in both individual- and organizational-level CMO configurations are the performance of boundary-crossing activities[35,36] and a strategic focus on networking activities[36] (Chart 1).

CMO configurations and program theory

Formulating CMO configurations (labeled as CMO 1–CMO 4 below) and then clustering the mechanisms (Chart 1) assisted in identifying 4 program theories that could be helpful in explaining the broker role of clinician–scientists. Figure 2 presents the overarching realist program theory.

Boundary crossing. Boundary crossing theory assisted in understanding the presence of both organizational- and individual-level outcomes. Boundary crossing theory stipulates that boundaries between related yet disparate contexts offer learning opportunities for brokers attempting to bridge the discontinuities between the culture, perspectives, and practice of the disparate contexts of research and health care practice.[38] Boundary crossing occurs at the intrapersonal, interpersonal, and organizational levels.

At the organizational level, the effectiveness of boundary-crossing activities of clinician–scientists depends in part on the degree of alignment between research and practice.[2,31,32,34–36] CMO 1 gives an example of this: A clinician–scientist who works in an organization where there is epistemological and cultural alignment between the scientific and clinical work contexts[2,32,34–36] (context) is able to effectively engage in boundary-crossing activities[35,36] (mechanism), which contributes to increased evidence application to improve care[30–32,34–37] (outcome).

Social network. Social network theory offers insights into how brokers occupy central positions in a network through which valuable resources can be accessed. Brokers are often seen as occupying

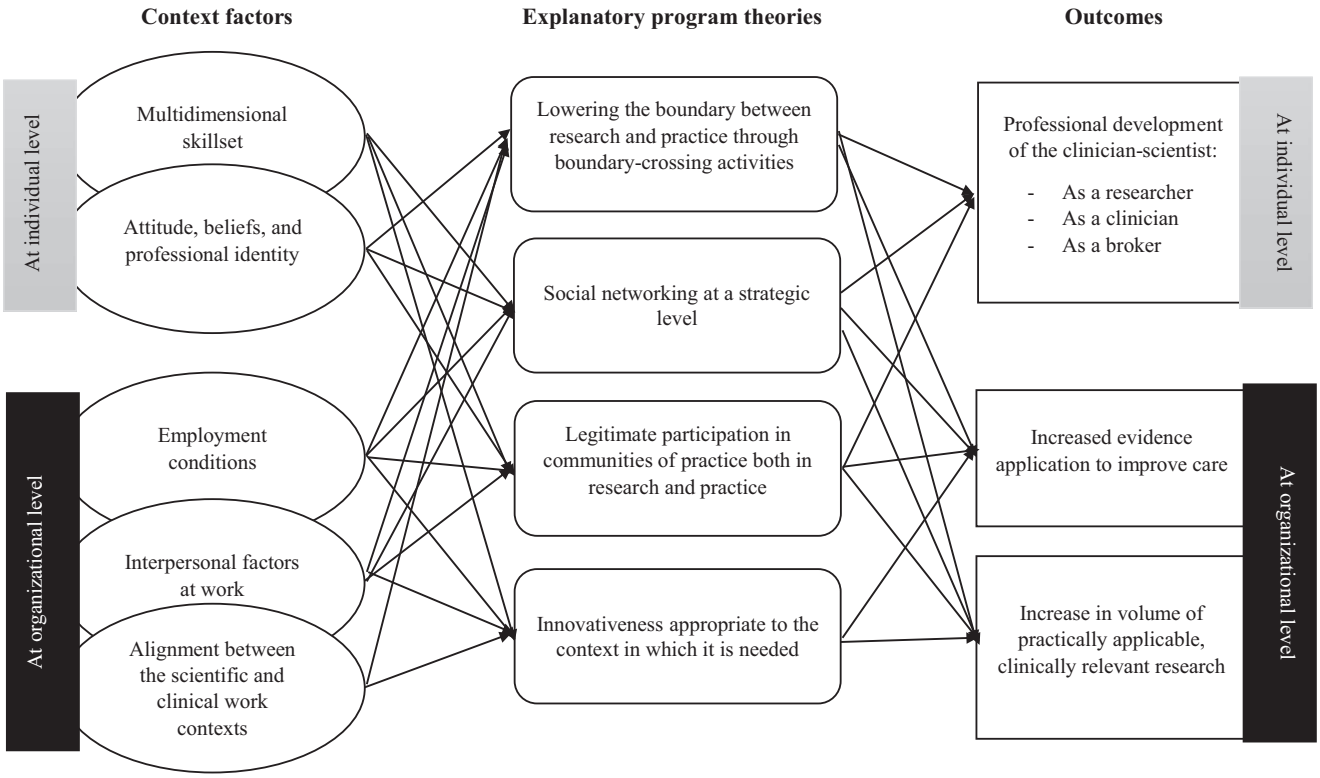

Figure 2 Overarching realist program theory for the broker role for clinician–scientists based on the findings from a 2017 realist review examining how clinician–scientists connect research and practice. The figure depicts how individual- and organizational-level context factors are linked to individual- and organizational-level outcomes through 4 explanatory program theories.

"structural holes"[39] in a network, in which they have valuable access and, therefore, hold disproportionate power over the distribution of resources (e.g., knowledge) in a group of people.

CMO 2 gives an example of this as applied to clinician–scientists: A clinician–scientist with good networking skills[32,36] and management support[30,35,36] (context) could establish collaborations between clinicians and researchers in the writing of research proposals[35] (mechanism). This can contribute to an increase in the volume of practically applicable, clinically relevant research results[2,31,32,34–36] (outcome).

Communities of practice. Communities of practice theory stipulates that professionals with a shared domain of practice work together in groups (or communities) in daily work activities.[40] The degree to which professionals engage with their community of coworkers either leads to full participation (community membership) or marginality (isolation). Community membership ascribes a level of competence to an individual and allows for participation in key decision-making processes.[41]

CMO 3 gives an example of this applied to clinician–scientists: A clinician–scientist who is viewed by clinicians as a plausible or competent clinician[32] (context) is in a position to be directly involved in key decision making in evidence-based change projects[31,32,35] (mechanism), thereby facilitating increased evidence application to improve care[30–32,34–37] (outcome).

Diffusion of innovation. Diffusion of innovation theory stipulates that new practices (innovations) are communicated through social systems within organizations. The adoption of these innovations by colleagues depends in part on the plausibility and competence of those leading change projects.[42] Innovativeness requires both an individual with new ideas and an organization that supports these, which then results in new products, services, or processes.[42]

CMO 4 gives an example of this as applied to clinician–scientists: A clinician–scientist who has an open mindset in allowing practice and policy to inform research[2,35] and has management support[30,35,36] (context) is able to critically reflect on public health issues and the patient perspective[32,35] (mechanism). This places them in a position to increase the volume of clinically relevant and practically applicable research[2,31,32,34–36] (outcome).

Discussion

In this realist review, we aimed to provide insight into how clinician–scientists connect research and practice through an analysis of the outcomes, context factors, and mechanisms in the included articles. Several inner and outer context factors are necessary to facilitate the mechanisms needed to achieve outcomes of interest. These mechanisms can be understood better using boundary crossing, social network, communities of practice, and diffusion of innovation theory, which were helpful in developing an overarching realist program theory (see Figure 2).

In our review, we encountered many papers in which the activities characterizing the broker role of clinician–scientists, who bridge the worlds of practice and research, were not described explicitly; instead, these papers focused only on reporting research or clinical activities or the mentor

role. While valuable, these papers did not offer insights specific to the broker role of clinician–scientists. They were, therefore, excluded from this review, yet they contributed to our initial finding that the broker role is frequently assumed without an in-depth understanding of what it really entails.

Our finding of a clinician–scientist who perceived herself as belonging to neither the community of practitioners nor the community of researchers[32] is singular yet relates to a known general difficulty experienced by professionals in dual roles.[21] Clinician–scientists might not be full members of communities of clinicians or communities of scientists; however, this appears to be an important mechanism by which they can achieve outcomes as brokers. As such, this could provide a target for interventions aiming to support clinician–scientists in their broker role.

Clinician–scientists facilitate bidirectional linkage and exchange[15] between the contexts of research and practice. They contribute to the design and development of research that is practically applicable and to the implementation of research results in practice. In the limited number of research papers found in this review that empirically studied how clinician–scientists facilitate these connections, evidence was mostly focused on organizational-level outcomes.[2,30–32,34–37] In contrast, individual-level outcomes were mentioned less frequently.[2,30,32,34,36]

Moreover, we did not find work that has been conducted to explore the impact of alignment (or the lack of alignment) between the scientific and clinical contexts on the broker role of clinician–scientists and its potential effects on the individual-level outcome. Given that boundaries between the scientific and clinical contexts play an important role in the ease with which clinician–scientists can perform their role[2] and that crossing these boundaries provides valuable learning opportunities for both contexts, it seems necessary to further explore these boundaries, the actual or perceived alignment (or misalignment) between research and practice, and the resulting broker outcomes. The organization has a role to play in creating a cultural alignment between the scientific and clinical work contexts,[2,32,34–36] which is, for the most part, beyond the capacity of a single broker.

The mechanisms found in our review suggest that clinician–scientists who are able to switch between strategic thinking and operational work tasks achieve organizational-level outcomes. An example of this is the ability to balance economic and scientific interests[34] while being directly involved in key decisions in conducting research.[31,32,35] Additionally, having a strategic focus on their networking activities[36] while also collaborating and strengthening ties with partners across boundaries[2,35,36] is essential. These are skills that are additional to the skills required for research and the clinical work of a clinician–scientist. We therefore suggest that very specific skills are required to broker a connection between research and practice.

Practical and theoretical implications

The mechanisms we identified offer valuable levers that policymakers and educators can use to support brokers in optimizing their role. One way to support the broker role could, for example, be to include the organization of opportunities for clinician–scientists to actively contribute to "reflection across boundaries" in strategic change projects that explicitly focus on bridging research–practice gaps. Individuals and organizations could gain from the expertise and frequent boundary-crossing activities of these professionals who connect research and practice, which, in many instances, are still disparate sociocultural domains.

Strengths and limitations of the review

Strengths of this review include the comprehensive literature search that was achieved through the use of 2 distinct search strings to capture a wide variety of articles on medical professionals in a dual role. A limitation of this study is that little empirical research has been done on the broker role of clinician–scientists, and, therefore, we had to base our findings on only 9 original research articles. In addition, the findings of the original articles are mainly qualitative in nature and, therefore, could reflect the perceptions and experiences of those participants rather than generalizable facts.

Conclusions

We identified 4 CMO configurations by which clinician–scientists achieve individual- and organizational-level outcomes in brokering a connection between research and practice. As such, our review provides insight into the inner and outer context factors and mechanisms that allow clinician–scientists to connect the worlds of research and practice. Clinician–scientists require additional skills, distinct from the skills they need to conduct research and carry out their clinical duties, to fulfill their broker role effectively, implying that organizational settings, initial training, and continuing professional development for clinician–scientists need to focus explicitly on skills for the brokering role, as well as those needed for research and clinical practice. Based on our findings, we expect that if more attention is paid to learning these skills and management support for the broker role is strengthened, stronger links between research and practice could be forged.

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