STRENGTHENING NETWORKS TO IMPROVE KNOWLEDGE TRANSLATION
IN PAEDIATRIC HEALTHCARE

by

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The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, the dissertation entitled:

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Abstract

**Background:** Knowledge translation (KT), or the process of moving research into action, takes 10-20 years, resulting in sub-optimal healthcare for Canadians. Most KT strategies designed to shorten this gap neglect the social factors that facilitate research use. Social network analysis (SNA) methodology can be used to examine these factors within a network of individuals, including identifying influential people, and describing interaction patterns that can be targeted to improve KT efficiency. No such studies exist in paediatric healthcare organizations. **Aims:** 1) determine how SNA can augment KT research; 2) describe the national KT support context within paediatric healthcare and research organizations; and 3) confirm the influence of networks on KT, and identify network-driven KT support strategies. **Methods:** Study 1: Scoping review of SNA and theory applied to KT research. Study 2: Survey-based environmental scan of organizational KT supports in Canadian paediatric healthcare and research organizations. Study 3: Mixed-methods SNA descriptive case study of one healthcare-research organization dyad’s KT network using visual tools, and SNA survey and interview data from researchers, clinicians, leaders and KT support personnel to triangulate network influences on KT, and to identify network interventions to facilitate KT. **Results:** Study 1: SNA use is emerging in the KT field, primarily to examine information flow through cross-sectional survey research of physician-only networks, while analyzing few network properties. Diverse theoretical perspectives appear to be applicable for SNA research. Study 2: Organizational supports for KT typically targeted healthcare professionals, leaders and researchers, and included library services, KT support personnel, internal and external collaborations, forums and communication strategies, policies and protocols, consultation, specialized initiatives and funding. Study 3:
Multiple network structures were perceived to influence KT. Reasons for network structure included individual attributes, relational considerations, and organizational context. Proposed network-driven KT support strategies included network development, communication, resources, personnel, visibly valuing KT, and evaluation. **Conclusion:** SNA can advance the science of KT by addressing the under-researched social determinants of evidence use, and by informing the design of network interventions. Participant engagement in applying a network perspective represented a novel application of SNA to KT research.
Lay summary

Moving research into action in healthcare is called knowledge translation (KT). The KT process can take 10 to 20 years. This research aims to find new ways to shorten this timeline. Social network analysis (SNA) is an under-used research method that can help researchers discover how connecting with others in a network or a group can improve KT efforts. Study 1 summarizes past research to help researchers using SNA methods learn to study how networks influence KT. Study 2 surveyed children’s healthcare and research centres across Canada to identify supports available for KT. Study 3 engaged staff in these centres to propose strategies to strengthen networks to support KT. Their ideas present new network-focused approaches that can be combined with the survey results to help move evidence into action more quickly and easily. Applying these strategies may help to ensure Canadians have timely access to the most effective healthcare available.
Preface

I identified and designed the research program presented in this thesis, led its conduct, performed all of the data analyses, and the initial drafts of all sections of the thesis. The relative contributions of collaborators and co-authors of the publications arising from this work are described below.

Relative contributions of collaborators and co-authors of publications arising from the work presented in the thesis:


   This work is located in Chapter 2 and was a collaboration with Dr. Emily Jenkins. My contribution to the research and writing was 70%. I was responsible for designing the study, conducting the literature search, screening for inclusion, extracting data, synthesizing the literature and drafting the manuscript. Dr. Jenkins screened for inclusion, contributed to study design refinement and revisions to the drafted manuscript. Dr. Kothari verified data extraction and contributed to study design refinement and revisions to the drafted manuscript. All authors read and approved the final manuscript.

This work is located in Chapter 3 and was conducted in collaboration with Andrea Ryce and Dr. Kimberly Miller. My contribution to the research and writing was 85%. I was responsible for leading study design, survey development, data collection, analysis, interpretation and manuscript writing. Ms. Ryce led search strategy development, conducted the scoping literature search and contributed to study design, survey development and data interpretation. Dr. Miller contributed to study design refinement, survey refinement and data interpretation. Drs. Nimmon, Kothari and Holsti provided input on study design and the presentation of findings. All authors read, provided input on and approved the final manuscript. This work was deemed by the University of British Columbia’s Children’s and Women’s Research Ethics Board to not require ethics approval.

The research presented in Chapters 4 and 5 was approved by the University of British Columbia’s Children’s and Women’s Research Ethics Board, Certificate #H17-01732.
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Glossary

**Actor:** A node in a network map that represents an individual or organization connected to other actors (through ties)

**Alter:** The node to which an actor of interest is connected

**Alternating independent two-paths:** Assesses the conditions required for transitivity (i.e. ties that form between each pair of actors in a set of 3 actors)

**Alternating k-stars:** The tendency of actors to create ties

**Alternating k-triangles/transitive triads &/or non-closure structures:** The extent to which sets of 3 actors form patterns of connections that create larger “clumps: within the network

**Betweenness centrality:** The extent to which an individual is tied to others who are not connected themselves

**Bonacich centrality:** Extent to which an actor is tied to others, weighted according to the centrality of those to whom the actor is tied/connected

**Brokers:** Actors who hold bridging positions in a network; that is, they play a role in connecting subgroups. All actors lying on a directed path between any pair of nodes are included in the brokering analysis

**Centralization:** The extent to which the network structure as a whole is concentrated around one or more central individuals, rather than demonstrating relatively equal connections across network members

**Clique:** Maximum number of actors who share all possible connections amongst themselves

**Closeness centrality:** Proportion of actors that can be reached in one or more steps
Clusters: Dense sets of connections in a network

Components and isolates: Components are portions of the network that contain actors connected to one another, but that are disconnected from actors of other components, resulting in sub-graphs that make up the network. As nodes without ties to any other nodes, isolates can also be considered components

Conventional content analysis: A qualitative analysis approach used to describe a phenomenon, which involves the researcher allowing coding categories and their names to flow from the data (i.e. inductive category development)

Core-periphery index: The core of a network represents the maximally dense area, whereas the periphery represents (to the maximum extent possible), the set of nodes without ties within their group.

Cyclic closure: Tendency for transitive triads (sets of 3 actors in which 2 ties exist) to lead to reciprocal ties within that triad

Degree centrality: The number of direct ties (connections) of an actor

Density: The proportion of all possible ties in a network that actually exist

Dyad: Pairwise relations among actors; represents one of three levels of analysis for social network data (the others being individual node-level and whole network level)

Euclidian distance: A measure of the dissimilarity between the tie patterns of each pair of actors in the network

Evidence-informed healthcare: The evidence-seeking, decision-making and implementation processes guided by evidence that are involved in developing, delivering and making changes to health services.
Flow betweenness centrality: How involved an actor is in all of the paths between all other actors (not just those representing the shortest paths)³

Hierarchical ties: Ties that join actors dissimilar in their status (e.g. according to profession, leadership or power position)¹⁰

Hubs and authorities centrality: The structural prominence of individuals within a core-periphery structured network¹¹

Indegree centrality: The number of individuals in the network who send ties to an actor³

Knowledge translation: The processes carried out or facilitated by researchers and others to identify the need for research evidence for decision-making, to effectively adapt/package and share evidence, to identify and apply strategies to address barriers to evidence implementation, and to evaluate evidence use in healthcare.¹²

Network: An interconnected group of actors (e.g. people, organizations)¹

Outdegree centrality: the number of direct ties an actor sends to others¹³

Quadratic Assignment Procedure (QAP) correlation: A statistical method used to test hypotheses by correlating matrices of dyadic (i.e. relational tie) data, which by definition fail to meet the assumption of independence required for conventional correlational analysis.¹⁴

Reciprocity: The extent to which directional ties to actors are returned³

Stochastic actor-based network modeling: A statistical approach for analyzing network dynamics over time, which takes into account the influence of network structure and position on the probability of tie changes occurring; used to estimate parameters influencing change, and to test hypotheses.¹⁵
**Structural equivalence:** When two nodes have the same relationships to all other nodes in the network - they can be substituted without altering the network\(^3\)

**Structural holes:** Absent ties in a network that limit exchange between actors;

**Constraint:** The degree to which an actor is tied to others who are themselves connected\(^3\)

**Ties:** The relations or connections among actors, or nodes, in the network\(^3\)

**Tie homophily:** The similarity of two connected nodes on a given attribute\(^1\)

**Tie heterophily:** The dissimilarity of two connected nodes on an attribute\(^1\)

**Tie hierarchy:** Connections between actors dissimilar in their status (e.g. according to profession, leadership or power position)\(^1\)

**Tie reciprocity:** The extent to which directional (e.g. outgoing) ties to actors are returned by their alters\(^3\)

**Tie strength:** Value associated with a tie/connection e.g. frequency of contact, emotional intensity, duration of connection, etc.\(^1\)

**Transitivity:** The network structure as it pertains to triads (the tendency for ties to exist between a set of three actors)\(^3\)

**Whole network centralization:** Extent to which interconnections are unequal across the network\(^16\) (i.e. concentrated around one or more central individuals)\(^1\)
List of abbreviations

ABI = acquired brain injury
ADHD = attention deficit hyperactivity disorder
AHSC = academic health science centre
AIMD = acronym for the AIMD (Aims, Ingredients, Mechanism, Delivery) Framework
ARCHE = Alberta Research Centre for Health Evidence
ASD = autism spectrum disorder
CADTH = Canadian Agency for Drugs and Technologies in Health
CAPHC = Canadian Association of Paediatric Health Centres
CCHCSP = Canadian Child Health Clinician Scientist Program
CDR = child development and rehabilitation
CEO = chief executive officer
CINAHL = Cumulative Index of Nursing and Allied Health Literature
CP = cerebral palsy
DCD = developmental coordination disorder
E-I Index = External-internal index
EIHC = evidence informed healthcare
EIP = evidence informed practice
ERGM = exponential random graph model
ERIC = Education Resources Information Center
FTE = full-time equivalent
iKT = integrated knowledge translation
KT = knowledge translation

min = minutes

MR-QAP = multiple regression quadratic assignment procedure

OACRS = Ontario Association of Children’s Rehabilitation Services

PARiHS = acronym for the PARiHS (Promoting Action on Research Implementation in Health Services) Framework

PRECEDE-PROCEED = acronym for the PRECEDE- (Predisposing, Reinforcing, and Enabling Constructs in Educational Diagnosis and Evaluation) PROCEED (Policy, Regulatory, and Organizational Constructs in Educational and Environmental Development) Framework

PICO = acronym for the PICO (Population, Intervention, Comparison, Outcome) Framework

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

QAP = quadratic assignment procedure

RE-AIM = acronym for the RE-AIM (Reach, Effectiveness, Adoption, Implementation, Maintenance) Framework

REDCap = Research Electronic Data Capture

SABM = stochastic actor-based network models

SIENA = acronym for the SIENA (Simulation Investigation for Empirical Network Analysis) Framework

SNA = social network analysis

SPOR = Strategy for Patient-Oriented Research

STRIVE = acronym for the proposed STRIVE (Systematize, Transmit, Resource, Invest, Value, Evaluate) Network Model
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Chapter 1: Introduction

1.1 Knowledge translation (KT) and evidence-informed healthcare (EIHC)

Knowledge translation (KT) is defined as “a dynamic and iterative process that includes the synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the healthcare system.”¹⁷ Evidence informed healthcare (EIHC) represents the end-stage of the KT process, which is generally carried out by healthcare professionals through their integration of evidence from research, clinical experience and the patient perspective to inform effective healthcare decision-making.¹⁸ The gap between what research has shown to be effective, and what we actually do in healthcare practice results in up to 40% of patients failing to receive treatments that reflect ‘best practice’, while another 20% of patients may be receiving ineffective or even harmful interventions.¹⁹,²⁰ The study of KT processes and outcomes, as well as the determinants of evidence use and the effectiveness of interventions designed to promote evidence uptake represents the scientific field of KT, which is critical for improving the efficiency and effectiveness of efforts to move research into practice.²¹–²⁵

An important step in addressing the research-to-practice gap is to identify the barriers and facilitators of practice change within the local setting in which evidence use is to occur.¹² KT best practices endorse the selection of KT interventions that target these barriers and facilitators of change.²⁶ This approach allows for the consideration of the key active ingredients and mechanisms of action by which the KT intervention is purported to be effective, which assists with the design of appropriate evaluation methods.²⁷ Barriers and facilitators of evidence use
may include individual, environmental, process-related, intervention-specific and social characteristics or influences.28,29

The findings from three extensive literature reviews on factors that impact research use within healthcare organizations that serve adult populations suggest that social factors, such as relationships and social interactions, are important for KT.30–32 Documented social considerations influencing KT in these contexts include collaboration between departments during implementation,30 support from peers, staff or supervisors,30,32 the social culture in which change is desired,31 and healthcare professional expectations regarding patients’ satisfaction and anticipated cooperation with a potential clinical intervention.30 Documented implementation interventions include opinion leaders and peers who model or facilitate desired behaviour,30–32 the development of social networks or communities of practice that support communication and influence,31 and the provision of recognition or reinforcement.30 No similar work was identified in paediatric sectors.

Despite the use of socially based KT strategies, little information is available about the mechanisms inherent in social relationships or connections that facilitate KT in healthcare.33 The detailed study of the social drivers of evidence use requires alternative approaches to the individual and system-level perspectives that have dominated the KT literature through the use of psychological and contextual theories, models and frameworks (e.g. the Theory of Planned Behaviour, the PARiHS framework, Institutional theory, absorptive capacity, organizational readiness).22 These aforementioned perspectives address primarily the influences related to the nature of the evidence itself, to individuals’ behavioural intentions, as well as to environmental factors (e.g. organizational resources and capacity for change).22 Attention to the patterns of interactions among individuals and groups, and to the nature of these interactions has been
limited, which restricts insight into their influences on KT processes and outcomes. Social network analysis provides a distinctive approach to address this gap, by offering more comprehensive theoretical and empirical explanations of the sources and influences of social phenomena than contextual or behavioural approaches alone.

1.2 Social network analysis (SNA) methodology and KT

SNA is a research approach that is concerned with the impact of social structure, position and relationships on the constraints and opportunities influencing actors in an interconnected group or network. Actors may be people or entities, such as organizations or countries; ‘ties’ represent the connections or interactions that are reported or observed among them. The goals of SNA are to measure and represent these structural relations accurately, to explain why they occur, and to determine their consequences. SNA assumes that actors’ relations within social systems are important influences on behaviour. SNA also enables multiple levels of analysis (e.g. individual, pairs of actors, individuals’ networks and whole networks) that can be applied to a range of contexts. A set of theories drawn from psychology, mathematics, sociology and the SNA field, among others, guides the study of networks and the interpretation of SNA findings.

The use of SNA is an emerging approach applied to examine the flow and uptake of knowledge in healthcare. SNA respects the social processes inherent in KT and enables the concurrent examination of individual attributes, network properties and KT processes and outcomes, as well as their interactions. Proponents of diffusion of innovations theory argue that for evidence to be accessible for widespread implementation, it must be mobilized through social channels, and become part of the collection of socially constructed knowledge shared among the group. Indeed, linkage and exchange efforts, involving the facilitation of relationships between
researchers and knowledge users (e.g. clinicians, health administrators) were identified as one of four most essential approaches for supporting organizational EIHC, along with creating a climate for research use, establishing infrastructure to improve access to evidence and enabling opportunities to access and implement evidence.\textsuperscript{36}

Quantitative surveys, qualitative interviews, document review and observation are typical data collection methods employed in SNA studies.\textsuperscript{34} With respect to surveys and interviews, name generator questions are used to identify ties between actors in the network.\textsuperscript{1} These questions typically invite respondents to recall or to identify from a list of actors those with whom they have interacted in a specific capacity. For example, to identify one’s recent research network, the survey question may read “With whom have you collaborated on research over the past year?”. Name interpreter questions are used to describe the characteristics of those ties (e.g. frequency of contact), as well as the similarities and differences in the attributes of individuals with ties to one another.\textsuperscript{1} Traditional demographic questions (e.g. “What is your profession?” “What is your gender?”) may be used to deduce these attribute similarities among actors.\textsuperscript{1} Conversely, name interpreter questions request information about tie characteristics directly (e.g. “For each of the individuals you named in your friendship circle, please indicate how often you communicate with them.” [sample response options: daily, weekly, monthly, less than monthly]).\textsuperscript{1} For this example, the response categories can be used to represent the strength of the ties that exist. The direction of ties can also be represented in response to name interpreter questions, such as “Who have you called in the past month?” (to identify outgoing communication), and “Who has called you?” (to identify incoming communication). Network maps are typically generated as outputs to visualize the structure of the relationships among actors to facilitate analysis and interpretation.\textsuperscript{3}
1.2.1 Social theories, network properties and KT

Socially based KT interventions have the potential to change behaviour by leveraging the power of social connections.\(^1\) From a social capital theoretical perspective, these connections afford an advantage that can enable access to expertise, knowledge, resources or support that augments performance or outcomes.\(^1\) In the context of KT, social capital may be drawn from connections with clinicians, leaders, researchers, KT support personnel or others whose input enhances the accessibility, relevance, applicability or implementation of new evidence.\(^{37}\) This capital manifests from the time, nature and quality of the interactions that are invested by individuals in these relationships.\(^{38}\)

Conversely, social influence theory purports that actors may share attitudes, knowledge or behaviours because they are connected to others who influence them.\(^{39}\) In the context of KT, social influence theory supports the idea that ties to others with positive attitudes toward KT, who access evidence regularly, or who model and support KT, will positively impact the KT attitudes, knowledge and behaviours of those connected to them.

Network properties related to social cohesion may be of interest as measures of access to social capital or to social influence.\(^{40}\) These properties include density (i.e. the ratio of actual ties relative to possible ties), connectivity (i.e. the extent to which subgroups within the network are interlinked), embeddedness (i.e. the constraints acting on an actor because of its position in the network), and bridging (i.e. actors who act as sole gatekeepers or brokers between subgroups within the network).\(^{40}\) Denser ties and greater connectivity are associated with greater flow of knowledge within a network, while centrality (i.e. the relative importance of actors based on their tie structures), embeddedness and bridging can be used to identify key actors.\(^{40}\) Knowledge of a network’s tendency to form specific types of ties, such as homophilous ones (i.e. ties
between two actors who are similar on a given attribute, such as gender, profession or role\textsuperscript{1}, may also be important for structuring interventions to foster specific types of ties within a network. Many more network properties exist, and can be examined in the context of KT to identify their influences on and significance for evidence sharing and uptake.

1.2.2 Research gaps

No systematic or scoping reviews of SNA research synthesize the KT literature specifically.\textsuperscript{41} However, recent SNA-focused systematic reviews in healthcare synthesize the outcomes of primary SNA research.\textsuperscript{33,42–47} This research tends to describe, explain or predict network-related phenomena, some of which may have relevance to KT (e.g. information sharing).\textsuperscript{46,48} While this research provides insights into some of the network properties of relevance to healthcare networks, the studies often employ only a small number of network properties linked to the specific research questions being addressed. Readers are left with the task of conducting their own analyses to determine the extent to which the various measures, methodological approaches and theoretical underpinnings may apply to KT or to their own research contexts and questions. A more comprehensive examination of the use of SNA methodology to study KT in healthcare contexts would enable the identification of a more thorough range of KT determinants worthy of examination, and provide direction for researchers with respect to how to select appropriate SNA measures and methodologies to address their research questions. Considering the breadth of theoretical approaches congruent with a SNA approach, a review of the literature to identify their application to SNA within the field of KT also serves to support KT researchers interested in employing SNA. A scoping review of the use of SNA methodologies applied to the study of KT in healthcare is needed to inform the design of
robust SNA-based KT research, including its theoretical approach, the assessment of network-related barriers and strengths, the selection of KT interventions, and the measurement of outcomes. Such an overview of how SNA methodology can be leveraged to advance the science of KT had not yet been published prior to this thesis research, and is the output of Study #1, presented in Chapter 2.

1.3 Organizations as KT networks

An organization in any sector can be seen as a bounded network within which individuals form an interconnected group. A given group of individuals within an organization may form an infinite number of unique networks with different properties, based on how the network and its boundaries are defined. \(^1\) For example, clinicians within a healthcare centre may have distinct inter-professional networks defined by their work within separate clinical programs, professional networks based on similarities in their disciplines (e.g. physiotherapist versus physician networks), and friendship networks based on social relationships they have forged within the organization. KT networks can be defined by patterns or interactions related to KT processes or activities, such as exchanging information, collaborating to implement evidence or evaluating KT outcomes. KT-related activities, such as participating in journal clubs, communities of practice, continuing professional development, or implementation projects, may form the basis of, or facilitate KT network ties. By examining KT networks within organizations, we can learn about the social processes involved in moving evidence into action, as well as identify potential barriers, along with differences that may exist, for example, between adult and paediatric sectors. Organizational supports for KT can then be designed and implemented with these social processes in mind.
1.3.1 Organizational supports for KT

Organizational supports for KT are strategies or interventions implemented to facilitate evidence use within (and sometimes external to) the organization. Just as understanding the social processes inherent in KT can inform the design of organizational supports, understanding the existing KT support infrastructure can assist in targeting social mechanisms to improve their effectiveness. By identifying and describing these KT supports, we can begin to understand the context within which KT is carried out, and the factors influencing positive KT outcomes. For example, delineating the active ingredients and mechanisms of actions of these KT strategies can help to identify those that are proposed to rely on or to affect social processes. These social processes can then be examined in more detail in order to determine their influences on KT outcomes.

A scoping search of the literature (see search strategy in Appendix A) identified three qualitative studies on organizational support infrastructure for evidence use in healthcare organizations serving adult populations, but none in the paediatric healthcare context. The identified publications reported on the perspectives of chief executive officers, librarians and managers in the Canadian provinces of Ontario and Quebec.\textsuperscript{36,50,51} This research suggests that organizational commitments paired with access to evidence, EIHC competencies and linkages to experts are essential for enabling and sustaining EIHC consistently within the organization.\textsuperscript{36,52} One support component alone is not considered capable of enabling real change.\textsuperscript{36} An EIHC culture, and the infrastructure to access evidence must be in place as foundational supports,\textsuperscript{36} while adequate human resources and financial investments are considered to increase the chances of successful and pervasive evidence use.\textsuperscript{50}
1.3.2 Social elements related to supporting KT

KT/EIHC supports can be multi-faceted; many of these approaches have implicit or explicit social aspects that may facilitate evidence use. Each of the organization-based EIHC support categories identified through the scoping search of the literature included one or more approaches that involved social elements. These categories are depicted in Figure 1, while the specific organizational supports that involve social elements are described below. Appendix B summarizes the complete list of organizational supports for EIHC identified in the scoping search, which have been mapped to the barriers they target, as described in the cited articles.

*Note: Dark boxes seen as most essential for EIHC by CEOs, librarians &/or KT unit managers

Figure 1. Categories of organizational EIHC support described in the literature

Establishing a climate for research use may involve setting up dedicated personnel roles to support evidence use or ensure accountability, group training programs, demonstrating leadership commitment to KT/EIHC, and establishing employee recognition processes, clear internal points of contact for accessing evidence, and formal and informal external relationships
to enhance access to evidence. Participation in research direction priority setting, program redesign projects, co-producing research, and the supervision of student projects are all research production efforts with a social component. By engaging in these activities with others, they become social processes by which influence is exerted, capacity is developed, and resources and expertise are accessed.

*Push efforts and their facilitation* include the sharing of knowledge by individuals, the engagement of knowledge brokers to support knowledge exchange and implementation of evidence, and appointing personnel to identify teaching moments to profile evidence. The attributes of these individuals, their social positions within the network (e.g. their degree of connectedness) and others’ perceptions of them are elements that can be explored through SNA. *Pull efforts* include engaging staff in training, establishing formal and informal external ties, hiring library personnel, accessing colleagues’ external affiliations to augment access to research, and identifying dedicated staff to pull research into decision-making processes. These efforts bring people together and/or leverage social capital of others in the network to augment capacity for research use.

*Linkage and exchange efforts* may include informal or formal relationship building between researchers, experts, knowledge brokers or opinion leaders and knowledge users, participation in external networks or groups, and meetings, such as journal clubs, medical rounds or quality improvement meetings that highlight relevant research and bring stakeholders together. *Evaluation efforts* may include workshops with embedded interaction, or interactions between staff and evaluators. These social processes may be important for gathering the relevant data, building capacity for evaluation, and conveying the importance of the implementation or evaluation processes.
1.3.3 Research gaps

This scoping search of the literature failed to identify any survey-based studies describing organization-based KT/EIHC supports. As a result, the breadth of KT/EIHC supports in place within healthcare organizations across Canada is not known. Only one protocol for an organizational survey of EIHC barriers and supports was identified through the scoping search. The protocol’s proposed survey focused on data collection to describe organizational missions, visions, values and accreditations, identifying key units supporting research synthesis production and sharing, the presence of personnel, library services and journal or database subscriptions, EIHC support in general, and evaluation efforts.\textsuperscript{52} Topics not addressed through this survey included challenges in implementing the supports, their effectiveness and cost-effectiveness, evaluation methods employed, the background and training of KT support personnel, the primary recipients or target audiences of the KT supports, funding, budget and staffing information, the nature of external supports accessed, organizational structures that support EIHC, and perceived changes required. Delineation of the supports that entail a relational component will also facilitate a more detailed study of organizational KT networks from a SNA perspective. The inclusion of questions to address these topics would provide a more comprehensive overview of the KT support context within healthcare organizations in Canada.

With respect to the qualitative literature, the studies took place in only two Canadian provinces, failed to include rehabilitation centres, and were not pediatric-specific, which limits confidence in the transferability of the findings. An examination of the KT supports available at healthcare organizations’ affiliated research institutes is also of interest because of the potential
for these organizational dyads to coordinate their provision of services and supports for staff related to KT. However, a scan of these research organizations has yet to be conducted.

While the views of chief executive officers, librarians and managers reported in the literature provided an overview of key KT barriers and supports, health professionals, researchers and KT support personnel are also important stakeholders involved in the sharing, appraising and direct use of evidence. Including their voices and experiences of engaging in KT and EIHC processes within their organizations is critical to determining the key factors to address and to informing the ways in which KT is supported. An environmental scan of the organizational barriers and supports for KT/EIHC that exist in Canadian paediatric healthcare organizations and their affiliated research institutes that addresses these gaps is the focus of Study #2, presented in Chapter 3.

1.4 Relevance of organizational KT supports to SNA-based research

Organizational supports for KT are implemented within a network context. The structure of the network has the potential to influence the effectiveness of these supports, and to shape the way they are implemented, adapted or taken up. For example, one relevant aspect of an organizational network may include its subgroups. Subgroups within an organization may include groupings of individuals by department, professional discipline, or clinical or research area. Organizational KT supports may target one or more of such subgroups inequitably, leading to the potential for differential outcomes across these sectors. The identification of a hierarchical structure of knowledge flow within an organization may lead to the need for tailored messaging to members using a top-down approach. Specific individuals (i.e. network actors), whether they are formal or informal leaders, may play more prominent roles than others in KT activities. For
example, a clinical manager may lead implementation efforts, a clinician may act as expert or mentor to colleagues in a practice area, or a study coordinator may engage various individuals in research or dissemination activities. Some of these individuals may be more or less connected to their colleagues. Identifying these individuals and their level of influence can inform recruitment or engagement processes for KT supports such that the influence of central (i.e. highly connected) actors can be leveraged, and isolated individuals can be engaged.\cite{26,53}

### 1.4.1 Network influences on KT within organizations

Several systematic reviews on SNA research examining network influences involving healthcare professionals included the study of networks related to KT, although as mentioned previously, no review addressed KT networks exclusively. These reviews examined networks related to communication or interaction patterns in general,\cite{46} care processes and patient outcomes,\cite{43} the adoption or diffusion of innovation or evidence,\cite{46} the implementation of change of any kind,\cite{33} and quality of care and patient safety.\cite{42} Within these reviews, only one of the included primary research articles was specific to paediatric healthcare or research settings.

In keeping with the principle of homophily, healthcare professionals generally tend to form advice, communication and friendship ties with members of their own profession and gender,\cite{43,46} even more so in the case of physicians,\cite{42} which may slow the spread of innovation.\cite{43,46} Inter-professional interactions are less prevalent,\cite{43,46,54} though may be facilitated by multidisciplinary training and targeted support to interact.\cite{7,46} Organizational arrangements, such as schedules, routines, team-based structures and shared caseloads, also tend to facilitate social connections, as may opinion leaders.\cite{46} Other factors that increase the prevalence of tie formation include geographic proximity,\cite{43,46} tenure,\cite{43,55} number of clinical hours per week,
holding a managerial role, and homophilous clinical specialty and attitudes toward EIP.\textsuperscript{43}

Different professions also tend to form different network structures, and to perceive those networks as being different from one another.\textsuperscript{46} For instance, nursing networks tend to be more dense, hierarchical, and centralized around nurse managers,\textsuperscript{42,43,46,56} while physician networks tend to have smaller, more closed clusters of individuals sharing information.\textsuperscript{10} Inter-professional networks have also been observed to have more hierarchical relationships between professions.\textsuperscript{43}

These network properties can influence outcomes in the healthcare setting. For example, increased hierarchy, density and centrality in some instances may improve efficiency and ability to cope with stress, while in others, may inhibit professional performance and the quality of care coordination.\textsuperscript{43} Direct ties, network homophily and centrality can influence EIP attitudes and behaviours in physicians, while recruiting peer-nominated opinion leaders can support desired behaviour.\textsuperscript{46} Of note is that the presence of brokers and of weak ties with colleagues can promote the sharing of useful information,\textsuperscript{46} while network gaps hinder dissemination and social influence.\textsuperscript{33,42} Timing of adoption, similarly, may be associated with centrality,\textsuperscript{46} with greater centrality being particularly important for late adopters.\textsuperscript{57} Stability in the network is associated with greater effectiveness, and may help to reduce the impact of limited resources.\textsuperscript{42} Although conflicting results have been reported, research suggests that communication network density and centrality may be associated with improved patient outcomes.\textsuperscript{47} Despite these general trends, variability exists across healthcare settings and KT contexts, while little information is available about paediatric settings. However, KT strategies that factor in network properties are suggested to be more successful.\textsuperscript{33}
1.4.2 Research gaps

While a number of studies have examined network structure related to knowledge flow and other factors of relevance to KT, no research exists that examines these factors in the pediatric rehabilitation context. Pediatric rehabilitation contexts differ from adult acute care settings in that rehabilitation teams tend to be more integrated, with diverse inter-professional representation and a tendency to draw knowledge from external sources, compared to more hierarchical networks with internal gate-keepers of information observed in nursing/physician-focused settings, which can inhibit information flow. The dynamics of KT also present greater complexity in rehabilitation because the patient-level outcomes of interest being evaluated in KT efforts may be more challenging to evaluate given the complexity of the team-based intervention approach (e.g. implementation of a new medication protocol resulting in immediate observable physiological patient outcomes in an intensive care unit, versus changes in models of care in a rehabilitation unit that influence a range of longer-term outcomes related to community re-integration). Paediatric settings also focus on family-centered care, which involves engaging children and families in the evidence-informed health decision-making process. As a result, team dynamics with respect to information flow may differ, as parents and patients may be engaged collaboratively in KT processes.

Without descriptive research examining the social influences of KT in paediatric rehabilitation settings, the extent to which these factors are relevant are not known. By targeting this significant research gap, I will identify effective strategies to move evidence more quickly and effectively into clinical practice. The direct impact to patients and families will be better access to the safest, most effective healthcare innovations for rehabilitation.
No studies identified through the scoping search of organizational KT supports described whole systems of support within an organization. This gap prevents a broad understanding of the context within which social processes related to KT occur. Similarly, the qualitative body of research describing the organizational barriers and supports for KT/EIHC described in section 1.3 does not examine in detail the social factors that influence KT within organizations. While a segment of the findings identify, for example, linkage and exchange efforts and/or supports as being important for EIHC, additional research is required to explore these social interaction elements in greater depth, and to validate their importance from the perspectives of additional stakeholders.

Finally, applying a SNA lens to the organizational context for supporting KT can provide valuable insight into the role of network position and structure on the sharing and use of evidence, as well as how best to support these processes from a network perspective. The extent to which observed network properties are perceived by network members to be relevant to and influential on KT processes also has yet to be confirmed. A mixed methods study that employs a SNA survey and gathers network member perspectives on the findings through qualitative interviews, provides the means of triangulating this descriptive network data. To address this gap, Chapters 4 and 5 report on Study 3, a mixed-methods SNA study involving multiple stakeholder groups within one of Study 2’s paediatric health centres and its affiliated research institute, to examine in detail the network structure and its perceived influence on KT.

1.5 Research goals, questions and hypotheses

The goals, research questions and hypotheses to be addressed in this thesis are as follows:
1.5.1 Study #1: Systematic scoping review of the use of SNA in KT science

Goals:

1. To identify the ways in which SNA methodology has been applied to study KT and EIHC processes and outcomes and can advance KT science
2. To describe the theoretical approaches employed in SNA-based KT research

Research questions and hypotheses

A1. How has SNA been applied to the field of KT/EIHC with respect to study aims, data collection methods, and populations, the KT process and structural properties under study?

H_{A1}: Knowledge sharing will be the most common KT process under study.

A2. What are the primary theoretical underpinnings that explain the link between network properties and EIHC?

H_{A2}: Prominent theories in SNA (e.g. social influence, social capital) will be prevalent.

A3. What are the gaps in the literature that can inform future research directions?

H_{A3}: A paucity of longitudinal and paediatric research will exist.

Armed with information about the ways in which SNA methodologies and its relevant theories can be applied to KT, I will be well positioned to examine the possible relationships between network properties and KT processes and outcomes.
1.5.2 Study #2: National environmental scan of organizational contexts for KT support

Goal:

1. To identify existing organizational supports for EIHC/KT, clinical research integration and stakeholder engagement in research that exist within paediatric academic health sciences centres (AHSCs) and their affiliated research institutes across Canada

Research questions and hypotheses

B1. What organizational supports (e.g. personnel, resources, services, organizational structures/processes) are in place to support EIHC/KT, clinical research integration and/or stakeholder engagement in research in Canadian paediatric AHSCs and their affiliated research institutes?

H_{B1}: Formal KT support units will be established in fewer than one third of the organizations surveyed

B2. Who are the primary audiences for these organizational supports?

H_{B2}: Most KT supports will target healthcare professionals or researchers

B3. What are the primary internal and external partnerships, collaborations or linkages that facilitate EIHC/KT?

B4. Which supports have been most successful in facilitating EIHC/KT?

B.5 What are the challenges associated with providing KT supports?

By mapping out the KT support contexts within healthcare and research organizations across Canada, I will understand more clearly the opportunities and constraints for KT that can be examined from a SNA perspective.
1.5.3 Study #3a: Mixed-methods SNA descriptive case study

Goals:

1. To define the network of social relationships related to KT that exist within one AHSC and its affiliated research institute.
2. To triangulate SNA findings through interviews to determine the extent to which observed network properties are seen as being influential on KT.
3. To identify the reasons for the observed network structure from the perspectives of network members.

Research questions and hypothesis

C1. What structural network properties that may support or hinder knowledge sharing patterns and KT processes can be observed in the network?

C2. To what extent do network members perceive the observed network properties to influence KT?

Hc3: Participants will see observed network properties as influential on KT

C3. What are the factors that network members perceive as explanatory for the specific structures observed in the network?

By describing the network of researchers, clinicians, health administrators and KT support personnel in one pediatric rehabilitation/research organization, I will be able to identify important network weaknesses and strengths that can be targeted through the use of socially based KT interventions to improve evidence use.37
1.5.4 Study #3b: Organizational network strategies for KT support: Qualitative findings

Goal:

1. To identify potential network-driven strategies that can be implemented at the organizational level to support KT processes and outcomes

Research question

D1. What network-related strategies do network members propose at the organizational level to support KT?

The identification of proposed network-driven strategies to strengthen networks to enhance KT processes and outcomes can inform the design of KT interventions from a network perspective. The future empirical testing of such interventions can provide insights into the most effective strategies by which to support evidence use from a network lens.

This work addresses a critical gap in the KT literature by examining in detail the network influences on KT, and the reasons for network structure. The research also employs a novel strategy in the field by engaging network members to critically reflect on their network’s structure and connections. Furthermore, I used network visualizations during the interviews as a tool to facilitate the gathering of participants’ perspectives despite them having minimal experience applying a network approach to reflect on KT. The outcomes of this research will inform strategies to enhance interactions among clinicians, researchers and patients and families to improve the safety and effectiveness of patient care. This proposed work establishes the foundation for a research program examining the effectiveness of socially mediated interventions to optimize KT.
Chapter 2: Study #1: Scoping review on the use of SNA in KT research

A version of this chapter has been published in the journal Implementation Science with co-authors Dr. Emily Jenkins and Dr. Anita Kothari. I designed the study, drafted the search strategy in collaboration with Andrea Ryce, clinical librarian, conducted the search, screened for inclusion, extracted data, synthesized the literature and drafted the manuscript. Dr. Jenkins screened for inclusion, contributed to study design refinement and revisions to the drafted manuscript. Dr. Kothari verified data extraction and contributed to study design refinement and revisions to the drafted manuscript. All authors read and approved the final manuscript.

2.1 Synopsis

To date, implementation science has focused largely on identifying the individual and organizational barriers, processes, and outcomes of knowledge translation (KT) (including implementation efforts). Social network analysis (SNA) has the potential to augment our understanding of KT success by applying a network lens that examines the influence of relationships and social structures on research use and intervention acceptability by health professionals. The purpose of this review was to map, comprehensively, the ways in which SNA methodologies have been applied to the study of KT with respect to health professional networks. Systematic scoping review methodology involved searching five academic databases for primary research on KT that employed quantitative SNA methods, and applying inclusion screening using predetermined criteria. Data extraction included information on study aim, population, variables, network properties, theory use and data collection methods. Descriptive statistics and chronology charting preceded analysis of findings. Twenty-seven retained articles describing 19 cross-sectional and two longitudinal studies reported on 28 structural properties,
with degree centrality, tie characteristics (e.g. homophily, reciprocity) and whole network density being most frequent. Eleven studies examined physician-only networks, nine focused on inter-professional networks and one reported on a nurse practitioner network. Diffusion of innovation, social contagion and social influence theories were most commonly applied. Emerging interest in SNA for KT- and implementation-related research is evident. The included articles focused on individual level evidence-based decision-making; we recommend also applying SNA to meso- or macro-level KT activities. SNA research that expands the range of professions under study, examines network dynamics over time, extends the depth of analysis of the role of network structure on KT processes and outcomes, and employs mixed methods to triangulate findings, is needed to advance the field. SNA is a valuable approach for evaluating key network characteristics, structures and positions of relevance to KT, implementation and evidence informed practice. Examining how network structure influences connections and the implications of those holding prominent network positions can provide insights to improve network-based KT processes.

2.2 Background

The ‘science’ of knowledge translation (KT), namely the study of the processes, determinants and outcomes of KT and evidence informed practice (EIP) efforts, is of high interest to researchers because of the significant challenges that exist in getting research into practice. To date, KT scientists have targeted their efforts primarily at identifying the key processes of KT, understanding the influences on these processes, and evaluating the effectiveness of various strategies to support them. However, identifying the specific
mechanisms by which KT strategies, particularly complex multi-faceted ones, have been effective requires additional research. Furthermore, limited information is available to clinicians and researchers about the role of social relationships and network connections in facilitating KT.33

Social network analysis (SNA) is a research paradigm concerned with the patterns of connections (i.e. ties) between actors (i.e. people or entities) within in an interconnected group or network, and how this ‘social structure’ impacts outcomes of interest.1 Key SNA terms that provide the context for this review are defined in Table 1, along with their application to the study of KT. Actors may be individuals, organizations, countries or other entities; ties reflect the connections or linkages between them.1 The structural characteristics of both whole and individuals’ networks can be studied. Included with the paradigm are theories, such as network, graph, diffusion and social influence theories, and a set of methodologies that can be applied across a range of substantive problems. Visualization tools, or social mapping, and the use of network descriptive statistics, can provide a visual and empirical basis for comparison across networks, including identifying important strengths, gaps or differences between networks that merit further exploration through qualitative means. Statistical and computational modeling can also be used to explain and to predict network-related phenomena, and to simulate the complexities inherent in network dynamics.
**Table 1. Social network analysis (SNA) terms and their implications for KT**

<table>
<thead>
<tr>
<th>SNA term [Frequency count]</th>
<th>Definition</th>
<th>Implication for KT and implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Network</strong></td>
<td>An interconnected group of actors (e.g. people, organizations)¹</td>
<td>Provides the social context within which KT occurs</td>
</tr>
<tr>
<td><strong>Actor</strong></td>
<td>A point (node) in a network map that represents an individual, organization or entity connected to other actors (through ties)¹</td>
<td>Represents the people, teams or organizations involved in KT processes</td>
</tr>
<tr>
<td><strong>Tie [10]</strong></td>
<td>The relations or connections among actors in the network³</td>
<td>Represents the interactions, collaborations or relationships involved in KT; Measures one- versus two-way communication, advice seeking, collaboration, etc.¹</td>
</tr>
<tr>
<td><strong>Dyad</strong></td>
<td>Pairwise relations between actors¹</td>
<td>Represents one of three levels of analysis for social network data (the others being individual node-level &amp; whole network level)¹</td>
</tr>
<tr>
<td><strong>Centralization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole network centralization [3]</td>
<td>Extent to which interconnections are unequal across the network¹⁶ (i.e. concentrated around one or more central individuals)¹</td>
<td>Thought to enhance ease of knowledge sharing &amp; to promote standard practices of existing protocols.⁶¹ Decentralization may support new innovations, but lead to mixed messaging &amp; decreased clarity because of multiple information sources.³⁹</td>
</tr>
<tr>
<td><strong>Centrality</strong></td>
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<td></td>
</tr>
<tr>
<td>Degree centrality [3]</td>
<td># of direct ties (connections) of an actor⁷</td>
<td>Seen as an indicator of visibility,⁶² prestige⁶⁴ or power³ resulting from lots of direct contact to many others</td>
</tr>
<tr>
<td>Indegree centrality [10]</td>
<td># of individuals who send (identify) ties to an actor</td>
<td>Considered an index of importance,³ power or influence⁴</td>
</tr>
<tr>
<td>Outdegree centrality [5]</td>
<td># of direct ties an actor sends (identifies) to others¹³</td>
<td>Used to quantify access to resources through colleagues, exposure to evidence &amp; others’ practices; positively associated with EIP use¹³</td>
</tr>
<tr>
<td>Betweenness centrality [4]</td>
<td>Extent to which an individual is tied/connected to others who are not connected themselves⁴</td>
<td>Used as a proxy for control of KT processes;⁶¹ high values reflect a favourable position (e.g. brokering potential)⁴ for information flow or power³</td>
</tr>
<tr>
<td>SNA term [Frequency count]</td>
<td>Definition</td>
<td>Implication for KT and implementation</td>
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<tr>
<td>Flow betweenness centrality [3]</td>
<td>How involved an actor is in all of the paths between all other actors (not just those representing the shortest paths)³</td>
<td>Used to determine contributions of individuals toward team decision-making; provides insights into structural hierarchy¹³; Used as a proxy for ease of bypassing the core individuals in the network³,6³</td>
</tr>
<tr>
<td>Closeness centrality [2]</td>
<td>Proportion of actors that can be reached in one or more steps³</td>
<td>Proxy for degree of access to information⁶³ or efficiency in communicating with the network (relative reach)¹</td>
</tr>
<tr>
<td>Bonacich centrality [1]</td>
<td>Extent to which an actor is tied to others, weighted according to the centrality of those to whom the actor is tied/connected³</td>
<td>Proxy for power or hierarchy within a network; may help to identify network fragmentation/brokering opportunities⁴⁶</td>
</tr>
<tr>
<td>Hubs &amp; authorities centrality [1]</td>
<td>The structural prominence of individuals within a core-periphery structured network¹¹</td>
<td>Proxy for importance¹¹</td>
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<td><strong>Tie characteristics</strong></td>
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<tr>
<td>Tie strength [7]</td>
<td>Value associated with a tie/connection e.g. frequency of contact, emotional intensity, duration of connection, etc.¹</td>
<td>Weak ties thought to increase access to new information/opportunities; strong ties seen as required for innovation implementation⁶⁴</td>
</tr>
<tr>
<td>Tie homophily (includes external-internal or EI index) [13]</td>
<td>Similarity of connected nodes on a given attribute¹</td>
<td>Similarities among people create conditions for social contagion (individuals may be more likely to modify their behaviours/attitudes to match those around them)⁶⁵,6⁶</td>
</tr>
<tr>
<td>Tie hierarchy [1]</td>
<td>Connections between actors dissimilar in their status (e.g. according to profession, leadership or power position)¹</td>
<td>Hierarchy may be a barrier to innovation adoption (e.g. lack of interest from above/resistance from below²)</td>
</tr>
<tr>
<td>Tie reciprocity [8]</td>
<td>The extent to which directional ties to actors are reciprocated (i.e. are bi-directional)³</td>
<td>Reciprocity may reflect greater stability or equality (versus hierarchy)³</td>
</tr>
<tr>
<td>Euclidian distance [1]</td>
<td>A measure of the dissimilarity between the tie patterns of each pair of actors in the network³</td>
<td>Can be used to identify key people by their dissimilarity to others (e.g. who has the most research productivity relative to connected peers)⁶⁷ (as a proxy of influence)</td>
</tr>
<tr>
<td><strong>Density</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole network density [8]</td>
<td>An index of the proportion of existing ties relative to all possible ties in a network³</td>
<td>Proxy for efficiency of information flow,¹³ solidarity⁶⁸ or cohesiveness within a network¹⁶</td>
</tr>
<tr>
<td>SNA term [Frequency count]</td>
<td>Definition</td>
<td>Implication for KT and implementation</td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Ego network density [2]</strong></td>
<td>Portions of the network that contain actors connected to one another, but disconnected from actors of other subgroups</td>
<td>Subgroups &amp; isolates can be targeted to increase connectedness, share information or mobilize action</td>
</tr>
<tr>
<td><strong>Subgroups</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Components/isolates [3]</td>
<td>Portions of the network that contain actors connected to one another, but disconnected from actors of other subgroups</td>
<td>Subgroups &amp; isolates can be targeted to increase connectedness, share information or mobilize action</td>
</tr>
<tr>
<td>Cliques [1]</td>
<td>Maximum # of actors who share all possible connections amongst themselves</td>
<td>Can describe paths for fostering awareness &amp; adoption of interventions</td>
</tr>
<tr>
<td>Clusters [4]</td>
<td>Dense sets of connections in a network</td>
<td>Identifying attributes that influence clustering helps understand KT-related behaviours, such as information seeking (e.g. experts; same department)</td>
</tr>
<tr>
<td><strong>Network roles &amp; positions</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brokers [1]</td>
<td>Actors holding bridging positions in a network (i.e. play a role in connecting subgroups)</td>
<td>Can leverage brokers’ positions for efficient KT by leveraging their tie paths/connectedness</td>
</tr>
<tr>
<td>Coreness/Core-periphery index [2]</td>
<td>The core of a network represents the maximally dense area of connections, whereas the periphery represents (to the maximum extent possible), the set of nodes without connections within their group</td>
<td>Power/influence at the core; The most active EIP practitioners may be found at periphery</td>
</tr>
<tr>
<td>Structural equivalence [2]</td>
<td>When two nodes have the same relationships to all other nodes in the network - they can be substituted without altering the network</td>
<td>These positions may generate social pressure within a network</td>
</tr>
<tr>
<td>Structural holes/constraint (ego network) [2]</td>
<td>Structural holes: Absent ties in a network that limit exchange between actors; Constraint: degree to which an actor is tied to others who are themselves connected</td>
<td>Inequality among actors can be identified &amp; targeted through KT interventions; may have implications for EIP adoption (e.g. many ties may restrict one’s actions/capacity)</td>
</tr>
<tr>
<td><strong>Transitivity/network closure (i.e. network structure related to triads)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alternating k-stars [4]</td>
<td>The tendency of actors to create ties</td>
<td>Used as an indicator of hubs within a network or the tendency to share/exchange knowledge</td>
</tr>
<tr>
<td>Alternating k-</td>
<td>The extent to which sets of 3 actors form patterns</td>
<td>Assesses tendency to build relationships outside of one’s</td>
</tr>
<tr>
<td>SNA term [Frequency count]</td>
<td>Definition</td>
<td>Implication for KT and implementation</td>
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<tr>
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</tr>
<tr>
<td>triangles/transitive triads &amp;/or non-closure structures [5]</td>
<td>of connections that create larger “clumps: within the network”^{2,3}</td>
<td>local group – access to new knowledge^{2}</td>
</tr>
<tr>
<td>Cyclic closure [1]</td>
<td>Tendency for transitive triads (sets of 3 actors in which 2 ties exist) to lead to reciprocal ties within that triad^{6}</td>
<td>Cyclic closure thought to reflect non-hierarchical knowledge exchange, which is more effortful to maintain &amp; therefore less likely to be seen in knowledge sharing networks^{6}</td>
</tr>
<tr>
<td>Alternating independent two-paths [2]</td>
<td>Assesses the conditions required for transitivity (i.e. ties that form between each pair of actors in a set of 3 actors)^{2}</td>
<td>Can determine the extent to which actors tend to build small, closed, non-hierarchical connections that limit broader access to new information^{2}</td>
</tr>
</tbody>
</table>

Note: SNA=social network analysis; KT=knowledge translation; square brackets indicate the number of publications examining each network property
SNA offers an alternate perspective to behaviour change theory-based approaches prevalent in KT science. These latter approaches focus on individual-level factors influencing behaviour change, often from a social cognition perspective. Conversely, SNA proposes a network-level perspective that examines how connections among individuals or entities, and the nature of the associated interactions, influence an outcome (e.g. accessing or sharing evidence, changing practice behaviours based on evidence). The paradigm respects the socially driven nature of innovation uptake, and the value inherent in examining not only the processes involved in KT, but also the social structures and characteristics of the networks of relationships within which KT occurs. Examples of network-related KT processes that can be examined from a SNA lens include one-way versus two-way exchange of information, gaps in the flow of or access to information or resources required for evidence use, and the timing and prediction of evidence uptake by different types of individuals. The influence of specific types of people on behaviour change, individuals’ capacity for change based on their positions in the network, and the effectiveness of strategies to address gaps or inefficiencies identified in the network can also be evaluated.

Recent systematic reviews on SNA in healthcare have focused on quality and patient safety initiatives, on a single profession (i.e. nursing) or on only select network properties (e.g. the study of brokers). Some reviews focus on conditions (e.g. obesity networks) to explore possible network interactions for potential treatments. Given the complex and inter-professional nature of healthcare practice, a study of the full breadth of health professions and network properties is required. Furthermore, some of these reviews included non-healthcare literature (e.g. from television production and corporate business contexts), or neglected to include social sciences databases in which most SNA journals are indexed. The existing broad
reviews of health professional networks \(^{33,46,47}\) do include some studies on KT-related phenomena (e.g. diffusion, knowledge transfer); however, the majority of their content centered on the study of social interactions that have implications for organizational functioning (e.g. friendships, work task assignments, staff recruitment, social support trust), but were not linked directly to the exchange or application of evidence to inform practice. Similarly, the emphasis on outcomes related to work satisfaction, leadership roles, professional behaviours, protocol efficiency, patient flow, operating room layout, technology adoption and workplace performance reduce the extent to which KT-specific outcomes can be explored. The review by Chambers et al.\(^{33}\) described primarily the settings and outcomes of these studies, whereas the current study aims to describe in detail the nature of the application of SNA to the study of KT. Such an approach aims to advance the science of KT by providing insight into worthwhile methodological directions this literature can provide. Evidence for the effectiveness of specific KT interventions or for the identified relationships between network properties and other variables relevant to KT can be sought elsewhere. Furthermore, none of these reviews examined the use of theory in their included body of literature specifically, despite this focus being an identified gap.\(^{33}\) Given the rapid growth of the use of SNA in the healthcare context over the past eight years (see Figure 3), an updated and more directed search is warranted. A targeted examination of the research specific to SNA in KT and EIP is required to inform the application of SNA methodologies in this field, with attention paid to the insights offered by both the structural properties examined and the theoretical perspectives applied.

A SNA perspective can broaden our understanding of the mechanisms by which KT efforts are effective by examining the social structures and relationships that facilitate or hinder KT and EIP. This understanding will augment our knowledge base by expanding the range of KT
determinants worthy of consideration. As researchers gain interest in the social drivers of KT and EIP, this review will provide a foundation for developing key research questions and SNA-driven methodological approaches for KT research that are based on established and relevant theories. Furthermore, this review will add to the current theorizing in the field related to a systems-focused understanding of KT and implementation processes. Specifically, implementation happens within a complex system, and network approaches have been used to study complex systems; the link between the two areas demands greater attention. Given these gaps, the purpose of this article is to synthesize the ways in which SNA methodology can be used to advance the science of KT.

2.3 Methods

The purposes of a scoping review are to examine the extent, range and nature of research in a given field, to determine the utility of conducting a subsequent systematic review, to summarize a body of research, and/or to identify research gaps, making it an ideal approach to map the KT literature utilizing SNA. The specific objectives of this scoping review were: 1) to describe the literature on SNA as it has been applied to KT and EIP involving healthcare professionals, in terms of its research design, methodology and key findings; 2) to provide a critical analysis of the results in the context of existing theory; and 3) to identify strengths and gaps to inform future research. The scoping methodology, as described by Levac et al.’s modification of Arksey and O’Malley’s guidelines were applied. Step six in the methodology, consultation with key stakeholders, is optional and was not applied in the current review.
2.3.1 Step 1: Identify the research question

The specific research questions developed for this review were:

1. How has SNA been applied to health professional networks in the field of KT/implementation/EIP with respect to study aims, data collection and analysis methods, and populations, context, variables and structural properties under study?
2. What are the primary theoretical underpinnings that explain the link between network properties and KT/implementation/EIP?; and
3. What are the gaps in the literature that can inform future research directions?

2.3.2 Step 2: Identify relevant literature

The search strategy involved a systematic search of peer-reviewed English SNA literature in November 2015, repeated in July 2018, within five primary literature databases: MEDLINE, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Embase, Web of Science (Science, Social Sciences Citation and Arts and Humanities Citation Indexes) and Sociological Abstracts. Wherever possible, I mapped keywords to subject headings, which were focused and exploded to best capture relevant articles. Keywords encompassed concepts related to social networks, KT, implementation and EIP, as well as healthcare professionals. Because of the lack of consistent indexing terms addressing the concept of KT and implementation, keywords and subject headings were drawn from empirically evaluated search strategies on this topic to foster relevant results. Appendix A provides the detailed search strategy I used for MEDLINE; other database strategies are available on request.
2.3.3 Step 3: Select the literature

Retrieved articles were screened independently for inclusion by two authors (SG and EJ). Selection criteria were pilot tested with five or six publications from a single database. Consensus was established through discussion of the screening criteria as they applied to a given article. This process was then repeated following screening of the results within each database. In instances where consensus could not be established, the third author (AK) was available to provide an independent screening.

Inclusion criteria included peer-reviewed articles describing outcomes of research studies employing quantitative SNA methodology to examine networks involving healthcare professionals in the context of KT, implementation or EIP (broadly defined as the exchange and/or application of information to facilitate best practices in healthcare). The health professional context was selected to narrow the scope of the review while maintaining high relevance to KT, as health professionals are common knowledge users or subjects of implementation efforts. Outcomes of interest included, but were not limited to competencies (i.e. attitudes, knowledge or skills) and behaviours by health professionals related to their sharing or use of evidence to inform clinical decision-making. Dyadic (i.e. pair-level), ego-network (i.e. individuals’ networks) and whole network (e.g. departmental or organizational-level) properties and variables were of interest.

Exclusion criteria included non-English articles for feasibility, and articles that did not quantify SNA data or network properties. This latter criterion prioritized articles that described, predicted or explained network-related phenomena in the context of KT in quantitative terms specific to SNA (e.g. empirical studies whose analysis employed network data and analysis methods, as opposed to discussion papers). To target the scope towards evidence use by health
professionals (i.e. to maintain relevance to KT involving health professionals within healthcare organizations), articles were excluded based on several criteria. These criteria included a focus on online or social media-based networks (e.g. virtual communities of practice), policy-level KT, use of research by patients, communication not explicitly involving research evidence or clinical decision-making about care based on evidence, or the implementation of non-clinical interventions (e.g. electronic medical records, non-research-related quality improvement initiatives).

2.3.4 Step 4: Chart the data

SG extracted the data using a structured table developed a priori in accordance with the research questions. Information from each study was captured with respect to study aim, population, sample size, variables, KT/implementation process and structural properties examined, theoretical perspective and data collection and analysis methods employed. A second reviewer (AK) screened the extracted data for accuracy.

2.3.5 Step 5: Collate, summarize and report results

Descriptive statistics, including frequency counts and percentages, were calculated to provide an overview of the literature’s breadth. Articles were charted by year of publication and country of first author to illustrate the chronological and geographical development of the field. Each network property identified in the reviewed articles is presented with respect to the relational parameter it represents in the context of studying KT/implementation. I compiled key findings related to network properties and summarized them narratively. I then performed an analysis of the use of SNA and the theory that informed this body of research.
2.4 Results

2.4.1 Publication characteristics

A total of 3531 articles were retrieved, of which 27 met inclusion criteria. Figure 2 shows the PRISMA flow diagram of included and excluded studies. Figure 3 depicts the frequency of publications by year. The United States and Italy (8 each) led in frequency, with Canada (4), Australia (2), the Netherlands (2), the United Kingdom (2) and Sweden (1) following. Study characteristics are presented in Table 2. Tallies and proportions of these studies presented in the following paragraphs do not sum to 100% in cases where the categories of characteristics are not mutually exclusive (e.g. a study may employ visualization of network properties while also presenting descriptive network property values).
Figure 2. Flow diagram of the article screening process
Figure 3. Publications by year
Table 2. Characteristics of included studies

<table>
<thead>
<tr>
<th>Citation</th>
<th>Study purpose</th>
<th>Type of network/setting</th>
<th>Network size (# participants)</th>
<th>Data collection methods</th>
<th>Theoretical perspective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zappa, 2011²</td>
<td>To describe relationships for knowledge sharing about a new drug</td>
<td>Physician network within a group of 338 hospitals</td>
<td>784 physicians</td>
<td>Survey</td>
<td>Diffusion of innovation</td>
</tr>
<tr>
<td>Yousefi-Nooraie, 2014⁷¹ (same study as 29)</td>
<td>To assess factors associated with information seeking in public health</td>
<td>Information seeking, expertise recognition &amp; friendship networks within an urban public health department</td>
<td>15 managers &amp; 13 professional consultants (n=28)</td>
<td>Survey</td>
<td>Transactive memory theory; Social exchange theory</td>
</tr>
<tr>
<td>Yousefi-Nooraie, 2012⁶⁹ (same study as 30)</td>
<td>To identify the structure of intra-organizational knowledge flow for evidence informed practice</td>
<td>Information sharing network</td>
<td>170 directors, managers, supervisors, epidemiologists, practitioners &amp; administrative support</td>
<td>Survey</td>
<td>Social influence theory</td>
</tr>
<tr>
<td>Tasselli, 2015⁸⁰</td>
<td>To describe knowledge transfer between professions, effectiveness of central actors &amp; brokers, &amp; the influence of organizational hierarchy on access to knowledge</td>
<td>Knowledge transfer network in a hospital department</td>
<td>n=118 53 physicians &amp; 65 nurses</td>
<td>Survey &amp; interviews</td>
<td>Sociology of professions theory; SNA paradigm</td>
</tr>
<tr>
<td>Sibbald, 2013¹⁶</td>
<td>To explore patterns of information exchange among colleagues in inter-professional teams</td>
<td>Information seeking &amp; sharing networks within 6 interdisciplinary primary healthcare teams</td>
<td>n=28 (physicians, residents, allied health professionals e.g. nurses, dietician, social worker); two sites: n₁=19 &amp; n₂=8.</td>
<td>Survey &amp; semi-structured interviews</td>
<td>SNA paradigm</td>
</tr>
<tr>
<td>Citation</td>
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<tr>
<td>Racko, 2018&lt;sup&gt;81&lt;/sup&gt;</td>
<td>To examine the influence of social position on knowledge exchange over time</td>
<td>Knowledge exchange networks within 3 academic-clinical KT programs</td>
<td>3 surveys: n&lt;sub&gt;1&lt;/sub&gt;=66; n&lt;sub&gt;2&lt;/sub&gt;=70; n&lt;sub&gt;3&lt;/sub&gt;=42 clinicians &amp; academics</td>
<td>Surveys</td>
<td>Social capital theory</td>
</tr>
<tr>
<td>Quinlan, 2013&lt;sup&gt;82&lt;/sup&gt;</td>
<td>To explore mechanisms of information sharing across professional boundaries</td>
<td>Knowledge contribution to decision-making by members within multidisciplinary primary healthcare teams (2 clinical decisions, so 2 networks for each of 4 clinical teams)</td>
<td>Nurse practitioners (n=13 or fewer)</td>
<td>Online survey</td>
<td>Habermas’ theory of communicative power</td>
</tr>
<tr>
<td>Paul, 2015&lt;sup&gt;83&lt;/sup&gt; (portion of data from study&lt;sup&gt;84&lt;/sup&gt;)</td>
<td>To test a model examining the role of triadic dependence on reciprocity &amp; homophily</td>
<td>Influence network</td>
<td>33 physicians</td>
<td>Surveys</td>
<td>SNA paradigm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient care network</td>
<td>135 physicians</td>
<td></td>
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</tr>
<tr>
<td>Menchik, 2017&lt;sup&gt;85&lt;/sup&gt;</td>
<td>To explore the type of knowledge valued by physicians &amp; the influence of hospital prestige on evidence-seeking behaviour &amp; perceived esteem by peers</td>
<td>Information seeking &amp; clinical case discussion networks, within 6 hospitals</td>
<td>126 physicians</td>
<td>Survey</td>
<td>Social influence theory</td>
</tr>
<tr>
<td>Mascia, 2018&lt;sup&gt;6&lt;/sup&gt;</td>
<td>To explore theoretical mechanisms explaining network formation across</td>
<td>Advice-seeking networks within 2 regional health</td>
<td>97 paediatricians</td>
<td>Survey</td>
<td>Balance theory; Structural holes perspective;</td>
</tr>
<tr>
<td>Citation</td>
<td>Study purpose</td>
<td>Type of network/setting</td>
<td>Network size (# participants)</td>
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<tr>
<td>Mascia, 2014&lt;sup&gt;13&lt;/sup&gt;</td>
<td>To explore the association between connectedness with colleagues &amp; frequency of evidence use within a physician network</td>
<td>Collaboration networks within 5 health authorities</td>
<td>104 paediatricians</td>
<td>Survey</td>
<td>Homophily principle</td>
</tr>
<tr>
<td>Mascia, 2015&lt;sup&gt;86&lt;/sup&gt; (same data as study&lt;sup&gt;11, 7&lt;/sup&gt; &amp; &lt;sup&gt;87&lt;/sup&gt;)</td>
<td>To explore the influence of homophily on tie formation</td>
<td></td>
<td></td>
<td>Survey</td>
<td></td>
</tr>
<tr>
<td>Mascia, 2011&lt;sup&gt;a&lt;/sup&gt;&lt;sup&gt;87&lt;/sup&gt; (same data as study&lt;sup&gt;11, 86&lt;/sup&gt; &amp; &lt;sup&gt;7&lt;/sup&gt;)</td>
<td>To determine the association between attitudes toward EIP &amp; network structure &amp; to identify predictors of collaborative ties</td>
<td>EIP advice-sharing networks within 6 hospitals</td>
<td>297 physicians</td>
<td>Survey</td>
<td>Homophily principle</td>
</tr>
<tr>
<td>Mascia, 2013&lt;sup&gt;11&lt;/sup&gt; (same data as study&lt;sup&gt;87, 86&lt;/sup&gt; &amp; &lt;sup&gt;7&lt;/sup&gt;)</td>
<td>To explore the relationship between attitudes toward EIP &amp; network position</td>
<td></td>
<td></td>
<td></td>
<td>Core/periphery model; Structural holes</td>
</tr>
<tr>
<td>Mascia, 2011&lt;sup&gt;b&lt;/sup&gt; (same study as&lt;sup&gt;11&lt;/sup&gt;, &lt;sup&gt;86&lt;/sup&gt; &amp; &lt;sup&gt;87&lt;/sup&gt;)</td>
<td>To explore the association between network structure &amp; propensity to adopt EIP</td>
<td></td>
<td>207 physicians</td>
<td></td>
<td>Social contagion; Structural holes perspective</td>
</tr>
<tr>
<td>Long, 2014&lt;sup&gt;70&lt;/sup&gt; (same data as)</td>
<td>To examine the influence of clustering on past, present &amp; intended collaboration</td>
<td>Past, present &amp; clinicians</td>
<td>68 researchers &amp; clinicians</td>
<td>Online survey</td>
<td>SNA paradigm</td>
</tr>
</tbody>
</table>

<sup>Homophily principle</sup>
<table>
<thead>
<tr>
<th>Citation</th>
<th>Study purpose</th>
<th>Type of network/setting</th>
<th>Network size (# participants)</th>
<th>Data collection methods</th>
<th>Theoretical perspective</th>
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</thead>
<tbody>
<tr>
<td>study 4</td>
<td>present &amp; future collaborations within a translational research network</td>
<td>networks within a research network</td>
<td></td>
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<td>Long, 2013&lt;sup&gt;4&lt;/sup&gt;</td>
<td>To identify key players within a research network, their common attributes, &amp; their perceived influence, power &amp; connectedness</td>
<td>Research collaboration &amp; dissemination networks within a research network</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Keating, 2007&lt;sup&gt;84&lt;/sup&gt;</td>
<td>To describe the network of influential discussions among physicians &amp; to predict network position</td>
<td>Frequency of influential conversations relevant to practice within primary care</td>
<td>38 physicians</td>
<td>Survey</td>
<td>SNA paradigm</td>
</tr>
<tr>
<td>Heijmans, 2017&lt;sup&gt;88&lt;/sup&gt;</td>
<td>To explore relationships between network properties &amp; quality of care</td>
<td>Information exchange networks within 31 general practices</td>
<td>180 health professionals (physicians, residents, nurses, pharmacy assistants, social workers)</td>
<td>Survey Document review (i.e. intervention &amp; referral charting)</td>
<td>SNA paradigm</td>
</tr>
<tr>
<td>Guldbrandsson, 2012&lt;sup&gt;89&lt;/sup&gt;</td>
<td>To identify potential national opinion leaders in child health promotion</td>
<td>Discussion network within national child health promotion context</td>
<td>153 researchers, public health officials, paediatricians &amp; other individuals</td>
<td>Emailed survey item</td>
<td>Diffusion of innovation</td>
</tr>
<tr>
<td>Friedkin, 2010&lt;sup&gt;73&lt;/sup&gt;</td>
<td>To examine the association between discussion networks, marketing &amp; physician prescribing</td>
<td>Advice &amp; discussion networks of physicians (re-analysis of Coleman, Katz &amp;</td>
<td>125 physicians</td>
<td>Document review (i.e. prescription records of)</td>
<td>Diffusion of innovation; Social contagion; cohesion;</td>
</tr>
<tr>
<td>Citation</td>
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<td>Data collection methods</td>
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<tr>
<td>Menzel, 1966</td>
<td>historical data on medication adoption</td>
<td>pharmacies</td>
<td>structural equivalence</td>
<td></td>
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</tr>
<tr>
<td>Burt, 1987</td>
<td>To test social contagion theory by examining cohesion versus structural</td>
<td>Advice networks of craniofacial surgeons within 14 countries</td>
<td></td>
<td>Online survey</td>
<td></td>
</tr>
<tr>
<td>Doumit, 2014</td>
<td>To identify opinion leaders &amp; their impact on EIP</td>
<td>Advice seeking networks within and external to a health authority containing 6 hospitals</td>
<td></td>
<td>Survey</td>
<td></td>
</tr>
<tr>
<td>Di Vincenzo,</td>
<td>To explain the impact of research productivity on tie redundancy (i.e.</td>
<td>Advice networks of clinicians (psychologists, social workers, others) &amp; leadership in 32</td>
<td></td>
<td></td>
<td>Structural holes</td>
</tr>
<tr>
<td>2017</td>
<td>connections that lead to the same people/information)</td>
<td>behavioural health agencies</td>
<td></td>
<td></td>
<td>perspective; Homophily</td>
</tr>
<tr>
<td>Bunger, 2016</td>
<td>To evaluate change in advice ego-network composition &amp; its impact on whole</td>
<td>Advice networks of clinicians (psychologists, social workers, others) &amp; leadership in 32</td>
<td></td>
<td>Surveys</td>
<td></td>
</tr>
<tr>
<td></td>
<td>network structure following implementation of a ‘learning collaborative’</td>
<td>behavioural health agencies</td>
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<td>SNA paradigm</td>
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<td>model in improve care quality</td>
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<tr>
<td>Citation</td>
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<tr>
<td>Ankem, 2003&lt;sup&gt;57&lt;/sup&gt;</td>
<td>To understand communication flow &amp; its influence on awareness/adoptions of a treatment, &amp; to identify opinion leaders with influence</td>
<td>Frequent discussion networks within a sample drawn from an online physician directory</td>
<td>32 interventional radiologists</td>
<td>Phone interviews</td>
<td>Diffusion of innovation; SNA paradigm</td>
</tr>
<tr>
<td>D'Andreta, 2013&lt;sup&gt;63&lt;/sup&gt;</td>
<td>To compare the network structures of 3 research/KT program initiatives</td>
<td>Informal advice giving &amp; seeking networks within each of three academic-clinical KT programs</td>
<td>n=–260 (directors, managers, program leaders, knowledge brokers, researchers &amp; others unspecified)</td>
<td>Online survey</td>
<td>SNA paradigm; Epistemic differences perspective</td>
</tr>
</tbody>
</table>

Note: SNA=social network analysis; EIP=evidence informed practice; KT=knowledge translation.
2.4.2 Study design and data collection

The 21 studies’ data sets were described in 27 articles, all but two of which employed cross-sectional designs yielding data at single time-points. Seventeen (81%) of the studies collected SNA data through surveys, two (10%) using a survey alongside interviews to support SNA data interpretation, \(^ {16,80}\) and one (5%) through telephone interviews. \(^ {57}\) Two (10%) studies employed document review (i.e. prescription, referral or intervention records); one for SNA data collection and one to support outcome measurement. \(^ {72,73,88}\)

2.4.3 Networks and actors

Physician-only networks were the most commonly studied (11, 52%), \(^ {2,6,87,90,7,11,13,57,67,72,73,83}\) followed by inter-professional networks of researchers and clinicians (6, 29%). \(^ {4,63,69–71,89}\) Only one study (5%) examined the network of nurses and physicians \(^ {80}\), and one a network of nurse practitioners. \(^ {82}\) Two of the inter-professional networks included public health officials, \(^ {69,71,89}\) one included leadership (i.e. directors, managers) and administrative support personnel, \(^ {69,71}\) and one included leadership and knowledge brokers. \(^ {63}\) In some cases, inter-professional network members’ professions or formal roles within the network were not clearly indicated. \(^ {16,63,89}\) For two studies, the analysis involved a subset of network members (i.e. managers/professional consultants; physicians with specific clinical workloads). \(^ {7,71}\)

Studies examined networks ranging in size from 13 to 784 participants, with a mean of 153. Just over half the studies (12, 57%) were conducted across organizational boundaries. \(^ {6,7,88,90,91,11,13,57,67,72,73,83,87}\) Eight (38%) were conducted within a single healthcare organization, \(^ {2,16,63,69,71,80,82,84,85}\) one (5%) was conducted within a research-focused network, \(^ {4,70}\) and one (5%) within a health-specific field at a national level. \(^ {89}\)
2.4.4 Study purposes and data analysis methods

A SNA perspective has been used to explore the patterns and efficiencies of information sharing within and across professions, to identify positions of influence and determine their effectiveness, to predict or to explain patterns of ties based on attributes or network structure, to compare the structural characteristics of different models of KT and to examine the relationship between network properties and EIP attitudes and behaviours. Using a longitudinal approach, SNA has been used to evaluate the influence of social structure on knowledge exchange over time, as well as to evaluate network change following a quality improvement intervention.

The majority of articles focused on information flow, while individuals’ adoption of a clinical practice, involvement in collaborations that support KT or EIP, and evidence-informed group decision-making garnered less interest. No research was available on other KT activities, such as the processes involved in developing guidelines or other KT tools, adapting knowledge to the local context, assessing barriers to change, facilitating departmental- or organizational-level practice or service delivery changes (including de-implementation), monitoring evidence use, evaluating KT effectiveness or sustaining change over time.\textsuperscript{12}

**Describing networks:** Eight (29\%) of the 27 articles described networks by deriving network properties from relational data.\textsuperscript{4,16,63,69,70,80,82,87} Two articles (10\%) used conventional descriptive statistics (e.g. frequency counts, proportions) to describe social network data.\textsuperscript{89,90} Network visualizations illustrated the data in 13 (48\%) articles.\textsuperscript{4,11,87,90,91,69–71,80,82–85} Of these, ten articles presented whole network graphs (i.e., illustrations of the network structure), two presented network graphs of subgroups within the network, and one mapped whole networks within graphs that accounted for covariates. Network properties represented in the graphs included centrality (i.e. connectedness, brokers (i.e. bridgers), core versus periphery structure
(i.e. central areas of high connectivity versus peripheral areas of lower connectivity) and tie strength (e.g. frequency of contact); and attributes, such as gender, professional role, size of clinical practice, and division, department or team, and organization or site. Visualizations were used to depict network property configurations (i.e. illustrated the definitions of network properties) in two articles. Conventional charts (e.g. boxplots, scatterplots and bar, line and area charts) were also used in six articles to visualize relationships between variables (e.g. network properties with one another, diffusion or adoption over time, centrality versus adoption timing or receipt of useful information, percentage of ties by strength at different time points).

**Testing hypotheses (network modeling):** Fourteen articles described the use of regression, including ordinary least squares,\(^{11,67,72,81,85}\) ordinal logistic regression,\(^{7,13}\) multi-level modelling,\(^{71,73,88}\) P2 logistic regression\(^{83,84}\), linear regression,\(^{80}\) and MR-QAP analysis.\(^{86,87}\) Regression was used to test theory about the cause of social structure,\(^{67,72,73,83,86}\) to explain the impact of social structure on knowledge exchange behaviours,\(^{81}\) ease of knowledge transfer,\(^{80}\) receipt of useful knowledge,\(^{80}\) or quality of care,\(^{88}\) and to describe the influence of hospital prestige on evidence-seeking behaviour and perceived esteem by peers.\(^{85}\) Three articles reported paired t-tests or Wilcoxon ranks to evaluate differences between groups\(^{80,88}\) or time points\(^{91}\), the latter of which also employed analysis of variance. Two articles described the use of the Chi-square test to examine associations between attributes and network position, or between two attributes.\(^{4,57}\) Exponential random graph models were used in three instances to predict or to explain the formation of ties based on attributes and network structure,\(^{2,6,71}\) and a single study employed factor analysis to construct groupings of individuals based on frequency of information exchange.\(^{57}\) No studies employed stochastic actor-based network modeling to examine network change over time.
Sample hypotheses relating to tie formation included predictors, such as homophily, existing ties (leading to reciprocity) and having a formal mechanism within the organization for interacting. Further hypothesis examples included that higher professional status would be associated with more knowledge exchange, tie homophily (i.e. sharing the same profession with a connection) would be associated with greater knowledge transfer ease, the presence of brokers (bridgers) would be associated with an increase the receipt of useful information, particularly to managers, and that greater connectivity, frequency of contact, homophily, the presence of a highly connected clinical coordinator and being an opinion leader would be associated with an increase in the use of best practices. For more information about the full array of correlational, dependent and independent variables and covariates (both relational variables and attributes) identified in the included studies, refer to Table 3.

Information seeking patterns varied across professions and networks, with health professionals from some disciplines having a tendency to form small, closed subgroups, while others demonstrated greater connectivity and reach within the network, increased hierarchy (e.g. reliance on ‘gatekeepers’ of information spreading it in a top-down approach), or relied more on sources of information or support external to the network (e.g. other organizations). Available information suggests that isolated individuals and those less connected at the periphery of the network may have more clinical experience and be more evidence-based in their practices than those at the network core. In the absence of a core-periphery structure (i.e. a more highly connected centre with a less connected network periphery), degree centrality (i.e. the number of connections an individual has) may be a key factor associated with EIP use, at least for physicians. A network-identified broker or opinion leader may increase access to useful knowledge, improve practice performance, and facilitate networking across professions.
2.4.5 Network properties

Table 3 summarizes the key variables under study, the network properties that were derived from relational data, and the relational parameters (i.e. the constructs for which the network properties were acting as proxies). For example, network density was used as a proxy for connectedness in one study, and for representing the number of shared patients in another. Attributes of interest (which included individual characteristics, such as profession and gender; environmental characteristics, such as organization; social attributes, such as perceived reputation; and KT-related measures, such as EIP attitude scores) are also presented to offer a summary of the nature of non-SNA variables that have been analyzed alongside network properties. Study findings are presented in the final column for interest.

Eleven articles explored only a single or pair of network properties. Although 28 network properties were identified during data extraction, the majority of authors examined centrality, tie characteristics (e.g. the directions of the interactions; similarity in characteristics among pairs of connected individuals) and density (i.e. the proportion of ties relative to all possible ties) as their network properties of interest. Tie homophily (i.e. similarity of connected individuals on a given attribute, such as gender), indegree centrality (i.e. the number of people naming an individual as being connected to them), whole network density, the presence of ties, and tie reciprocity (i.e. bidirectionality in reported interactions or connections) were the most prevalent structural properties studied. The study authors’ discussions about the influences of these network properties were clearly linked to prominent theoretical perspectives. Less emphasis was placed on the analysis of centralization (i.e. the evenness of the distribution of connections), subgroups (i.e. groups of connected individuals not connected to other groups within the network) and
transitivity (i.e. patterns related to sets of three individuals and their tendencies to share connections with one another).

Attributes, such as research versus clinical productivity, professional field or specialty, leadership role and organizational prestige, as well as the presence of other types of ties (e.g. friendship, expertise recognition, previous collaborations) appear to be predictive or explanatory factors for the formation of information seeking or research collaboration ties. Conflicting findings regarding the influence of EIP attitudes, experience, gender and geographical proximity on tie formation were identified.
<table>
<thead>
<tr>
<th>Citation</th>
<th>Primary data analysis method</th>
<th>Variables of interest</th>
<th>Findings</th>
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<tbody>
<tr>
<td><strong>Descriptive/exploratory studies</strong></td>
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<tr>
<td>Yousefi-Nooraie 2012&lt;sup&gt;69&lt;/sup&gt; (same study as 71)</td>
<td>Deriving network properties to describe the network</td>
<td>Connectedness</td>
<td>Low density (1.2%) observed</td>
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<td>Information exchange</td>
<td>Head management division identified as central cluster bridging organizational divisions, with hierarchical information flow.</td>
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<td>Prestige (key actors)</td>
<td>Expertise recognition &amp; information seeking clustered within divisions; friendships spanned departments; Friendship &amp; expertise recognition predicted information seeking ties; Network-identified brokers should receive same interventions &amp; supports as formal brokers</td>
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<td>Mediating power of actors</td>
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<td>Subgroups of connected actors</td>
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<td>Brokers (actors connecting distinct teams/clusters of alters)</td>
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<td>Brokerage patterns (measured by which groups the information source &amp; its recipients belonged)</td>
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<td>Sibbald 2013&lt;sup&gt;16&lt;/sup&gt;</td>
<td>Deriving network properties to describe the network</td>
<td>Cohesiveness related to giving &amp; seeking research-related information</td>
<td>Low density for information seeking &amp; giving (7-12%) observed; suggested these behaviours not a central focus of the inter-professional relationships</td>
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<td>Whole network density</td>
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<td>Key players (prestige) in giving &amp;</td>
<td>Medical residents prominent in knowledge exchange; physician</td>
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<td>Indegree centrality</td>
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<tr>
<td>Quinlan 2013</td>
<td>Deriving network properties to describe the network</td>
<td>Profession, Tenure of the team, Occupational distance among members, Number of team members</td>
<td>Seeking research information, Communicative power (i.e., the facilitation of mutual understanding among other team members)</td>
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<tr>
<td>Long 2014 (same study as 4)</td>
<td>Descriptive SNA; Correlations among specific network properties &amp; attributes</td>
<td>Geographic proximity, Profession (e.g., clinicians/researchers)</td>
<td># components</td>
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<td>Actor’s reputation</td>
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<td>Key actors (with respect to power, influence or connectedness)</td>
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<td>Membership in other networks</td>
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<td>Approach to work</td>
<td>Qualifications</td>
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<td>within the network</td>
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<td>Long, 2013(^4)</td>
<td>Traditional descriptive statistics e.g.</td>
<td>Traditional descriptive statistics e.g.</td>
<td>Information seeking about child health promotion</td>
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<td>(same study as (^70))</td>
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<td>Information seeking about child health promotion</td>
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<td>Guldbrands son 2012(^89)</td>
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<td>Information seeking about child health promotion</td>
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<td>Frequency counts, percentages</td>
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<td>Doumit 2014⁹⁰</td>
<td>Percentage of people</td>
<td>Influence by central</td>
<td>Degree centralization</td>
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<td>nominating an actor;</td>
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<td>Descriptive statistics</td>
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<td>in medical approach</td>
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<td>percentages)</td>
<td>(proportions)</td>
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<td>Barriers to clinical</td>
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<td>(proportions)</td>
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<td>D'Andreta 2013⁶³</td>
<td>Deriving network properties</td>
<td>Prestige within the</td>
<td>Degree centralization</td>
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<td>to describe the network</td>
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<td>(descriptive SNA)</td>
<td>Control over</td>
<td>Betweenness centralization</td>
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<td>KT model adopted</td>
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<td>Core actors –</td>
<td>Coreness scores (core-periphery algorithm)</td>
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<td>External communication (#)</td>
<td>Colleagues with whom knowledge is discussed</td>
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<td>Zappa, 2011²</td>
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<td>Components</td>
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<td>Primary data analysis method</td>
<td>Attributes</td>
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<td>Exponential Random Graph models (p* models)</td>
<td>visits from drug representatives; Research orientation (# publications);</td>
<td><strong>Tendency to exchange information with a number of sources</strong></td>
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<td>Clinical experience; Hierarchical position (administrative role); Medical</td>
<td><strong>Tendency to share knowledge within a small peer group (network closure)</strong></td>
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<td>specialty*; Hospital affiliation*</td>
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<td><strong>Tendency to interact with similar others</strong></td>
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<tr>
<td>Yousefi-Nooraie, 2014</td>
<td>Descriptive SNA</td>
<td>Relative connectedness of actors of a given role</td>
<td><strong>Key individuals</strong></td>
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<td>(same study as 69)</td>
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<td>Citation</td>
<td>Primary data analysis method</td>
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<td>Organizational division</td>
<td>Tendency to connect to peers from other units</td>
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<td>*Role (e.g. manager)</td>
<td>Tendency to reciprocate expert recognition &amp; information seeking ties</td>
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<td>Exponential random graph modeling (ERGM)</td>
<td>*Organizational division</td>
<td>Score on EIP implementation scale</td>
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<td>*Role (e.g. manager)</td>
<td>Tendency to connect with those with similar attributes</td>
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<td>Score on EIP implementation scale</td>
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<td>Score on EIP implementation scale</td>
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<td>Multilevel logistic regression</td>
<td>*Role (e.g. manager)</td>
<td>Tendency to connect with those with similar attributes</td>
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<td>*Organizational division</td>
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<td>Friendship connections</td>
<td>Ties</td>
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<td>Citation</td>
<td>Primary data analysis method</td>
<td>Variables of interest</td>
<td>Network property used as proxy for structural parameter</td>
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<tr>
<td>Tasselli, 2015</td>
<td>Paired t-test Linear regression</td>
<td>*Gender, Tenure, Profession, Organizational unit, Rank (i.e. leadership role)</td>
<td>Ease of knowledge transfer, Perceived receipt of useful knowledge, Connectedness, Hierarchy, Network fragmentation, Individual reach, Brokerage potential, *Network size</td>
</tr>
<tr>
<td>Menchik, 2010</td>
<td>OLS regression</td>
<td># medical literature database searches per month, # journals read regularly, *Age, Gender, Tenure at hospital, Medical school, % clinical time, Sub-specialization, Prestige of hospital (published rankings)</td>
<td>Relational esteem by colleagues, Indegree centrality</td>
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<tr>
<td>Mascia, 2014</td>
<td>Ordinal logistic regression</td>
<td>Self-reported frequency of EIP use, *Gender</td>
<td>Degree of collaboration with colleagues, Outdegree centrality</td>
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<td>*# patients in caseload</td>
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<td>*area of clinical practice (e.g. asthma, urology, etc.)</td>
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<td>*# article subscriptions</td>
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<td>*perceptions of barriers to availability of evidence</td>
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<td>*perceptions of difficulty applying evidence to practice</td>
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<td>*Affiliation to formal groups</td>
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<td>*Collaborative nature of actor’s medical practice</td>
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<td>Primary data analysis method</td>
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<tr>
<td>Mascia, 2018&lt;sup&gt;6&lt;/sup&gt;</td>
<td>Exponential random graph models</td>
<td>*Past task force involvement *Tenure *Gender *Geographic distance *Association members *Health district</td>
<td>Tendency to reciprocate advice Tendency to seek advice from an indirect tie Tendency for local, generalized exchange of advice *Tendency to form advice ties *Popularity as an advice source *Advice-seeking activity *Brokering</td>
</tr>
<tr>
<td>Mascia, 2015&lt;sup&gt;86&lt;/sup&gt; (same data as &lt;sup&gt;7&lt;/sup&gt;, &lt;sup&gt;87&lt;/sup&gt; &amp; &lt;sup&gt;11&lt;/sup&gt;)</td>
<td>Multiple regression-quadratic assignment procedure (MR-QAP)</td>
<td>Age Gender Tenure/seniority</td>
<td>Frequency of collaboration Similarity of professional role, institution &amp; geographical location</td>
</tr>
<tr>
<td>Mascia, 2013&lt;sup&gt;11&lt;/sup&gt;</td>
<td>Descriptive SNA</td>
<td>Age* Gender*</td>
<td>Connectedness Whole network density</td>
</tr>
<tr>
<td>Citation</td>
<td>Primary data analysis method</td>
<td>Variables of interest</td>
<td>Findings</td>
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<tr>
<td>(same data as 86, 87 &amp; 7)</td>
<td>OLS regression</td>
<td>Hospital tenure* Tenure in health authority* Managerial role* Geographical distance from colleagues* Affiliation with other organizations* Self-reported EIP adoption (i.e. frequency of database searching)</td>
<td><strong>Network authority</strong> (i.e. importance - relevant &amp; popular)</td>
</tr>
<tr>
<td>Mascia, 2011b* (same data as 86, 11 &amp; 87)</td>
<td>Ordinal logistic regression</td>
<td><strong>Tendency to adopt EIP</strong> (self-reported frequency of peer-reviewed research use) Age* Gender* Tenure in health authority/organization* Managerial role* # publications* Perceived access to evidence*</td>
<td>Extent to which a given tie is redundant because of concurrent ties with another alter</td>
</tr>
<tr>
<td>Citation</td>
<td>Primary data analysis method</td>
<td>Variables of interest</td>
<td>Network property used as proxy for structural parameter</td>
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<td>Attributes</td>
<td>Structural or relational parameters</td>
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<tr>
<td></td>
<td></td>
<td>Hospital affiliation*</td>
<td>Average number of advice exchange colleagues</td>
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<tr>
<td></td>
<td></td>
<td>Descriptive SNA</td>
<td>Tendency for colleagues to both give &amp; receive advice with one another</td>
</tr>
<tr>
<td>Mascia, 2011a^87</td>
<td>Multiple regression quadratic assignment procedures (MR-QAP analysis)</td>
<td>Advice exchange among pairs of physicians</td>
<td>Similarity between pairs of tied actors in: Geographical distances, Gender*, Age*, Medical specialization*, Clinical experience*, Tenure in health authority/organization*, Managerial role*, # publications*, Co-authorship*, EIP adoption (self-reported frequency of peer-reviewed research)</td>
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<tr>
<td>(same data as 86, 7 &amp; 11)</td>
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<td>Citation</td>
<td>Primary data analysis method</td>
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</table>
| Paul, 2015   | Extended p<sub>2</sub> model with Bayesian modeling & estimation | Attributes: *Age, Patient age, Patient sex, Patient race, Patient health status, Patient intensity of care  
Structural or relational parameters: Relative # shared patients, *Same gender, *Same specialty, *Same location, Reciprocity, Social dependence (clustering)  
Network property used as proxy for structural parameter: Density, Tie homophily, Tie reciprocity, Alternating independent two-paths, Transitive triads, Alternating k-stars (two-stars) | Low network density (0.10) observed. Triadic clustering higher than chance. Ties not associated with gender/specialty homophily. Location positively associated with ties. Complementary expertise positively associated with patient sharing. Transitivity may account for reciprocity. |
| Keating 2007 | P2 logistic regression analysis                                  | Attributes: Gender, Clinic, % female patients, Self-identify as expert, # clinics per week, # years practicing in the city, Tenure at hospital, Years clinical experience, Location of training  
Variables of interest: Involvement in influential discussions, Being perceived as influential, Perceiving others as influential  
Structural or relational parameters: Whole network density  
Network property used as proxy for structural parameter: Indegree centrality, Outdegree centrality | Low density (0.154) observed; reciprocity more likely than not may be an artefact of transitivity; high triadic clustering observed; same clinic & gender, expert, higher clinical caseload increased tendency for tie formation. Self-identified experts seen as more influential; no relationship between # years in practice or location of work or training. Clustering with respect to EIP knowledge exchange observed. |
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<th>Citation</th>
<th>Primary data analysis method</th>
<th>Variables of interest</th>
<th>Findings</th>
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<tbody>
<tr>
<td>Heijmans, 2017</td>
<td>Paired sample t-tests/Wilcoxon tests Logistic multi-level analyses</td>
<td>Attributes</td>
<td>Findings</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Structural or relational parameters</td>
<td>between those with greater # of patients &amp; higher frequency of clinical sessions.</td>
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<td></td>
<td></td>
<td>Network property used as proxy for structural parameter</td>
<td>High reciprocity observed in the absence of opinion leaders with high centrality.</td>
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<td></td>
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<td>(information seeking)</td>
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<td></td>
<td></td>
<td>Reciprocity</td>
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<td></td>
<td></td>
<td>Tie reciprocity</td>
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</tr>
<tr>
<td></td>
<td>*Patient age</td>
<td>Connectedness</td>
<td></td>
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<tr>
<td></td>
<td>*Patient sex</td>
<td>Frequency of contact</td>
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<td></td>
<td>*Patient group</td>
<td>Influence of coordinator</td>
<td></td>
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<tr>
<td></td>
<td>*Patient illness status</td>
<td>Similarity in attitudes related to treatment goals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Treatment/control group for parallel randomized controlled trial</td>
<td>Presence of opinion leader</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*Network size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Density</td>
<td>Low density (0.37 &amp; 0.38) observed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tie strength</td>
<td>Most ties between those who did not value achieving treatment goals.</td>
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<tr>
<td></td>
<td></td>
<td>Degree centrality</td>
<td>General practitioner most likely named as opinion leader.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Homophily (E-I index)</td>
<td>Nurse performance associated with consistently identified opinion leader.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of possible in-degree ties</td>
<td>Lack of tie homophily for positive attitudes associated with poor clinical outcomes.</td>
</tr>
<tr>
<td>Friedkin, 2010</td>
<td>Random intercept multi-level event history model</td>
<td>Professional age</td>
<td>Cohesion &amp; structural equivalence were correlated, &amp; may be useful in combination to improve reliability in the evaluation of network structures across settings.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chief or honorary position (yes/no)</td>
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<td>Number of journals read</td>
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<td></td>
<td></td>
<td>Value keeping up with scientific developments</td>
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<td></td>
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<td>Physicians’</td>
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<td></td>
<td></td>
<td>Influence of advisors/discussion partners</td>
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<td>Contact Network Role (CNET) - a summative measure of 4 measures of structural cohesion &amp; structural equivalence; Position in the medical advice network</td>
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<tr>
<td>Citation</td>
<td>Primary data analysis method</td>
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</tr>
<tr>
<td>Di Vincenzo, 2017</td>
<td>Ordinary Least Squares regression</td>
<td>Attributes: # publications * Tenure * Managerial role * Geographic distance * Hospital affiliation * # publications from same-specialty colleagues</td>
<td><strong>Findings</strong>&lt;br&gt;Young employees appeared to have more redundant networks (greater need for advice). Hospital affiliation (i.e. context) influenced constraint. Constraint negatively associated with ego-network size &amp; relative productivity (mediated by professional group membership), positively with productivity, Euclidean distance, role/specialty homophily (augments impact of productivity on prestige).</td>
</tr>
<tr>
<td>Burt, 1987</td>
<td>Ordinary Least Squares</td>
<td>Variables: Timing of adoption Relative timing of adoption within the Position in the medical advice/discussion network</td>
<td><strong>Ego-network constraint</strong>&lt;br&gt;Euclidian distance&lt;br&gt;*Ego-network size&lt;br&gt;<strong>Dependence on others/access to new information</strong>&lt;br&gt;Relative productivity among ego-network colleagues&lt;br&gt;Same role&lt;br&gt;Same specialty&lt;br&gt;Adoption by others in equivalent positions within the network was a stronger</td>
</tr>
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<td>Citation</td>
<td>Primary data analysis method</td>
<td>Attributes</td>
<td>Structural or relational parameters</td>
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|           | regression with likelihood-ratio chi-squared test | network  
Professional age  
Contact with drug company  
Number of journals read  
Number of house calls vs. office visits  
Value keeping up with scientific developments | Influence of advisors/discussion partners | Structural cohesion | predictor of adoption than adoption by those in an individual’s advice or discussion networks. Early adopters tended to participate in a range of EIP behaviours. Adoption by prominent physicians seen to be related to their desire to avoid being late adopters. |
| Ankem 2003 | Chi-square statistics | Preferred information source  
Timing of awareness of the intervention | Timing of intervention adoption | - | Clinical networks were most prominent in fostering awareness & adoption of a clinical intervention, but research & social networks also likely to influence these processes. Early adopters tended to rely on journals & conferences for information informing practice change; late adopters to a greater extent by network contacts. |
| Factor analysis | Specialization  
Hospital  
City  
Timing of adoption  
Frequency of communication with colleagues | Types of relations within the network (e.g. clinical, research, leisure)  
Ties | Groupings of information exchange relations  
Cliques  
Ties | - | |
<table>
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<tr>
<th>Citation</th>
<th>Primary data analysis method</th>
<th>Variables of interest</th>
<th>Findings</th>
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<td>Attributes</td>
<td>Structural or relational parameters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional status (ranking)</td>
<td>Research collaboration</td>
</tr>
<tr>
<td>Racko, 2018</td>
<td>Ordinary Least Squares regression</td>
<td>Professional role</td>
<td>Joint decision-making</td>
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<tr>
<td></td>
<td></td>
<td>Gender</td>
<td>Connectedness to high-status individuals</td>
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<td></td>
<td></td>
<td>Education</td>
<td>Connectedness to knowledge brokers</td>
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<td></td>
<td>Organizational status</td>
<td>Connectedness to unfamiliar peers</td>
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<td></td>
<td></td>
<td>*Intra-professional whole network size</td>
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<tr>
<td>Bunger, 2016</td>
<td>Paired t-tests; One-way Analysis of Variance; Descriptive SNA; Network visualization</td>
<td>Role (faculty expert, internal colleague, external peer, private practitioner, other)</td>
<td>Connectedness</td>
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<tr>
<td></td>
<td></td>
<td>Lack of advice seeking/sharing</td>
<td>Reciprocity</td>
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<tr>
<td></td>
<td></td>
<td>Reciprocity</td>
<td>Similarity in connectedness</td>
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<td></td>
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<td>Tendency for sub-groups to form same institution</td>
<td>Indegree centralization</td>
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<td></td>
<td></td>
<td>Frequency of communication</td>
<td>Tie homophily</td>
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<td>Citation</td>
<td>Primary data analysis method</td>
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<td>Structural or relational parameters</td>
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<td></td>
<td>Network property used as proxy for structural parameter</td>
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Reciprocity & tie heterophily increased over time.

Note: KT=knowledge translation; EIP=evidence informed practice. Where indicated by the article’s author, **bold text** = dependent variable; *=covariate
2.4.6 Use of theory

Diffusion of innovation was the theory most frequently applied (7 articles); social contagion theory and social influence theory were used in four and three studies, respectively. The following perspectives were applied in one instance each: Habermas’ theory of communicative power, social capital theory, sociology of professions theory, balance theory, an epistemic differences perspective, and a model combining transactive memory theory and social exchange theory. Most commonly, theory was used to select network properties to examine and to develop hypotheses to test. In addition, theory was used to provide background information about SNA or the topic under study, to assist in the interpretation of findings, and to develop and test new analytical methods to advance the field of SNA.

Several other articles employed SNA-specific theoretical perspectives to exploratory analysis, including applying Granovetter’s strength of weak ties perspective, examining the association between structural holes (i.e. areas lacking connections) and the establishment of brokers that bridge network gaps or between a lack of ties and EIP attitudes, examining the role of social pressure on tie formation, exploring the influence of being within a highly connected core of the network versus a less connected peripheral area on attitudes toward EIP, and evaluating network dynamics relative to the homophily principle (i.e. the tendency of people to form connections with similar others). Seven articles employed a SNA paradigm without reference to a specific theory. This paradigm encompassed an interest in patterns of relationships within networks, and the associations between these patterns and either individual attributes, or other structural patterns.
2.5 Discussion

2.5.1 Publication characteristics

While SNA has a long history in fields, such as sociology, mathematics and psychology, its popularity in healthcare has shown momentum since the early 2000s. Annual publication trends suggest an emerging interest in SNA as an approach to study KT processes and determinants since 2010. This concentration follows work by Thomas Valente and colleagues in the mid-late 2000s. Their work applied SNA in healthcare to identify and to evaluate brokers and opinion leaders as a means of promoting behaviour change, linked communication networks and diffusion principles to health promotion research, and applied network principles to the study of community-based cancer research. Increasing interest in the utility of SNA across a range of healthcare contexts, and the relative maturity of this field, may contribute to its continued use in the newer field of KT to embed new practices across settings.

2.5.2 Study design and data collection

More longitudinal research would allow us to determine the direction of the causal relationships between network structures and attribute variables, such as EIP attitudes and behaviours, for better prediction of implementation outcomes. Such research would also enable the evaluation of changes in network connection patterns over time. This approach can be used to assess the impact of network interventions. Network interventions can use socially based strategies to identify and target network gaps (e.g. interactive forums to help establish connections for isolated individuals or groups) to enhance KT processes, organizational capacity or adherence to desired behaviour (e.g. through social influence). Network interventions may also harness strengths in a network (e.g. engaging highly connected individuals to exert
influence or to share resources) to better mobilize EIP attitudes, behaviours or information flow for sustained implementation.

The Simulation Investigation for Empirical Network Analysis (SIENA) framework offers a means of evaluating whole network dynamics, particularly with networks defined by connections that persist over time, which could be particularly helpful in identifying barriers to the successful introduction of interventions in specific settings. The SIENA framework can evaluate change in repeated measures of a network with respect to actors and ties, as well as the interplay of these network changes alongside changes in the behaviour of network members. For example, a network intervention aimed at reducing isolation within the network, or at increasing the connectedness of individuals who are positioned well to influence many others, can be evaluated for its effectiveness using the SIENA framework. The evidence of these changes would serve as supporting mechanisms for new evidence-based interventions.

Computational models, such as agent-based modeling, can also be used to represent individuals and their interactions. Multiple simulation experiments that are programmed based on attribute data and structural characteristics allow researchers to specify and to control the parameters of the computational algorithms in order to determine the effects of specific variables.

Survey use was the dominant method of SNA data collection employed, which is consistent with the broader SNA field. Although interviews were not prominent in the reviewed articles, they can gather the same relational data as surveys, while allowing the participant and interviewer to clarify question and response meaning (e.g. defining operational terms in more depth; describing the reasoning behind naming specific people in one’s network). A qualitative data collection approach may have implications for the size of the sample, but the opportunity for discussion can increase response validity, while the relational network data can be quantified for
Qualitative interpretive strategies can also be used to understand context and meaning within the network and the phenomenon of interest, such as the extent to which network structure and/or specific attributes or contextual factors are perceived to influence attitudes, knowledge or behaviour related to the introduction of a new intervention. Mixed methods can be used to triangulate findings to validate results, and to strengthen the explanatory power of the research by exploring the complexities involved to a greater depth.

Limited use of document review was also observed, none of which involved electronic data. The use of secondary data (e.g. email records, social media interactions, medical records) to quantify networks may be more or less time intensive than primary data collection; limitations may also exist in the types of variables available to study. However, particularly with electronic data, documentation of network activity may be readily available through regular quality monitoring, and span a time period to enable longitudinal analysis. For example, data related to evidence sharing communication patterns and subsequent use of best practices by health professionals (e.g. intervention approaches, treatment intensity or dosage) within and across clinical teams can be leveraged to identify network strengths and gaps, and to monitor KT strategy effectiveness.

Observation is a fourth means of SNA data collection, which was absent from the reviewed studies. Although more resource-dependent and not without risk of observer-influenced behaviour change, observation may enable the identification of ties not captured through self-report. For example, interpersonal dynamics during a meeting may be recorded by a third party more objectively than meeting participants may recall, while concurrently focusing on the content of the meeting. Self-report data also presents potential bias related to recall, particularly when respondents are asked to think back to interactions in the past, or to report their
frequencies.\textsuperscript{1} While network rosters can be used to help mitigate this problem in clearly bounded networks (e.g. an organization), in larger networks this strategy can create excessive burden on respondents.\textsuperscript{1} Careful attention to the way questions are worded, and consideration of the number of alters requested of respondents must be made to gather meaningful and accurate data.\textsuperscript{1}

2.5.3 \textbf{Networks and actors}

With more than half of the included studies examining physician-only networks, and only a handful studying inter-professional healthcare teams, great opportunity exists to expand the range of professions under study. Because of the growing shift in health services delivery from profession-based to collaborative practice models involving inter-professional teams,\textsuperscript{97} further research is needed to evaluate the generalizability of findings beyond physician networks, as well as in other healthcare contexts. The diversity of network sizes and settings, however, demonstrates the utility of SNA for a broad range of applications, from the study of interventions in small hospital healthcare teams to large multi-organizational or national networks. The examination of inter-organizational networks (i.e. organizations as nodes) in the context of KT was beyond the scope of this review. Further study may be warranted to scope out this literature and to determine its implications for informing KT from an organizational network perspective.

2.5.4 \textbf{Study purposes and data analysis methods}

The examination of information exchange processes, key players, reasons for tie patterns, associations between network properties and various attributes, and the evaluation of KT intervention outcomes, is crucial for understanding how to successfully embed a new practice. However, because of its examination of information flow, predominantly, this body of research
presents a narrow view of KT that focuses primarily at the individual level of evidence-based decision-making. This limitation relates in part to the scope of the review, as well as the consideration that other actors (e.g. health leaders, researchers) rather than health professionals may typically manage many of the KT activities that were not represented. Extending the application of SNA to broader organizational or group processes and through a wider range of KT-related activities and actors will advance our understanding of the network dynamics involved in all aspects required to move evidence into action. Such phenomena of interest may include the collaborative production of KT tools, barriers assessments, implementation processes and evaluation efforts. Examining these processes from a network perspective has the potential to identify strengths and gaps in the network that need to be addressed, to explore the structural characteristics and associated attribute-level variables that might contribute to their success, to describe the role of health professionals in these processes, and to evaluate network-level KT interventions to facilitate them.

The limited number of network properties (i.e. three or fewer) examined in more than half of this body of literature suggests that the potential for greater SNA-related insights from these studies to inform future research and practice in KT remains largely untapped. Simply describing networks or examining a single network property (e.g. tie homophily, centrality) and its association with attribute variables fails to leverage SNA’s full potential. As KT scientists, we are interested not only in what is happening, but also why it occurs, the processes involved, and the practical and theoretical relevance. With this information, we are positioned more effectively to design network-based KT interventions.

For example, basic SNA can be used to identify key players with influence within the network; subsequent analyses can be used to explain how these individuals came to hold these
positions. Knowledge of an individual’s structural position may also help to determine from whom they may seek evidence or KT support. This information can be used to develop KT interventions that target specific health professionals or groups of individuals based on their network structure or key attributes to strengthen KT processes. For instance, influential individuals can be leveraged as champions or knowledge brokers to improve the efficiency of information exchange or behavioural influence within a disciplinary group. Individuals with attributes in common with key players can be selected to lead KT interventions within an interprofessional healthcare team. Alternate paths for efficient information exchange or behavioural influence can be accessed if resistance by specific individuals is encountered.

An understanding of relational influences can also advance the science of KT by improving the specificity of KT interventions, and by supporting their evaluation. For instance, KT intervention fidelity (e.g. intended versus actual information flow) can be monitored using SNA, and the KT intervention can be adjusted accordingly over time to address gaps or barriers. Network-specific outcomes of a KT intervention (e.g. increased connectedness, access to information) can also be evaluated empirically based on relational data. Collaboration between KT and SNA researchers may enable a more in-depth examination of the data available from KT research, to bring new insights from a network perspective.

Visualizations are an asset in SNA research because of their ability to represent the data in a way that makes it more accessible to those less familiar with SNA methodologies. Surprisingly, fewer than half of the articles presented network maps, which suggests that researchers could do more to elucidate descriptive relational findings for readers. While more complex than descriptive analyses, graphing the results of p2 models can illustrate the relationship between binary network data and covariates, while factoring in network structure.
Stacked correspondence analysis of matrices representing different time periods can be used to visualize network data at different time points.\textsuperscript{1} Supplemental graphing using conventional visualization methods (e.g. bar, scatterplot, line charts) is also available as an approach to visualize the relationships among network properties and attributes that has yet to be fully leveraged. Appropriate visualization methods and techniques must be selected to answer the research questions of interest, while preserving clarity.\textsuperscript{1,49}

While a range of analytical techniques was identified, many studies employed traditional analytical techniques designed for data meeting assumptions of independence. By their nature within the SNA paradigm, dyadic data do not meet these assumptions. Techniques designed to account for interdependencies in the data, including quadratic assignment procedure (QAP) analysis and exponential random graph models (ERGM) are considered more robust for those analyses of specific hypotheses involving dyadic ties or network characteristics. These approaches enable the modeling of relationships between dyadic (i.e. relational) variables (e.g. information exchange) and attribute variables (e.g. gender), between dyadic variables (e.g. similarity in EIP attitudes, and engagement in research collaboration), or at the whole network level (e.g. density of communication ties relative to time to evidence adoption).\textsuperscript{1} An example from the included literature is the use of ERGM to help determine whether particular individuals – say those with similar personal characteristics – are connecting for information sharing more than expected due to chance.\textsuperscript{10}

With the inclusion of longitudinal designs, analysis approaches, such as stochastic actor-based network models (SABM) that examine network change over time, can begin to be represented in this body of literature. SABM can represent both ties and individual attributes to examine network change. As an example, Yousefi-Nooraie et al.\textsuperscript{100} used SABM to determine the
effect of their intervention (evidence-based decision-making skills) on participants’ status as knowledge brokers.

2.5.5 **Network properties**

Further KT-related research that includes analyses of centralization, subgroups and transitivity may afford a more in-depth understanding of the network-related influences on KT among health professionals. Centralization (i.e. the unevenness of connectivity across the network) can be calculated for the whole network, or for departments or sectors within an organization for the purposes of comparison. Subgroups (e.g. smaller connected groups within a network) can be identified and addressed individually during a KT intervention. For example, isolated individuals can be engaged to form connections with colleagues to benefit from their knowledge or influence. Different subgroups may receive different KT interventions based on their relational or structural characteristics and what evidence or theory suggests their influence might be. Efforts to link or to expand subgroups may precede implementation efforts to establish an environment more conducive to change.

Transitivity has been used to examine the tendency of individuals to exchange information with a small versus a large number of sources, and for the network to form highly connected hubs. This analysis can inform the design of KT interventions to improve the efficiency of information sharing or influence (e.g. identifying targets for the intervention and relying on transitive processes to spread the information rather than targeting all network members). Such a strategy can then be compared to alternatives, to test hypotheses about the influence of different network properties on the effectiveness of KT interventions. This
evaluative work is critical to improve our understanding of network influences on KT processes and outcomes.

The range of structural properties examined suggests that researchers consider multiple structural phenomena to be relevant to KT processes and outcomes. Considerable overlap also existed in the real-world phenomena being evaluated by proxy through these properties. This diversity provides a foundation on which to build a stronger knowledge base about networks’ multiple influences on research use. This approach aligns closely with current discussion in the KT literature about complex health systems, and the need to use “complexity-informed approaches” to embed evidence-informed changes in the healthcare system. Such systems models assume that healthcare organizations are dynamic, interdependent, contain sub-systems with feedback loops and exhibit emergent properties. A combination of a complex adaptive system lens and SNA modeling to measure and explain features of networks and individuals, and most critically the relationship between networks, sub-networks (like cliques) and individuals as they change over time, is an underutilized approach to KT and implementation. The approach moves from a mechanical understanding of KT barriers and facilitators to a much more complex picture of what is required to introduce and to sustain adaptation and change in healthcare organizations.

While complex statistical models are more difficult to apply, they present the benefit of multivariate analyses to better examine the interaction between various factors, as well as the opportunity to control for covariates that may be inflating or masking key effects. As statistical models for SNA continue to emerge, these tools will become increasingly important in clarifying the relative influence of various network properties and attribute effects thought to influence KT.
An understanding of the influences of individual attributes and different types of ties (e.g. friendship) can support the structuring of the healthcare environment to strengthen network density within homophilous groups (e.g. discipline groups), or to foster greater diversity of collaborations within the network (e.g. inter-professional clinical, project or professional development work). Knowledge of network structure can be used to target EIP behaviours using a social influence approach that introduces innovation into the network’s core or brokers to reduce pervasive information bias, or that facilitates greater density overall. Unsurprisingly, different approaches to KT (e.g. leader-driven vs. collaborative; researcher-led dissemination vs. researcher-clinician collaboration) may present different structural properties (e.g. hierarchical vs. clustering). This finding has implications for information flow, as well as for the development of network interventions to address gaps or to leverage prominent actors in the network to champion the innovation. Those with formal healthcare leadership roles may not be the only individuals with influence; informal brokers may be more recognizable by network members (particularly peers) as central to KT processes than formal leaders.\(^4,71\) Alternatively, some networks may not present with prominent central actors or opinion leaders for EIP.\(^2\) A SNA lens can assist in identifying these individuals when they exist, analyzing the extent of their reach, determining the reasons for their prominence, and developing a network-informed plan to leverage their position to advance KT.

Normative group processes and structural position can also explain the timing of adoption, which may be useful in identifying early adopters, opinion leaders and shared attitudes within a network.\(^57,72\) Differences reported in the preferred information sources and network influences for early versus late adopters from a diffusion of innovation perspective can be used to guide differential approaches to behaviour change.
2.5.6 Theoretical insights

Various theories, frameworks and models guide KT research efforts,\textsuperscript{24} although only in a small proportion (3-6%) of primary research articles in the broader KT field.\textsuperscript{104,105} The included articles demonstrated a broad range of theoretical approaches drawn from the fields of sociology and psychology (e.g. diffusion of innovation, social influence, social contagion, social exchange), as well as from the field of SNA itself (e.g. perspectives that explain the role of weak ties, structural holes, cohesion or tie homophily on network dynamics). The variety of approaches used suggests that diverse theories may merit exploration for their utility in KT-related SNA research, and that multiple theories may be applied in a single study (e.g.\textsuperscript{13,72,73}).

Diffusion of innovation theory is applied commonly in the KT literature,\textsuperscript{24} so its frequent application here was not unexpected. The theory’s principles lend themselves well to a SNA paradigm, in that the theory was developed to predict or to explain how information or innovation spreads within social systems.\textsuperscript{65} The collection of attribute data about network members permits the analysis of characteristics that influence an individual’s adoption of innovation, relative to their network position and other contextual factors.\textsuperscript{31} While the majority of KT strategists have adopted an educational approach (i.e. by implementing KT interventions based on an ‘information dissemination paradigm’)\textsuperscript{24,106} to improve awareness, understanding and attitudes as a means of influencing uptake,\textsuperscript{107,108} the role of social networks in their impact has yet to be comprehensively studied. Studies that pair traditional educational and behavioural outcomes research with SNA may provide greater insight into the social mechanisms that influence these outcomes.

Social contagion/influence theories are common in the SNA literature, and purport that actors share attitudes, knowledge or behaviours because of their ties to others who influence
them. This perspective highlights the role of peers and others in fostering behaviour change, attitudes and identities. The study of opinion leaders, audit and feedback and mentoring may follow a social influence perspective, as does a growing body of research on knowledge brokering as a human mediator of research uptake in healthcare. Social capital theory, another prominent SNA theory, attributes tie formation to an individual’s need for social capital from others (e.g. resources, information, power). This contrasting approach was used in the context of knowledge brokering; its application in tandem with social influence theory may provide insight into the direction of causality (i.e. ties form because of attributes vs. attributes are the result of ties).

Transactive memory theory, social exchange theory, Habermas’ theory of communicative power, sociology of professions theory, balance theory and an epistemic differences perspective have logical applications to SNA. Each of these perspectives addresses social factors applicable to networks. The transactive memory-social exchange model describes how information-seeking behaviour is influenced by the awareness and valuing of another individual’s knowledge or skills, their accessibility, and the cost or effort involved in seeking the information. Communicative power is meant to describe the influence of a third party on the mutual understanding achieved between a pair of individuals. Sociology of professions theory describes how members of a shared profession tend to develop a collective status based on their unique healthcare jurisdictions, common training, and mutual knowledge, which can limit their tendency to interact outside this peer group. Balance theory contends that individuals tend to develop balanced relationships (e.g. tie reciprocity) in order to circumvent unease. An epistemic differences perspective purports that individual attributes in combination with structures, processes and other features of the environmental context (including power), influence individual
performance and experiences. These differences create diversity within the network that generate opportunities for novel sharing and innovation. By understanding the structural network factors that contribute to information seeking, epistemic differences, power dynamics and communication processes, we may gain a more holistic understanding of KT. Further analysis is required to determine the utility other theories and frameworks from the KT and SNA literature to SNA-related KT research.

The study of networks is particularly relevant when considering the role of social evaluation in the diffusion of innovation. Gartrell argues that social evaluation is a key driver of decision-making, noting the role of networks in providing norms and comparison opportunities that influence behaviour. Social influence theory, and the principles of tie homophily, social contagion, and structural equivalence parallel this line of thought. While the role of context is addressed relatively commonly in KT and implementation models and frameworks, the concept of social evaluation is largely absent from the non-SNA KT literature. SNA can be applied to identify the attributes, structural positions, or nature of the relationships that are most influential for KT processes from a social evaluation perspective, including the role of brokers, homophily, hierarchy, centrality, and other network properties. These network characteristics offer insights into the patterns and restrictions in the flow of information as well as into power structures, key actors, and their reach and efficiency. Normative group processes and structural position can also explain the timing of adoption, which may be useful in identifying early adopters, opinion leaders, and the development of shared attitudes within a network.

Social constructivist and cognitive learning theories have also emerged in the KT literature to explore the means by which health professionals interact within their social context.
to construct and to understand knowledge.\textsuperscript{105,113,114} The network perspective has not been combined with these approaches to enrich our understanding of the role of this social context on evidence uptake. Also missing from the included articles is reference to behaviour change theories that have been prevalent in the KT literature.\textsuperscript{24} These theories emphasize the various barriers and facilitators to change, including personal, organizational, and system-level factors.\textsuperscript{104} Integrating a SNA lens to behaviour change models may augment their utility by including social structure as a determinant of behaviour change.

2.5.7 Limitations

The search and screening process used in this review limited inclusion to studies involving quantitative analysis of SNA data; a greater depth of understanding about SNA’s utility for KT may also be gained from theoretical discussion papers. Also omitted was the contribution of qualitative data from network research, which can provide insight into how social structures, network properties, and the nature of relationships influence KT from the perspectives of network members. A broader set of inclusion criteria that encompassed studies on the adoption of non-clinical best practices, including technologies, training strategies, quality improvement initiatives, and other innovations, as well as KT in the policy context, may also inform aspects of KT research and implementation initiatives, but was beyond the scope of this review.

This discussion only addressed these studies’ SNA-specific findings. Important non-SNA-related findings (e.g. the most important sources of evidence to augment awareness and adoption\textsuperscript{57}) have not been summarized but can also inform KT research and practice. In addition, the scope of this paper prevented an in-depth discussion of the full breadth of theoretical
perspectives represented in the SNA KT literature, which may warrant a separate review. Finally, because of the variability in study designs, the lack of inclusion of quality appraisals in scoping review methodology, and the inconsistency of network properties examined across the studies, results should be interpreted with caution until further research can evaluate their quality and generalizability.

2.6 Conclusion

Given the diversity and complexity of health professional KT networks, optimal strategies for KT may vary depending on the structure of a professional or organizational network, as well as on professional identities and personal attributes. Within a given setting, inter-professional dynamics, hierarchy, social influence, centralization, brokers and other important structural properties are worthy of consideration. The SNA paradigm offers a broader lens by which to examine and to influence KT processes and outcomes across contexts, while drawing on established theories known to the KT science field. SNA extends the scope of KT influence to include social relationships and structural characteristics of individual and whole networks. However, its full potential has yet to be realized.

Suitable for relatively small (e.g. a dozen) to larger networks of several hundred members or more, SNA can be used to describe or to evaluate groups within or across departments, organizations, countries, or beyond. Longitudinal research, a more representative range of populations, the use of interviews, document review and observation for data collection, greater depth of analysis, and the leveraging of network visualizations can augment the contributions of SNA to the KT science knowledge base.
Understanding how network properties can be used as proxies to measure social processes (e.g. information exchange, best practice adoption, decision-making, influence) can help KT scientists to apply SNA effectively to expand the range of measures that can be used to evaluate KT efforts. The approach can be used to describe a network as a precursor to a KT intervention, as a means of supporting planning (e.g. identifying target groups or individuals), as well as for testing hypotheses. Evaluating information sharing, positions of influence, relationships between network connection patterns and individual attributes (e.g. attitudes) or behaviours, and the effectiveness of KT interventions relying on or targeting networks are all feasible. Predicting or explaining patterns of connections, comparing groups, time points or contexts are also possible.

Finally, while this article did not present a comprehensive overview of the use of theory across the entire body of SNA-related KT literature, it does offer a starting point for conceptualizing theory-based SNA applications in KT research. In keeping with a systems or complexity theory approach, SNA can offer a wider spectrum of determinants to examine in evaluating KT processes by addressing social factors, and broadening understandings generated from an individualistic lens.

The targeted SNA research outlined here may help to highlight the role of interactions, relationships and other social dynamics throughout the full scope of activities and processes required to move evidence into action within healthcare settings and beyond.
Chapter 3: Study #2: Environmental scan of organizational supports for KT in Canadian paediatric healthcare and research organizations

A version of this chapter has been submitted for publication to BMC Health Services Research as a manuscript. I led the study design, survey development, data collection, analysis, interpretation and manuscript writing. Ms. Ryce led search strategy development, conducted the scoping literature search and contributed to study design, survey development and data interpretation. Dr. Miller contributed to study design refinement, survey refinement and data interpretation. Drs. Nimmon, Kothari and Holsti provided input on study design and the presentation of findings. All authors read, provided input on and approved the final manuscript.

3.1 Synopsis

With a thorough understanding of the applications and research gaps in SNA literature related to KT, I am positioned advantageously to design targeted SNA research to advance the field. The previous chapter identified clear directions for future research, including greater emphasis on inter-professional networks, network roles or positions and their implications for KT, the association of individual attributes to network position, and the use of mixed methods to triangulate SNA findings. However, before I can apply SNA to the paediatric healthcare and research context, I must first understand that context. An awareness of the supports in place for EIHC/KT and for stakeholder engagement in research provides a foundation for this understanding. An appreciation of the receptivity of these organizations to establishing or to strengthening these supports garners insight into appropriate approaches for implementing targeted infrastructure or network interventions to advance KT. In order to establish this
foundational knowledge, an examination of the existing organizational supports for EIHC/KT within paediatric healthcare and research institutes is required. This chapter describes the conduct and outcomes of a pan-Canadian environmental scan of paediatric academic health science centres and their affiliated research institutes in order to identify the types of KT supports that exist. This information will allow us to examine in depth the network within such an organizational pairing of clinical service delivery and child health research, as a means of gaining clarity about the individual, social, organizational, and system-level influences on KT.

3.2 Background

Moving evidence into action is critical for ensuring safe, quality health service delivery that optimizes health outcomes.\textsuperscript{19,115} Evidence may include research findings, professional experience and patient/family perspectives, which are often considered together in making informed decisions about healthcare delivery.\textsuperscript{116,117} Evidence-informed healthcare (EIHC) is typically carried out by healthcare providers, health leaders and policy makers during the evidence-seeking, decision-making and implementation processes involved in developing, delivering and making changes to health services.\textsuperscript{8,9} Knowledge translation (KT) is usually understood to reflect the processes carried out or facilitated by researchers and others to identify the need for research evidence for decision-making, to effectively adapt/package and share evidence, to identify and apply strategies to address barriers to evidence implementation, and to evaluate evidence use in healthcare.\textsuperscript{12} The EIHC and KT processes intersect at the end-users of the evidence. The implementation of supports for EIHC and KT within health centres and other organizations engaged with them, has the potential to facilitate evidence use.
Limited resources (e.g. funding, staff), time constraints, and negative attitudes toward change are among the primary barriers to organizational EIHC. Organizational commitments, an EIHC culture, infrastructure to ensure access to evidence, EIHC competencies, and linkages to expertise (e.g. researchers, knowledge brokers, librarians, others) are considered foundational for enabling, sustaining, and evaluating consistent organizational EIHC. Appropriate investment in both human and financial resources are thought to produce the best chance for successful organizational support of KT. However, no empirical evidence exists on the effectiveness of different types of supports to inform their prioritization.

Organizational supports are being used increasingly to address the challenges health systems face in moving evidence into action, but easily identifying these supports across the KT literature is difficult. To our knowledge, no organizational surveys on the topic have been published. A single study protocol from 2014 provides preliminary directions for conducting such a survey; the findings of this study were not published because of a low response rate (M. Ouimet, personal communication, September 14, 2018). An environmental scan can generate an overview of existing organization-based EIHC and KT supports. These findings can guide administrators to develop or refine programs to facilitate evidence use. The insights have the potential to identify feasible support strategies and their key active ingredients, to inform their prioritization, and to highlight known gaps.

An environmental scan is a systematic and objective method of reviewing research evidence, stakeholder perspectives, and current and anticipated policies, practices, processes and/or protocols across sectors. This data gathering methodology is used commonly within the business, policy and healthcare sectors to inform decision-making, to identify trends and promising practices, to avoid pitfalls experienced elsewhere, and to understand the broader
context outside one’s own organization. The increasing prevalence of environmental scans is illustrated by examples, such as a scan of breastfeeding resources in Canadian neonatal intensive care units, of emergency response systems and services in remote First Nations communities, of local resources and needs related to vaccination guideline implementation, and of the evaluation of cancer genetics services across healthcare sites. Research and grey literature searches are often combined with stakeholder engagement methods (e.g. surveys, interviews) to report on topics of interest across sectors. This mixed-methods approach is recognized as an efficient means of accounting for varied yet valuable sources of information, including tacit knowledge. The outcomes of the scan can be used to inform the design or strategic direction of projects or programs. The purpose of this environmental scan was to identify existing organizational supports for EIHC/KT, clinical research integration and stakeholder engagement in research that exist within paediatric academic health science centres (AHSCs) and their affiliated research institutes across Canada. This article reports on the stakeholder survey component of the environmental scan. The insights are critical for advancing evidence use and enhancing research relevance in child health.

3.3 Methods
3.3.1 Survey development

The survey consisted of single- and multiple-response option questions, Likert scales and free text items. Survey items were developed based on analysis of an existing survey protocol proposed for adult healthcare organizations. Additional items were developed to gather data about challenges and successes, primary recipients of supports, funding, human resources and roles, internal and external collaborations, stakeholder engagement in research, and specific
supports across the spectrum of the EIHC and KT processes. Supports deemed to be of interest to our team included, but were not limited to, personnel, resources, services, organizational structures or processes, and/or internal or external partnerships/collaborations. The aims of the supports of interest could include providing access to research evidence, facilitating its sharing, supporting the appraisal, adaptation, or implementation of evidence in practice or policy, promoting the evaluation of evidence use in healthcare or research; and/or building individual and/or organizational capacity for EIHC or KT. Respondents’ demographic information was also gathered with respect to role, department and years with the organization. Data on organizational characteristics, such as type (i.e. research versus healthcare), membership/staff size, and geographic separation of the research institute and the healthcare organization were also collected.

The survey draft underwent internal review by two senior leaders of KT within our organization. The refined version was translated into French to enable participation in the two official languages of Canada. Appendix C presents the research questions alongside their corresponding survey item numbers. The complete survey is provided in Appendix D.

3.3.2 Inclusion/exclusion criteria

The survey targeted leaders at paediatric AHSCs and their affiliated research institutes as the key stakeholders. AHSCs are healthcare organizations with missions involving not only excellence in the delivery of clinical care, but also with strong research and education mandates. These organizations typically maintain affiliations with academic institutions, and may have affiliated research institutes. Inpatient and ambulatory primary care settings and rehabilitation settings were eligible for inclusion. The Canadian Association of Paediatric Health Centres
(CAPHC) assisted in identifying the eighteen healthcare organizations and their seventeen research institutes across eight provinces for inclusion. Targeted stakeholders included directors of clinical care and research institutes, and leaders of clinical programs, professional practice, EIHC/KT support units, libraries, education, quality improvement and grant facilitation offices. Other individuals (e.g. clinicians, KT support staff) with knowledge of the topics under study were also free to respond.

### 3.3.3 Recruitment

Because of its nature as a quality improvement/program evaluation initiative, our university-health centre’s joint research ethics board deemed ethics approval unnecessary. Participants indicated consent before accessing the survey. Prospective respondents were invited to participate through librarian listservs, social media and blog posts, emails distributed through project team members’ professional networks, the Canadian Child Health Clinician Scientist Program (CCHCSP) mailing list targeting child health clinician-researchers, and the CAPHC mailing list and a webinar presentation that targeted health administrators. Snowball sampling followed through invitations to individuals identified by survey respondents as having knowledge of the topic and roles at qualifying organizations. Up to two reminders were sent to prospective participants.

### 3.3.4 Data collection and analysis

I collected and managed the data using REDCap electronic data capture tools hosted at our organization’s research institute. I compiled data provided by multiple respondents about a given organization for analysis at the organizational level. Generally, responses indicating the
presence of a given support were taken to represent the organizational context in instances in which two respondents provided conflicting responses. When discrepancies existed between respondents, I used respondent roles to determine the most credible source (e.g. librarian, for information about library services). I grouped data about EIHC/KT supports thematically and organized them in accordance with the AIMD Framework. This framework was chosen because it was designed and validated to describe interventions (in this case, organizational supports) to promote and integrate evidence into healthcare.\textsuperscript{126} The framework’s four components operationalize the Aims, key active Ingredients, Mechanisms of action and Delivery methods of KT interventions.\textsuperscript{126} Mechanisms of action categories were drawn from the Behaviour Change Wheel Framework. These categories specify the means by which the active ingredients are presumed to produce the aim.\textsuperscript{104} The nine categories are: Education, Persuasion, Incentivization, Coercion, Training, Enablement, Modeling, Environmental Restructuring, and Restrictions.\textsuperscript{104} I grouped barriers thematically and presented in narrative form. Descriptive statistics, including frequency counts and proportions, were calculated for multiple-response option questions and demographics.

3.4 Results

3.4.1 Demographics

Thirty-one respondents from 17 of 35 possible sites (49\%) participated in the survey. These sites included nine healthcare organizations, seven research institutes, and one organization funded by the provincial health authority, with a mandate to support EIHC/KT at all of its health centres. 78\% (14 of 18 possible) health centre-research institute dyads (i.e. pairs) were represented. Snowball sampling contributed to 19\% (6) of respondent recruitment.
Respondents reported a mean of 12.6 (range 0.75 to 33) years with their organization.

Respondents’ diverse positions included director, manager, knowledge broker, research development coordinator, professor, program officer/coordinator, clinician, researcher, professional or collaborative practice lead, healthcare improvement specialist and librarian.

Respondents selectively responded to the sections of the survey (e.g. library services, stakeholder engagement) for which they perceived having knowledge about their organization’s supports.

More than one respondent at multiple sites augmented the amount of data available for analysis.

Represented provinces included Alberta (5 sites), Ontario (4 sites), British Columbia (3 sites), Quebec (2 sites), Manitoba (1 site), Nova Scotia (2 sites) and Newfoundland and Labrador (1 site). Saskatchewan was the only province with a paediatric AHSC that was not represented.

Organization size ranged from 200 to 3700 staff and researchers. Ten of the 14 dyads (71.4%) reported sharing a physical site.

### 3.4.2 EIHC/KT supports

Five sites reported having a dedicated staff person to support KT/EIHC, and six sites reported having a KT support unit or team. The organizational supports reported for EIHC/KT are summarized in Figure 4 in accordance with the AIMD Framework. Included in the figure are the objectives, target audiences, theorized key active ingredients, mechanisms of action and delivery methods for the supports. Eight of the nine mechanisms of action from the Behaviour Change Wheel were represented. Missing was the Restrictions category. Additional details about the supports are summarized below. The frequency of reporting of specific supports is presented in Figure 5.
Note: EIHC=evidence-informed healthcare; KT=knowledge translation; FTE=full-time equivalent; CEO=Chief Executive Officer; ARCHE=Alberta Research Centre for Health Evidence; SPOR=Strategy for Patient-Oriented Research; CADTH=Canadian Agency for Drugs and Technologies in Health; OACRS=Ontario Association of Children’s Rehabilitation Services

Figure 4. Summary of reported organizational supports for EIHC/KT, detailed according to the AIMD Framework
Sixty-five percent (11) of sites reported having an on-site library. Funding for library services came from the healthcare organization (7 sites), a university library (2) or the research institute (1). Mean full-time equivalent for librarians was 1.3 (range 0.3 to 3.0), and for librarian technicians, 1.5 (range 1.0 to 2.0). Mean full-time equivalent per 100 staff was 0.28 for librarians (n=5) and 0.13 for library technicians (n=3). Additional library services identified through open-ended responses included bibliometrics and support with evidence synthesis.

Note: Library services shown in yellow; other survey-prompted supports in blue

Figure 5. Proportion of sites reporting specific organizational supports
Library education topics included: formulating PICO (Population, Intervention, Comparison, Outcomes) questions, conducting systematic and scoping reviews (including design and analysis), creating other evidence syntheses, searching literature databases and grey literature, using citation management tools, developing evidence surveillance strategies (e.g. journal alerts), conducting environmental scans, and tracking metrics on research impact.

Formats included workshops, webinars, online resources and individual training/consultation.

Other educational opportunities were delivered internally or sought through affiliated research institutes and research groups, provincial, health or research organizations, and provincial and national associations (e.g. Strategy for Patient-Oriented Research Support Units, Centre for Clinical Epidemiology and Evaluation, Centre for Health Evaluation and Outcome Sciences, Centre for Health Services and Policy Research, Centre for Healthcare Innovation Manitoba, CAPHC). These educational forums included Telehealth video broadcasts, webinars, workshops and courses, including formal KT/implementation science training (e.g. St. Michael’s Hospital’s KT Program; SickKids Hospital’s KT Professional Certificate).

Procedures or protocols to support EIHC/KT included developing or adapting clinical practice guidelines, carrying out the steps of evidence-informed practice, creating a KT plan, conducting an environmental scan or a rapid evidence review. Care pathway committees were described in some cases as department-specific (e.g. nursing).

Research supports were accessed from affiliated research institutes, partnerships with provincial SPOR Units, mentorship from academic partners, and affiliated university libraries. Research and KT supports were also obtained from government-funded (e.g. Canadian Agency for Drugs and Technologies in Health, Alberta Innovates) or university affiliated (e.g. CanChild,
3.4.3 Clinical research integration and stakeholder engagement

Respondents relayed an awareness of the benefits of integrating research within clinical sectors and engaging clinicians in research. Survey responses indicated that respondents recognized the need for formal supports and more investment in this area. Supports were delivered through specific departments, roles, funding, partnerships and organizational processes or programs, some of which were contingent on external funding. In some cases, supports were more limited for clinical staff as compared to researchers. Table 4 outlines the supports for research-clinical integration, which included operational, human resource, capacity building and collaboration-related provisions. Strategies currently in place at one or more site are marked with an asterisk; all other table entries reflect additional strategies or supports identified by respondents as being required, but not yet implemented.

Table 4. Supports for clinical research integration and stakeholder engagement in research

<table>
<thead>
<tr>
<th>Support category</th>
<th>Supports reported by participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational</td>
<td>• Financial support to displace clinical or clinical support personnel (i.e. protected time for research)</td>
</tr>
<tr>
<td></td>
<td>• Protected time for research support tasks (e.g. recruitment, coordinating participant visits, obtaining consent, collecting data/specimens)</td>
</tr>
<tr>
<td></td>
<td>• Expediting research agreements within the hospital</td>
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<tr>
<td></td>
<td>• Research-dedicated space on clinical units</td>
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<tr>
<td></td>
<td>• More timely access to population-based health information</td>
</tr>
<tr>
<td></td>
<td>• *Incorporating research integration strategies into strategic objectives</td>
</tr>
<tr>
<td></td>
<td>• Establishing knowledge translation support roles within clinical program &amp; committee structures</td>
</tr>
<tr>
<td></td>
<td>• *Research full-time equivalent allocation program for clinical staff</td>
</tr>
</tbody>
</table>

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### Support category

**Supports reported by participants**

<table>
<thead>
<tr>
<th>Support</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Human resources</strong></td>
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<tr>
<td>• Research proposal writing</td>
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<tr>
<td>• Research methodology consultation</td>
</tr>
<tr>
<td>• Data input &amp; management support</td>
</tr>
<tr>
<td>• Developing systematic reviews, meta-analyses &amp; clinical guidelines</td>
</tr>
<tr>
<td>• Information technology</td>
</tr>
<tr>
<td>• Conducting research</td>
</tr>
<tr>
<td>• Facilitation of research implementation in clinical sectors</td>
</tr>
<tr>
<td>• Needs assessment to guide the enactment of targeted supports</td>
</tr>
<tr>
<td><strong>Capacity building</strong></td>
</tr>
<tr>
<td>• Research methodology</td>
</tr>
<tr>
<td>• Grant writing</td>
</tr>
<tr>
<td>• Navigating the ethics application process</td>
</tr>
<tr>
<td>• Scientific writing</td>
</tr>
<tr>
<td>• Knowledge translation</td>
</tr>
<tr>
<td>• Development of knowledge broker competency development pathways</td>
</tr>
<tr>
<td>• Needs assessment to guide capacity building efforts</td>
</tr>
<tr>
<td><strong>Collaboration</strong></td>
</tr>
<tr>
<td>• *Hospital recruitment of investigators, with support to develop/implement their research programs</td>
</tr>
<tr>
<td>• Engagement of research sector with clinical managers &amp; operational leads</td>
</tr>
<tr>
<td>• Formal collaboration of clinicians with the research institute to support interaction and exchange, planning for capacity building, and research</td>
</tr>
<tr>
<td>• *Engaging RI Executive Director on hospital Operations committee</td>
</tr>
<tr>
<td>• *Engaging management, leadership, families &amp; the Foundation to review clinically-situated research projects</td>
</tr>
<tr>
<td>• *Research institute partnerships with regional organizations funded by the health authority/university (e.g. Northern Alberta Clinical Trials and Research Centre)</td>
</tr>
<tr>
<td>• *Clinical sector partnerships with a university department</td>
</tr>
</tbody>
</table>

Note: *=supports in place in at least one site; all others were reported as additional support needs that had not been implemented

Three respondents identified specific roles within their organizations that facilitated clinical engagement in research: 1) a Clinical Team Investigator, who supported clinical staff to have dedicated research time and research institute affiliation; 2) university-funded research coordinators who worked with clinical staff to conduct research; and 3) a KT practitioner who worked with the clinical director to encourage clinician involvement in research.
Funding was reported to support specific projects of direct clinical relevance, which in some cases required clinician-researcher collaborations. Some projects were funded, facilitated or overseen by an internal hospital department. Moreover, some research institutes had dedicated funding for clinical research capacity building, clinician-scientist training (in partnership with the CCHCSP), clinician-community research integration and support, resident research projects or KT/implementation grants to support clinical staff involvement in projects or to mobilize clinical practice change. Funding came from internal (including hospital-affiliated charitable foundations) or external sources.

Fifteen sites (88%) reported formal collaborations between internal researchers and clinicians to conduct primary research and/or systematic reviews, while 12 (71%) reported the same for external researcher-clinician collaborations. However, approximately one third (6, 35% and 7, 41%, respectively) reported only occasional collaboration in these areas. Formal invitations or forums for researchers to share evidence with the organization’s clinical sector were reported at 16 sites (94%), with 12 (71%) and 10 (59%) sites reporting regular, frequent or continual activity in this area for internal and external researchers, respectively. The frequency of reporting of supports to engage these and other stakeholder groups in various research or KT phases is presented in Figure 6.
Clinicians external to the AHSCs were engaged in EIHC/KT through networks (e.g. with other health organizations or national associations), partnerships (e.g. with health authorities or universities) and collaborations (e.g. with researchers) or through the organization’s funded research initiatives (e.g. a Research Challenge program for staff). Logistical engagement strategies included tele-/videoconference applications, the selection of physical meeting places to mitigate geographical barriers, and outreach education by clinicians in rural areas, during which they shared evidence with and mentored community-based clinicians. Offering professional development opportunities to external clinicians, support from a KT practitioner or clinical
research unit consultant on request, maintaining a resource website developed for community
stakeholders, and tailoring project-specific KT materials to a specific site, stakeholder group or
network were other reported methods. One site relied on external organizations (e.g. SPOR Unit)
to carry out this work.

3.4.4 Perceived effectiveness of EIHC/KT supports

Personnel supports perceived by respondents as being most effective in supporting
EIHC/KT were staff identified as champions to support KT, and establishing a dedicated KT
practitioner, committee or quality improvement/KT support unit with KT expertise and protected
time. Activities linked to these roles included creating resources, collaborating or partnering with
clinical sectors around evidence-informed standards of care, developing a KT strategy, and
building capacity. Research support personnel for clinicians were also identified as a facilitator
for EIHC/KT.

Several specific KT support initiatives or programs were identified as being most
effective. Multiple sites mentioned library services. A rapid review service was described, which
supported clinical leaders to access and apply evidence to inform decision-making. A knowledge
broker initiative involved clinicians acting as knowledge brokers to facilitate evidence use within
their clinical sectors. A student evidence-informed practice initiative was developed to build
capacity for students and clinicians and to increase awareness of clinically relevant evidence to
apply to practice. A Research Challenge program was also established to support researcher-
clinical collaborations in clinically relevant research. A structured continuous quality
improvement management system, and site-wide projects supported visibly by sponsors and
marketed in a way that resonated with clinicians were also seen as facilitators. Formal support
infrastructure (e.g. dedicated team or personnel, resourced initiatives) was favoured over informal supports (e.g. relying on personal networks, one-time project assistance).

Respondents touted the merits of support and commitment for research, KT and innovation from leadership (e.g. Chief Executive Officer, inter-professional practice chiefs, managers). Inter-departmental (e.g. public relations, clinical practice & education, project management office, research institute) supports, including those for capacity development, imparting research expertise and KT support were also perceived as effective. External drivers for engaging in KT (e.g. Accreditation Canada, Best Practice Spotlight Organization candidacy) were also noted. Respondents also emphasized the importance of tailored, contextually relevant KT products, such as clinical toolkits, or evidence syntheses.

Logistically, protected time, close proximity of research and clinical staff, scheduling standing meetings to facilitate interaction, funding (including for strategic flagship projects), and strong collaboration between clinical and research programs or teams, and between the KT support unit and clinical leadership, were also perceived as enablers of EIHC/KT. In addition, one respondent identified the value of provincial practice leads that disseminate knowledge and clinical practice information as effective supports for KT.

3.4.5 **Barriers to supporting EIHC/KT**

Operational constraints, such as caseload demands, limited clinician time or capacity to backfill, and competing priorities, were perceived to limit the delivery of EIHC/KT supports. Lack of resources, including funding, personnel and research support, were also identified as barriers. Individual-level barriers included lack of research expertise within clinical sectors, skills across the entire spectrum of the KT process, clinician interest in engaging in research
and/or EIHC/KT, and awareness of existing supports. The state of the evidence in paediatric rehabilitation, and the tendency not to share local solutions with the larger healthcare community were also raised as limiting factors.

The lack of a strong, overarching approach for KT support (e.g. only a single KT practitioner holding other concurrent roles) was seen as cause for lack of success. At times, the success of the supports was unclear, as exemplified by one respondent’s statement: “I’m not sure that any of our [organization’s] strategies have been particularly effective.” At one site, capacity building was a challenge because of staff turnover and lack of consistency in training new staff. KT support personnel also lacked practice opportunities to sustain their skills. Challenges in identifying personnel with training and practical experience in KT support existed for those hiring. Supports and networks for stakeholder engagement were seen as poorly established, and sustainability of KT support infrastructure was perceived to need greater attention. Finally, one respondent indicated the need to focus efforts on fostering a culture that values KT and prioritizes EIHC.

The most significant perceived barriers were lack of funding, time, personnel, management support, understanding about the processes of care, knowledge about research, KT and implementation and how to facilitate it, and staff capacity to support and to engage in change. Themes relating to barriers in communication (e.g. inability to connect with staff because of its size or email response habits), and silos between clinical teams, research and education departments also predominated.
3.5 Discussion

This survey provides a snapshot of the many organizational EIHC/KT supports that exist within paediatric AHSCs and their affiliated research institutes in Canada. A range of organizational structures, processes, personnel and partnerships were identified. The diversity of service models highlights the need for greater evidence to inform resource allocation and decision-making in this area.

3.5.1 The sample

Our response rate represented 49% of our target sites and exceeded the mean organizational survey response rate in the literature of 35%. Research and health organizations were both well represented. Representation from the majority of provinces supports the generalizability of the findings. Respondents represented a diverse range of leadership and professional roles, and held more than a decade of experience on average, lending credibility to their reporting. Recruiting multiple respondents at eight sites provided greater comprehensiveness in the reporting.

3.5.2 Supports

Although two-thirds of sites reported having an on-site library, limited access to library collections was reported, especially for those without university affiliations. Ellen and colleagues have identified this type of support as a priority for enhancing evidence use in healthcare organizations. This lack of resourcing has significant implications for accessing and applying current research. Much of the funding burden for library services appears to fall on healthcare organizations. This situation has the potential to draw resources from other operational priorities,
or to result in the organization’s information access needs not being met. Additional work is thus required to determine the extent to which library staffing levels meet organizational needs.

The environmental scan revealed a greater number of dedicated KT support units than anticipated. However, some sites reported EIHC/KT support responsibilities being left to one or two individuals, or supports being informal and unfunded. Apart from the supports specifically prompted on the survey (i.e. journal clubs/meetings/workshops, procedures/protocols to support EIHC/KT, care pathway and clinical guideline committees), little overlap existed in responses between participants. This observation suggests that organizational supports may be diverse, and inconsistent across sites. Some organizations appear to be leveraging external resources and supports, whether for training, research, stakeholder engagement or access to evidence. The range of external organizations from which these supports were drawn may reflect the diversity in the support landscapes across provinces. Further examination from the perspective of KT support personnel through follow-up interviews will provide insight into the structures, services, personnel, training methods and governance of these support units, and the availability of internal and external resources. Implementing all of the EIHC/KT supports described within this article would not be feasible. However, having a snapshot of different models of support can help health and research administrators identify strategies by which to assess or to establish their own support infrastructures.

With respect to the proposed mechanisms of action of the supports as delineated by the Behaviour Change Wheel, only Restrictions was missing. However, incentivization was leveraged only from external sources. Further examination of each support and its proposed mechanisms from the perspectives of those delivering the supports will generate a clearer picture of their key ingredients, mechanisms of action, and delivery modes.
3.5.3 Integrating research and stakeholders

Despite their three-pronged mandate for clinical care, research and education, variable supports existed for research integration in clinical settings across these AHSCs. Although research integration within clinical settings themselves is not a requirement of this mandate, such an approach, which engages clinician end-users as research partners, has the potential to improve organizational performance, enhance the relevance of the research, and facilitate its implementation in practice or policy. Examples of such models exist (e.g.), which involve researchers embedded in clinical sectors, co-funded research, support for implementation research, introducing structured processes to identify and to address gaps in best practices through research activities, establishing communities of practice to address these gaps, and the development of new roles and core units to support strategic clinical research integration and KT. From a leadership perspective, these strategies may involve a shared governance structure across healthcare and research organizations, distributed leadership across different stakeholder groups, stakeholder-engaged advisory committees, and senior leadership, research and management positions held, or initiatives led, by individuals with both healthcare and academic appointments. Through these modes, research directions can be aligned with healthcare priorities, and findings can be implemented more efficiently while building research and KT capacity for both clinicians and researchers.

Existing supports identified by respondents included operational, human resources, capacity building activities and collaboration/network building. These approaches were similar to the nature of the supports reported for EIHC/KT, and in many cases may make use of similar infrastructure. The majority of identified barriers pertaining to clinical research integration, however, related to challenges in engaging the clinical sector, suggesting clinical sector-specific
supports may be required to bridge this gap. More information is required from the clinical sector to determine the extent to which the current leadership and research roles, project funding programs, FTE allocation programs, external partnerships, and hiring of hospital-funded investigators are effective at mitigating these barriers. Structured context-specific needs assessments are required to understand more clearly the challenges and opportunities for strengthening clinical-research integration in order to inform the implementation of these recommendations.

Broader networks seemed to be the primary strategy for engaging external clinicians in EIHC/KT, although internally funded projects and professional development opportunities were also offered. The extent to which external clinician involvement is prioritized as a mandate for organizations may positively influence these efforts. For example, healthcare organizations with a responsibility to support community-based health professionals may be required to report on engagement outcomes and therefore to establish and to maintain infrastructure that sustain these outcomes. These efforts might be conducted through resource websites, outreach processes, consultation services, and so forth.

Regular stakeholder engagement in research was reported across the majority of sites, most commonly with patients/families and healthcare professionals. However, supports for engagement were less common than for other aims (i.e. KT and clinical research integration), and room for improvement exists. Caution should be taken in interpreting data related to the frequency and pervasiveness of stakeholder engagement, as it may not reflect accurately engagement rates at the research project level.
3.5.4 Evaluation

The smaller proportion of respondents that reported on the effectiveness of EIHC/KT supports may reflect a lack of knowledge on the part of respondents, or a lack of evaluation and reporting practices related to these services. Respondents mentioned no specific outcomes or indicators, and supporting effectiveness data was not requested. More detailed analysis of evaluation processes and outcomes during the interview phase may provide more objective reports of effectiveness, and information by which to inform best practices in the evaluation of EIHC/KT supports.

Numerous internal programs or initiatives were identified that support various stakeholders, including health leaders, knowledge brokers, health professional students and researchers. Supports identified as most effective from the perspectives of stakeholders included personnel, targeted initiatives, leadership, inter-departmental expertise, external drivers, and logistical support. Detailed description of these initiatives may allow others to learn more about their features and effectiveness, and to adapt and apply them elsewhere.

While one respondent perceived having a dedicated KT practitioner as being the most effective support, another respondent suggested that a single support person rendered the service ineffective because of its limited reach. More research is needed to determine adequate staffing levels for KT support personnel, with consideration for the scope of their roles. A needs assessment that takes into account capacity and resources can help to inform the development of a targeted, context-specific EIHC/KT support plan that integrates leadership, personnel, network building, logistical processes and infrastructure with structured programs and resources as appropriate.
3.5.5 Barriers

Supports identified as most effective from the perspectives of stakeholders included personnel, targeted initiatives, leadership, interdepartmental expertise, external drivers and logistical support. Clearly, additional resources were seen as key to the success of EIHC/KT supports, along with a coordinated approach involving more than a single KT practitioner. Limited supports may compromise capacity to support all staff, leading to inequities. Lack of research expertise within clinical sectors, and lack of skills across the entire spectrum of the KT process, point to the need for additional supports for capacity building, consultation and/or facilitation. However, effective communication about the nature of supports available and who is eligible to access these supports may support broader reach and impact of services. Systematic data collection can yield insights into the reach, satisfaction, effectiveness and impacts of EIHC/KT supports.

Sustainability also appears to require ongoing education and training, not only for KT support personnel, but also for staff, to address workforce turnover. Structured external KT training programs may help to address this gap in the absence of tailored internal programs. Knowledge of the healthcare and research contexts, and a bridging of their cultures may also be necessary to facilitate effective collaboration and research integration. One support strategy alone is not considered adequate to enable real change. However, limited funding exists in the Canadian healthcare system for these non-clinical priorities. External partnerships, strategic use of research and quality improvement resources and less resource-dependent strategies (e.g. strengthened communication networks, establishing protocols and forums to support research and KT processes, leadership commitment) may be important for sustainability and for strengthening a culture of research and EIHC/KT.
3.5.6 Limitations

The AIMD Framework was used in the analysis phase but not to design the survey items. As a result, some detail about the aims, ingredients and mechanisms of action of the KT supports was missing, making it unfeasible to document each element of the AIMD Framework for each support identified. Instead, characteristics of all of the supports were grouped under each component heading. Further exploration into the characteristics of these supports, particularly in the context of empirical studies, would be beneficial in defining them further, and in evaluating their effectiveness at achieving their intended aims. This environmental scan and its analyses provide a foundation for this work.

In some instances, the survey yielded brief answers for which context and layers of qualitative richness were lacking, leading to the potential for misinterpretation or misrepresentation of the respondent’s intent. In-depth follow-up interviews that can probe for context, personal meaning, emotional and social dynamics or nuances will address this gap and elicit further detail. Respondents also shared their organizations’ support strategies and challenges with the understanding that confidentiality would be maintained during reporting. As a result, readers who desire more information about specific EIHC/KT support strategies lack the ability to make direct contact with site representatives to learn more. Joining provincial or national networks focused on KT may provide a forum for continuing the conversation and connecting those individuals or sites.

3.5.7 Future directions

Future directions include research to determine which supports are effective in which contexts and at what intensities, and economic analysis to determine the cost-effectiveness of
these supports. The results of this survey will also inform the development of an interview guide to examine in greater depth the structure, personnel characteristics, resources and sustainability of the dedicated KT support units identified through the survey. Comprehensive study of individual sites may also enable a clearer understanding of the multi-faceted factors that influence EIHC/KT support from the perspectives of healthcare professionals, leaders, researchers and KT support personnel. No studies on whole systems of supports within an organization currently exist.51 A systematic approach that describes the different KT support unit models of support is critical. This exploration should aim to capture the interaction between organizational supports and individual-, network- and systems-level barriers and facilitators of EIHC/KT in order to inform tailored strategies to optimize evidence use within these organizations.

3.6 Conclusion

This environmental scan summarizes for the first time the supports for EIHC/KT, clinical research integration and stakeholder engagement in place within paediatric research and healthcare organizations across Canada. Serving up to nine different stakeholder groups, the supports leveraged individuals, internal departments, and external organizations to facilitate the co-production of research, access to and implementation of evidence, capacity building, evaluation and network strengthening. These novel findings can be used to inform the design or refinement of EIHC/KT support programs within AHSCs and their affiliated research institutes. Following a local assessment of the barriers and facilitators of evidence use, targeted strategies can be considered from the array of approaches described. Deliberate attention to the intended mechanisms of action and key ingredients of the support strategies can ensure that appropriate
modes of delivery are enacted. Evaluation in practice will provide greater insight into the effectiveness and sustainability of these supports. No one-size-fits-all solution exists for supporting EIHC/KT. Organizational objectives and needs, internal and external resources, and training and partnership opportunities will influence the directions taken by those facilitating EIHC/KT, research integration and collaboration. The findings provide an important foundation for enabling research use from an organizational perspective, and for supporting the involvement of clinical and other stakeholders to augment the relevance and impact of child health research.
Chapter 4: Study #3a: Perceived reasons for KT network structure in an AHSC-research institute dyad: A mixed methods descriptive SNA case study

4.1 Synopsis

Now that I understand the KT support context of Canadian paediatric AHSCs and their affiliated research institutes, I can examine in more depth one AHSC-research institute dyad to uncover the SNA-specific factors influencing KT. Only health administrators, leaders and others involved in KT supports were surveyed in the environmental scan presented in Chapter 3. Four key stakeholder groups can provide valuable insights into the dynamics of KT within these settings: researchers, healthcare professionals, health leaders and KT support personnel. The perspectives of network members gathered through qualitative methods can augment our understanding of the reasons for network structure, and its perceived influence on KT. The current chapter reports on a mixed-methods SNA study employing a survey and individual interviews to describe the KT network and its characteristics within one AHSC and its affiliated research institute, and to present stakeholders’ explanatory perspectives about network properties and their influence on KT.

4.2 Background

Limited understanding exists about the social influences on KT that occur within healthcare and research organizations. SNA can be applied to examine network structure, its role in shaping the attitudes and behaviours of individuals in an interconnected group or network, and the factors that contribute to the existing structure. Understanding these dynamic can assist in
decision-making about how to organize the physical environment, the structuring of incentives, and the provision of personnel and supports.

The majority of research on KT in healthcare focuses on physician-only networks. This is the first study on inter-professional organizational KT networks in pediatric research and healthcare organizations. The integration of healthcare professional, leader, researcher, and KT support personnel perspectives affords the inclusion of multiple stakeholder experiences.

Although quantitative SNA methods generate statistical network property values that can be used to describe the network, few researchers in the field of KT that use SNA apply mixed methods to triangulate their findings. Rigour in the results from SNA is enhanced when corroborated with qualitative findings. Mixed methods can also be employed to understand more clearly the reasons for network structure, and to make sense of how this structure impacts phenomena of interest, from the viewpoints of network members.

The purposes of this study were to: 1) describe the structure of a KT network of researchers, clinicians, health leaders and KT support personnel in a Canadian pediatric healthcare-research organization dyad; 2) triangulate the SNA survey findings using interview data to determine the extent to which network structure influences KT; and 3) identify the reasons for the observed network structure from the perspectives of network members. The study also drew on participant engagement activities to support these stakeholders in applying a network lens to reflect on their experiences so as to generate potential network-driven strategies to strengthen their own capacity for KT. These methodological contributions can be applied in other research or practical settings to extend the value of SNA for KT-related applications.
4.3 Methods

4.3.1 Study design

This chapter describes the findings of a mixed-methods SNA descriptive case study comprised of a SNA survey and follow-up interviews. Although this study did not employ a participatory research methodology through the engagement of knowledge users (i.e. network members) as research team members, it did include participant engagement in its design.\textsuperscript{137} This engagement included the researcher taking on a role enabler or mobilizer of knowledge co-production, employing new data collection methods to meet the needs of knowledge users, and the empowerment of knowledge users to produce knowledge shaped by their own expertise and perspectives while gaining new insights.\textsuperscript{137} For example, I introduced participants to foundational research knowledge about network structure, and supported them to apply a network lens to interpret the quantitative SNA data describing their own network (i.e. enabling/mobilizing knowledge co-production). This reflective process was guided by the collaborative exploration of network visualizations I derived from this quantitative data (i.e. new data collection methods). This reflection supported them to share the research questions and hypotheses that emerged for them, which will be addressed in a subsequent publication. The process also helped them to generate specific actions that could be taken to improve their own context for KT, at both an individual and whole network level (i.e. empowerment, gain new insights). This latter outcome will be addressed in Chapter 5.

4.3.2 Research questions

The research questions that guided the study were:
1. To what extent do network members perceive the observed network properties to influence KT?

2. What are the reasons for the observed network structure, from the perspectives of network members?

4.3.3 Site selection, sampling and recruitment

One paediatric AHSC with an affiliated research institute was selected from among the 18 included in the environmental scan described in Chapter 3. AHSCs were purported to permit the gathering of a large data set with the potential to capture KT-related interactions within and across departments or units, organizations and clinical and research sectors. The specific site was selected purposively because of the presence of a KT support unit, a separate campus for the health centre and research institute, and for convenience and feasibility. An organization with a KT support unit was preferred for its potential to offer richer relational network data focused on KT-related ties than a site without prominent KT support. An organizational dyad with separate campuses was preferred for the ability to examine both intra- and inter-organizational ties and their implications.

The entire network of health professionals, leaders, researchers and KT support personnel (e.g. library staff, KT support unit staff) within the umbrella organization was invited to participate in the survey. The clinical staff at the health centre was comprised of 125 health professionals or technical staff (i.e. rehabilitation technicians, clinical technologist or engineers) from 14 disciplines, and 20 administrators, leaders and KT support staff. An estimated 85 of the 326 RI-affiliated researchers were involved in child development and rehabilitation (CDR) research, along with up to 15 clinician-researchers at the health centre. REB-approved invitations
to participate in the survey were circulated to all network members at both organizations through site-wide emails, internal e-newsletters, recruitment posters and display monitor announcements in lobby areas, letters of recruitment (see Appendix E) circulated through administrative assistants and presentations about the study at site-wide, departmental or program meetings. Screening questions following the online consent form (see Appendix F) were used to facilitate inclusion/exclusion screening.

Theoretical sampling was used to gather diverse perspectives through follow-up interviews using a naturalistic inquiry approach. This approach involves research within participants’ natural settings (i.e. their organization), with the aim of understanding participants’ varying subjective, contextualized perspectives, interpretations and experiences about a phenomenon. Research questions may evolve over time based on learning that emerges, while inductive processes and consideration of the influence of context on participant views and experiences are central. Participants were selected theoretically from the survey sample based on their network position (i.e. KT influence as defined by high, low and “average” indegree, outdegree and betweenness centrality values), formal roles within the organization, tenure with the organization, and identities as members of one or more stakeholder group (i.e. researchers, leaders, clinicians, and KT support personnel). I contacted prospective participants by email (with up to two reminders) and invited them to review the interview consent form and indicate their willingness to participate.

4.3.4 Stakeholder engagement

Approval to conduct the study was obtained from senior directors at both organizations. Feedback on the research questions, outcomes, study design and protocols was obtained from the
health centre leaders. Input on recruitment and feasibility was also gathered through meetings with research institute research managers and clinical sector administrative assistants. Participant engagement during the qualitative interview phase enabled them to identify priority research questions and hypotheses to address through post-hoc data analyses in the future. Participants also had the opportunity to describe their preferred methods for learning about the findings of the research (e.g. manuscripts, infographics, site-wide presentations, team- or program-specific meetings).

4.3.5 **Inclusion and exclusion criteria**

In order to focus the project’s scope, the network boundary was defined as 1) healthcare umbrella organization employees involved in clinical care or health services leadership focused on child development or rehabilitation; 2) internal researchers and research support staff involved in CDR research; and 3) staff within the organizations providing KT/EIHC support to network leaders, clinicians and/or researchers involved in CDR clinical care or research. The operational definition of CDR is provided in Box 1.

**Box 1. Operational definition of child development and rehabilitation**

**Child development and rehabilitation (CDR):** The health field related to children from birth to 18 years with developmental or behavioural conditions (e.g. attention deficit hyperactivity disorder, developmental coordination disorder, autism spectrum disorder, neuromotor/neurological conditions (e.g. acquired brain injury, cerebral palsy, muscular dystrophy), physical disabilities (e.g. limb amputation), musculoskeletal diagnoses (e.g. bone fracture) or primary sensory impairments (e.g. visual or hearing impairment, complex/chronic
pain) that require health services, such as therapy, diagnostic assessments, consultations or other non-emergency patient care.  

Participants whose research focused only on acute care or community settings or did not address health services issues, populations or health-related conditions serviced by the health centre were excluded. These criteria were chosen in order to minimize the presence of individuals who were isolated because the nature of their clinical or research work did not lend opportunity for network ties.

### 4.3.6 Ethics and confidentiality

Ethics approval was obtained from the joint Research Ethics Board of the health centre and its affiliated university. Data were stored on an encrypted memory stick, secure server or locked filing cabinet accessible only to the researchers. An information sharing agreement (see Appendix G) was signed by organizational leadership at the health centre and was made available to all prospective participants through a link provided on the survey consent form (see Appendix F). This agreement described the nature of the information that I would be able to share with leadership, and measures in place to protect participants.

### 4.3.7 Instrument design and data gathering

I administered the online SNA survey designed for this research to all consenting participants using REDCap. The survey was designed to identify the nature and properties of relational ties between actors within the network in the context of information seeking, information sharing and research collaboration. The survey was administered in two, one-month waves, beginning with researchers, followed by health centre staff. Data were also gathered
about individual attributes hypothesized to influence network structure. Survey items addressed in this chapter, including name generator questions for the SNA relational data, are presented in Appendix H.

The semi-structured qualitative interview guide (see Appendix J) designed for this study generated data about the mechanisms facilitating KT within the network, the existing gaps in supporting KT, and the perceived influence of network properties on KT. The consent form is provided in Appendix I. The audio-recorded interviews I conducted were transcribed verbatim for analysis.

The interviews were conducted in two 2-month waves as per the survey administration protocol. These waves began approximately three months after the respective survey waves had closed. This timeline allowed for quantitative analysis of the SNA data to inform interview participant selection. During the interviews, I used a visualization of the interviewee’s network to support communication about SNA and the data. I provided written definitions and visual representations of common network properties to each participant, and reviewed them orally before beginning the interview. During the interviews, an image of the whole network’s nodes and ties allowed participants to see the types of connections I was exploring. A velum overlay of their own ego-network was then used to convey their position within the whole network. Discussion about the network visualization was used to help establish the rigour of the network data through triangulation. Field notes were documented following the interviews to gather data on body language, challenges, data of particular interest, and to record other impressions.
4.3.8 Data analysis

I conducted all of the analyses. Descriptive statistics, including counts, proportions and central tendencies were used for demographic data. Multi-response and open-ended item data were not included in the current analyses, and will be presented in subsequent publications. Whole and ego-network properties, including indegree, outdegree and betweenness centrality, density, and subgroups, were derived from relational data entered into adjacency matrices in Microsoft Excel and imported into UCINet software. Each network’s adjacency matrix was symmetrized using the union rule to calculate undirected degree centrality, which was used as a proxy for importance in the network diagrams.\(^1\) This approach is based upon the assumption that an actor’s reported ties exist regardless of whether or not the alters confirm them.\(^1\) The union rule was chosen to account for unintended asymmetry introduced through recall bias, given the size of the network; as a result, this approach creates denser networks than the non-symmetrized data.\(^1\) I generated network diagrams with NetDraw software using these adjacency matrices. My interpretation of SNA and qualitative data were guided by social influence and social capital theory.\(^ {39,66} \)

I analyzed the qualitative interview data using a six-phased approach as described by LeCompte.\(^ {140} \) First, the data were sifted to identify codes that aligned with the research questions, or represented ideas of interest. Next, the codes were categorized into groups by contrasting and comparing them. This process resulted in a classification scheme that was subsequently refined, through the creation of subdivisions, the reassignment of codes, and modifications to group names. Memos documented key points in this process. The following phase involved the creation of patterns that formed meaningful relationships in the data. The final step involved assembling the patterns into the final themes presented in the data. The codes
were then reviewed to confirm their categorizations within the final themes. Quotes compiled
within themes were then reviewed for their relevance to social influence and social capital
theories, which guided the interpretation presented in the Discussion section. Data related to
structural properties and their influence on KT were also coded according to network properties
(e.g. centrality, isolates, subgroups) to enable mapping to quantitative data. Coding was
terminated when theme saturation was achieved (i.e. themes were adequately explained, no new
data needed to be added).141

4.4 Results

4.4.1 Demographics

The survey phase included 103 participants of an estimated total population of 220
(47%). The sample included members from 13 different health professions. Nearly half (43, 43%)
of respondents identified with multiple roles (e.g. clinician, leader, KT support, researcher). Mean number of years of clinical experience was 18.1, in research 9.0, and with the organization 13.0. The interview phase included 29 participants comprised of clinicians, KT support personnel and leaders who spanned all six clinical programs at the health centre, as well as researchers, a research manager, and trainees, with and without affiliations with the research institute. Demographics for each phase are presented in Table 5.
Table 5. Survey and interview participant demographics

<table>
<thead>
<tr>
<th>Category*</th>
<th>Response options</th>
<th>Survey (n=103)</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization*</td>
<td>Health centre</td>
<td>78 (76%)</td>
<td>21 (72%)</td>
</tr>
<tr>
<td></td>
<td>Research institute</td>
<td>32 (31%)</td>
<td>12 (41%)</td>
</tr>
<tr>
<td></td>
<td>Other affiliated organization</td>
<td>45 (44%)</td>
<td>14 (48%)</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>83 (80%)</td>
<td>24 (83%)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>21 (20%)</td>
<td>5 (17%)</td>
</tr>
<tr>
<td></td>
<td>Non-binary</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Role*</td>
<td>Leaders</td>
<td>22 (21%)</td>
<td>8 (28%)</td>
</tr>
<tr>
<td></td>
<td>Clinical staff or physicians</td>
<td>72 (70%)</td>
<td>18 (62%)</td>
</tr>
<tr>
<td></td>
<td>Researcher or trainee</td>
<td>40 (39%)</td>
<td>12 (41%)</td>
</tr>
<tr>
<td></td>
<td>KT support</td>
<td>41 (40%)</td>
<td>16 (55%)  (3 formal, 3 knowledge brokers)</td>
</tr>
<tr>
<td>Profession of primary role*</td>
<td>Clinical technologists, rehabilitation technicians &amp; assistants, engineers</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>KT support personnel</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Registered nurses</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Occupational therapists</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Physical therapists</td>
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<td></td>
<td>Physicians</td>
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<td></td>
<td>Psychologists</td>
<td>1</td>
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</tr>
<tr>
<td></td>
<td>Recreation, aquatic &amp; music therapists</td>
<td>1</td>
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<tr>
<td></td>
<td>Research managers and coordinators</td>
<td>1</td>
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<tr>
<td></td>
<td>Research trainees</td>
<td>2</td>
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<tr>
<td></td>
<td>Researchers</td>
<td>6</td>
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<tr>
<td></td>
<td>Social workers</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speech-language pathologists</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Directors, program managers, professional/collaborative practice &amp; team leaders, family engagement advisors</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Tallies exceed 100% because multiple-response questions allowed participants to self-identify in more than one category.
4.4.2 Descriptive network properties

This chapter reports on two KT-related networks: information seeking (derived from relational data from the name generator question ‘From whom do you seek evidence about CDR?’) and information sharing (name generator question: ‘With whom do you share evidence about CDR?’). Whole network size, density, and isolate counts, and mean ego-network values for network size and centrality for these two networks are presented in Table 6. The networks are presented visually in Figures 7 and 8, with node size representing degree centrality (undirected, for visual simplicity as a proxy for importance), and yellow node colour indicating interview participants. Indegree centrality relates to the number of ties coming into a node (e.g. number of people who seek information from an actor, in Figure 7). Outdegree centrality reflects the number of ties an actor sends to others (e.g. number of people from whom an actor seeks information, in Figure 7). Degree centrality is a non-directional centrality measure that includes incoming and outgoing ties. Betweenness centrality represents the extent to which an actor connects other subgroups that would not be connected otherwise (e.g. bridger or structural broker). Higher values indicate greater connectivity. Isolates are individuals without ties.

<table>
<thead>
<tr>
<th></th>
<th>Information seeking network</th>
<th>Information sharing network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole network value</td>
<td>271 nodes</td>
<td>282 nodes</td>
</tr>
<tr>
<td>Mean ego-network value (range)</td>
<td>1.472</td>
<td>2.411</td>
</tr>
<tr>
<td>Density</td>
<td>0.50%</td>
<td>0.90%</td>
</tr>
<tr>
<td>Indegree centrality</td>
<td>-</td>
<td>0.140 (0-39)</td>
</tr>
<tr>
<td>Outdegree centrality</td>
<td>-</td>
<td>0.076 (0-22)</td>
</tr>
<tr>
<td>Betweenness</td>
<td>-</td>
<td>76.083 (0-714)</td>
</tr>
<tr>
<td>Isolates</td>
<td>31</td>
<td>17</td>
</tr>
</tbody>
</table>
Figure 7. Visualization of the information seeking network showing low density connectivity
Figure 8. Visualization of the information sharing network showing low density connectivity
4.4.3 Perceptions of the network

Twenty-six participants affirmed one or more network properties presented to them as being congruent with their experiences of the network, thirteen of whom did so without elaboration. The others referred to experiences or specific attributes to support their assertions, as described in Section 4.4.5. The nature of the whole network property affirmations included low density by three participants, greater density for information sharing than seeking by one, the presence of many subgroups by five, and low reciprocity by three: “It may not be a two-way linkage. It may be, if I need information I go to that person, or I present to a group, but I don’t know that there would be as much two-way [exchange].” [11] Five participants confirmed specifically that their ego-network structure was represented accurately, while 10 participants affirmed their network position (e.g. high or low centrality): “It resonates with my experience, feeling a little out there in left field.” [14, positioned at the periphery of the network’s core]

Surprise (32 instances) and even shock (4 instances) were also prominent descriptive terms used in response to the network diagrams, with the term ‘wow’ appearing 33 times. General surprise at the diagrams was common, which stimulated discussion about the characteristics of note for participants. Responses to the unexpected presence of distinct subgroups (“It’s a bit shocking that we have a couple of people that are off to the side” [10]), recognizing the contrast in individuals’ centrality levels (“Wow! So these people have no connections? But this person in the middle here has all those connections? Wow!” [26]), or data representing higher or lower centrality than anticipated (“I’m blown away! I’m one of those [isolates]!” [27]) were the most animated.

Ten participants expressed perceptions that differed from the network property data presented. These perceptions related to their own ego-network size (i.e. being smaller or larger
than they anticipated), their position in the network (“Oh – closer [to the core] than I thought” [20].), or to the whole network structure. These whole network differences included the lack of reciprocity with respect to information sharing and seeking, and the existence or number of subgroups, including isolates: “I’m honestly a little surprised there aren’t more disconnected subgroups that have connections within them – just from our own experience of operation – which is actually a pleasant surprise to see.” [18] Nine other participants related this sense of happiness, relief or validation about specific network properties, such as this researcher-clinician who learned of her structural broker position:

Well that’s cool! I like that. I want research to influence practice, and because I have lived in both worlds, I feel like I’m a good in-between person to translate knowledge into practice. When I went into academia, I didn’t want to be in the ivory tower and just do research, and it doesn’t go anywhere. So I value this [information], and I’m glad I’m there [in this broker position]. [7].

When participants (n=8) expressed confusion about interpreting the diagrams, these comments guided further conversation about their meaning. Confusion centred around the way the network was defined (i.e. asking for a reminder of the name generator questions, or to revisit the definition of KT): “I guess it’s making sure I understand the context of what you mean by these networks.” [22], or what the symbols represented: “So tell me what I’m looking at here” [20], [16]. One participant related the novelty of the exercise of exploring network visualizations and network influences when asked if the network looked the way he had anticipated: “Not really. I mean, it’s a lot of squares and lines.” [16].

Nonetheless, the stemmed term ‘interesting’ was the most frequently uttered term (52 times, apart from the term ‘people’, 53 times) as participants reacted to the diagrams, suggesting they were reflecting on the diagrams and the implications of networks, or on their own roles within them. These impressions were reinforced by participant comments:
That’s great! Like I said, I never thought of it. Seeing it dance and filled with people is interesting to me – whereas I keep thinking of people at their computer like I am – you know how you view the world as you see yourself - in front of a computer. [21]

Other participants appeared to gain insights from the visual network representations and discussions, including fifteen who expressed a sense of curiosity: “Now I’m interested to see the overlay [of my ego-network]…I do try to talk and make connections” [14]. All participants were willing to engage in discussions to gain an understanding of the network structure and its potential implications. These discussions generated hypotheses that could be tested, and research questions that could be addressed through further analysis of the data.

4.4.4 Perceptions of the influence of network structure on KT

Every interview participant confirmed the nature of KT as a social process, and the role networks play in supporting or hindering KT. The benefits of using networks included accessing or sharing evidence, expertise, resources and support in order to move evidence into action, engaging stakeholders, and implementing change. Overall, participants valued increased connectivity, with few exceptions. One leader expressed the benefits of connectivity, while sharing with me the psychological consequences that emerged from not having the capacity to reach the whole KT network in her leadership efforts:

If I didn’t try to stay connected, I would be hampered in the ability to either ask good questions, or to advocate for redirection of resources. So I believe quite strongly in it, and [that’s] probably why I judge myself fairly harshly about what I can’t do. [6]

Despite having high density within clinical subgroups, networks were also seen by one leader to be inadequate for moving evidence into action, particularly with respect to the misperception that information sharing networks alone were effective at mobilizing change. This
leader shared her struggles with this challenge, based on her knowledge of KT best practices that support active engagement over passive information sharing strategies to change behaviour:

When I think about one of our [clinical team members] who went to a conference and sent this article around to the entire team…It’s almost like, you scatter some seeds and you walk away. I’m not opposed to those kinds of things, I just don’t know what the hope is when that person has reached out to a large group of people. Because sometimes I hear that the hope is really that it changed people’s behaviours. [6]

In keeping with this goal of active engagement, one researcher expressed the importance of relationship building for KT, and explained the facilitating role KT support infrastructure plays in this process:

Implementation and knowledge exchange depend on relationships, and the role in my mind of infrastructure in knowledge exchange and KT and implementation (and they’re all different), is it facilitates the development of relationships and supports them in meaningful ways to allow that connection to occur. [28]

This perspective is congruent with a SNA perspective, and provides a segue into the consequences of isolation and poor connectivity on KT. Isolation within the network was perceived by ten participants to restrict access to information that could facilitate the implementation of best practices, particularly for those individuals with limited experience, as proposed by one clinician:

I think it impacts of the quality of care that we would provide because again, we don’t have all the answers. We know what we know clinically, and it depends on how many years’ experience you have. [8]

Ties to others in the network that held this experience were therefore considered critical for eleven participants, in terms of accessing the evidence required to deliver best practices. Small networks were seen as beneficial for supporting communication, but detrimental in terms of limiting access to knowledge, as expressed by this clinician:

There’s a lot of benefit to the kind of close-knit team approach or reality of my team. But it is insulating in terms of the amount of knowledge - it’s a set amount, - a few people. So you tap those people and then we have our knowledge base. So what would
be nice to change would be the physical number of people I could easily be seeking information from or that I would be contributing information to. Just in the interest of amassing knowledge more quickly, and a greater quantity of it, and not being that insulated. [25]

These preliminary interpretations of the role network structure by participants exemplify that network structure can have an enabling or hindering effect on KT. This finding reinforces the value in examining KT networks within healthcare and research organizations. In order to design strategies to modify the network in ways that can augment the efficiency or effectiveness of KT efforts, we must first gain more clarity about the reasons for this network structure. This understanding can provide insights into the mechanisms by which these structures can be altered for the benefit of KT success.

4.4.5 Perceived reasons for network structure

Figure 9 depicts the four main themes that emerged from the data with respect to participants’ perceived reasons for the observed network structure.
4.4.5.1 Theme 1: Individual attribute-level influences

Attributes are characteristics of the individual, which may or may not be associated with the tendency to form ties within the network. Participants identified seven attributes as potential influences on network structure: 1) Expertise; 2) Experience; 3) Role; 4) Attitudes and values; 5) Personality; 6) Learning styles and preferences; and 7) Socioeconomic vulnerability.
4.4.5.1.1 Expertise

Higher ego-network centrality was attributed by ten participants to greater levels of knowledge and skills that were sought by, or shared with others, as described by one leader: “I would go to someone…I perceive to be expert in that [area], and then ask for help to either connect me or help me find the answer, the information.” [15] When specific expertise was limited to few individuals within the network, demand was seen to increase these individuals’ indegree centrality for information seeking, as explained by a clinician who held this network position: “It’s only the two of us, so if people have questions about [our clinical area], they’re going to come to us….and I’m here full time, so I’m here all the time.” [26] Conversely, a high personal knowledge base was identified as a reason for an isolate position, for one clinician:

There are very few people I ask questions of now because I’ve been working here for so long. So it’s my experience. I don’t have a need to ask people knowledge questions. Although I do – I would ask outside the field. My perception is [my internal colleagues’] knowledge in this area would be less than my own. [16]

Another explanation for lower centrality was a lack of competency and confidence in KT itself, which two participants believed held leaders back from engaging in the KT network, and in supporting their staff to do so, as exemplified by one program manager:

Maybe we are doing KT on a regular basis and I just haven’t recognized it as such, or vice versa. So maybe we could do it a lot more, and I’m missing opportunities that I didn’t even realize were opportunities. So I think that’s a barrier for me – that I don’t have a sound feeling or understanding or competence in [KT] for myself. So sometimes that hinders me from putting myself out there a little more, putting our program [out there] – getting ourselves a bit more involved. [15]

A sub-theme related to expertise was education level, and how it was assumed to influence the tendency to develop larger networks for KT, as well as perspectives about being involved in KT-related activities. One leader described her observations:
I think also it’s the level of school preparation. I noticed that too. In therapists I would see that there was more of a network or a sense of not as much individuality [as compared to nurses]…But I wonder if part of it is attributed to individuals that are also Masters-prepared…Because you’re looking at your education and your role in a different way, so I think that’s inherent in it. [29]

The extent to which these behaviours were associated with training were not examined across disciplines during the interviews; however, differences appeared to originate from the way in which different professions conceptualized evidence and the need to share it with families during their interactions. One nurse relayed her own behaviours and values in speaking to families in this respect:

We [nurses] don’t talk about [the evidence] as much with families. I think the other team members do more. I don’t know if we think that way…I don’t go into the whys, and you know, that would probably be really helpful. Parents are very – they look at you, you know the answer, ‘I’ll do what you tell me to do’. Not many ask ‘why are you doing that’… But it’s also me as a nurse – honestly, it’s nothing I think of in my language or when I’m talking. And maybe I do it and I just don’t know that I do it, but it’s not something that I think of. [13]

A clinician also echoed this sentiment with respect to education and its impact on KT, in terms of parents seeking evidence to support their healthcare decision-making:

I was speaking to a very educated parent the other day. She’s a veterinarian and she had a very different approach to this whole disability that her child has. And she had done the literature review, she knew, she was looking for resources. She knew what she was entitled to. It was a very different flavour…I think professional people have a different way of looking at things. [27]

4.4.5.1.2 Experience

Nine participants identified tenure with the organization and experience in research or clinical practice as facilitating central network positions, which was put succinctly by one clinician: “I’ve been here a long time. I carry a lot of information.” [8] Time in the network was also seen as a means of accumulating network ties, and being able to identify relevant expertise on which they could draw. One leader explained: “I’ve been here a long time so I just know a lot
of people that I would go to if I have a question...I just probably have a broader network because of time.” [12] Five newer network members related their limited connectivity to time with the organization or in KT. While their external networks were described as dense, their internal ties were still under development. This lack of experience, which included clinical, KT or contextual knowledge, hindered them from taking the lead on KT-related initiatives. This was the case for the following clinician, even though she had a history of doing so in other contexts:

On my other team I was very involved in moving a particular kind of therapy into the team, and fought for it for many years, because I felt it was the best practice...[Here,] I don’t know enough. I’ve only been here 9 months. I don’t know enough about the leadership, about what they’re implementing in the community. That’s why I didn’t feel qualified [to take that on here]...because I’m too new. [27]

However, not all participants with experience held positions of high centrality. With respect to sharing, one experienced clinician isolate attributed the bounded scope of a solely clinical role as being responsible for limiting knowledge sharing behaviours, because of the value of the type of knowledge he had to share: “Well, I wouldn’t say ‘hey, I’ve got this great information, because I don’t always have great information to share. Because I don’t do any research.” [16]

Not all participants deemed experience necessary for establishing a high-centrality network. For one leader, the valuing of connectivity and the intrinsic effort that came with that were able to overcome the limitations of a shorter time in the network:

I understand who all the players are, whether I’ve accessed them or not. I’ve only been here for a year and a half, so not everyone, but I’m fairly resourceful, so will seek if I need. I’m a bit persistent that way. So if I need to find out something, I’ll use every means I can to try to figure it out. [9]
4.4.5.1.3 Role

Another factor perceived to influence high centrality was the role a person held, either currently, or in the past. These roles included leaders of any kind, KT support personnel, such as a clinical librarian, as well as educator roles. Ten participants spoke to the importance of role, reporting increased access to information and greater reach within the network than clinical staff. These factors contributed to their capacity to act as gatekeepers of information from other areas of the network. In addition, they had increased opportunities to develop relationships within their sectors, as described by one clinician-leader:

I was the [discipline lead]. People started to develop those relationships – coming to me with questions. And then I became the [a team leader], and so people came to me with questions. And now that I’m not the [discipline lead], I think it’s hard for people [from my disciplinary group] to break those ties, because we already have those relationships. [8]

4.4.5.1.4 Attitudes and values

Attitude was considered a potential factor limiting network size by one researcher who spoke candidly about the way her own attitude might serve to dissuade others from establishing connections with her:

I tend to spout off my opinions a little bit too much (laughing) - I admit that. Maybe it’s off-putting to some, but you know, I’ve always been a love me or leave me kind of person, and I’m going to do what I’m going to do. And I’m determined to get it done the way I think it should be done, and do it well, and no one is going to stop me. That’s my attitude. I guess I could build a few barriers around that perhaps, others might build them for me. That’s a possibility. [4]

Attitude also related to the willingness of others to engage in the change inherent in KT, as observed by a clinician. “A lot of people are resistant to change. The nay-sayers that say ‘We like things the way they are’.” [27] This attitude was seen as isolating these individuals from the
core of the KT network’s activities. This mindset was also seen by one clinician to be a factor for some parents who had not acted on his evidence-informed recommendations:

[Some parents] are indifferent [about the evidence]. There’s just no motivation to change. Some parents [believe] the child is just the way they are and there’s nothing to change. Or they don’t follow through on suggestions. You could give them the information but they don’t receive it and implement it. [16]

Further speculation from participants about what leads to an isolate position included withdrawing because of lack of recognition, and being overwhelmed by the pace of change, as related by a clinician:

Maybe they feel their expertise isn’t valued. Maybe they feel that they could be used more in terms of teamwork. I mean I know some of those people (laughing). Maybe they’re just burnt out and they’ve been here too long and seen too many changes, and it’s feeling more and more alienating. [27]

Alternatively, five brokers reported valuing connections as the explanation for their central positions. This personal value drove them to establish ties with others, and led to confusion as to how others could remain isolated within the network. One clinician described her tendency in this way: “My perspective on that is that if I didn’t feel connected I would reach out, so I wouldn’t stay on the side [as an isolate], ever.” [27] Connections afforded them a sense of satisfaction in their roles, helped them to exchange knowledge and ideas, and gave them a feeling of understanding their environment: One clinician-leader expressed it this way:

I want to be a person who is continually seeking and gaining more information so that I can change my personal practice, and then influence other people to change their practice, if there’s evidence for it. [12]

These benefits were seen to help network members in their own professional development and job performance, as well as with the quality of care at a broader level.
4.4.5.1.5 Personality or personal strengths

Four female structural brokers saw the primary reason they held their positions in the network as being their ability to connect with others, as one structural broker describes: “I think it comes back to those relational skills. That’s my area, my strength.” [8] In addition to enjoying communicating with others, one leader saw herself as having a responsibility in her role to link others, whether or not it was part of the formal job description. However, a common theme shared by these women and the one male broker was valuing connections and having an intrinsic drive and self-identity of being a “connector.” The male clinician-researcher who held such a role explained: “Actually creating connections is something I feel is important to do in this area, and that is me, to some extent. I believe in that, if you know what I mean.” [17]

A non-broker reinforced this perception based on her observations of others who either held structural broker positions, or informal leadership roles as knowledge brokers within the network. These knowledge brokers, regardless of their status as structural brokers, had self-identified and been endorsed by their clinical leaders to facilitate evidence use within their teams or disciplinary groups. All of the knowledge brokers were women. Their personalities were seen to lead them to these roles, while support from the organization served to reinforce their more central positions in the network, as observed by a KT support person:

There’s always a personality, there’s always someone in a group that wants to, that finds something interesting and wants to say ‘Hey - hey check out this, what would happen if we did this?’ And I think there are always people in the organization who want to do that facilitating, and those guys probably gravitate to the [knowledge broker] roles, so I think it would happen naturally to some degree. But having it sanctioned I think makes it stronger. [21]
Some individuals were seen by one structural broker to be less relational by nature, and benefitted from support from others to create or to maintain connections that would allow them to receive the support they required. She described her method of supporting these individuals:

When I was [discipline lead], every Monday I would do the rounds and I would visit, I would touch base with everybody who was in, just to see how everybody was, touch base with them, find out what their plans were for the week, if there were any issues. Because not everybody has that ability to go and ask for help, and I suspect that that’s maybe what those [isolated] people are. [8]

Despite valuing connections the one male structural broker (for information sharing, a clinician-researcher) described his own personality in a disparate way to that of the female structural brokers described at the beginning of this section:

I’m probably not the most giving or open. I do a good job of disseminating and sharing and looking for opportunities to talk about my own work or my own knowledge. Even when I go to conferences and come back, and people say ‘what did you learn?’, I don’t necessarily give or share a whole lot – it’s just not part of my style. [17]

This account suggests that a pattern in the data related to gender differences may be at play. Although participants did not discuss gender specifically, seven of the eight structural brokers were women, and all held roles in the clinical sector.

4.4.5.1.6 Learning styles and preferences

Preferred sources of evidence also shaped the network, as evidenced by these contrasting inclinations for information seeking that appear to be based on personal learning styles. The first approach came from a clinician with high centrality, who was happy with the size of her ego-network:

One of the ways that I process is verbally. I learn by talking through things, and I enjoy people. So if I have a clinical question, for example, I will often go talk to my colleagues first, then maybe look and see what is there in research or online. [2]
A clinician-researcher with lower centrality, who was also content with his ego-network size, shared his opposing approach to evidence seeking, in keeping with the gendered pattern of connectivity discussed previously:

I often look in the literature first when I need information. It depends on the question, I guess. If it’s a quick and clinical thing that you’re looking for, I might reach out to another person in the network, but otherwise I might equally look at other sources of information. So I think [my network is] adequate. Yea. It could be better; I’m not sure, maybe. I think it’s adequate.” [17]

These polar approaches were seen to lead to many, recurring network contacts in the first instance, and a smaller, less frequented network in the latter case.

4.4.5.1.7 Socioeconomic vulnerability

Socioeconomic vulnerability also came to the forefront in discussing with three participants the capacity for certain patients and families to participate in KT, as well as the level of trust that was established between families and healthcare providers. Anxiety, education level, openness to change, the availability of supports to enable change, and the added time and energy required to apply evidence or to engage with others around it were seen as confounding factors.

These challenges led to reduced sharing of information, and decreased receptivity to connect. One researcher-clinician described some of these challenges:

A third of our parents are not literate, or more. Maybe they don’t speak English. Many of them don’t open their mail, and then nobody ever gets back to us as a clinic and says ‘oh you know what, we are having trouble getting a hold of this family’. …their phone is often cut off, they move frequently, they don’t have stable housing…And then when they finally do realize that there is a problem, [the child is] five [years old] and aging out of the childhood services… So literacy, poverty, several people have felt really judged by [healthcare providers]; I’ve heard that a whole bunch of times…there’s a lot of stigma in [my practice area], and so that makes people more reluctant to engage with any other health provider. [24]
4.4.6 Theme 2: Relational considerations

4.4.6.1 Who you know

Twelve participants recounted coming to have the contacts they did because of who they knew. These internal ties helped them to gain awareness of others’ expertise, to access knowledge or support, to navigate new experiences, and to make inter-professional or external ties. One KT support person expressed this:

I connect with other people who I know have connections with those that I’m trying to get the evidence to or connect with, and have basically used these connections as a conduit. [1]

However, whom one includes in one’s network may relate to one’s preferences on a personal level. These choices may be made at the expense of others, who feel like outsiders, and may therefore have inequitable access to the network’s knowledge, resources and opportunities. One technical personnel member described his experience:

Some of the professionals that I work with have a clear preference for working with other professionals (laughing) and there’s a bit of cliquing. I don’t want to say that it’s outright cliquishness, but nonetheless, there’s a definite preference. So the network gets lopsided in that direction a little bit. [14]

Individuals not known to participants were correspondingly a key factor in the development of the network structure. For one research trainee, this gap resulted in her accessing what she came to realize were the wrong people, or possibly having nowhere to turn for the support she needed:

…[there] just seems to be a general lack of knowledge of who else is out there that might have expertise that you can pick their brain on, or recognizing even if they seem like they’re in a completely different realm, that their expertise could be cross-cutting for something specific that you need. [18]

Lack of awareness was also perceived to limit access to KT support services, such as the clinical librarian. This awareness related to knowing the support existed, understanding who
could access it, and that these connections were encouraged. Familiarity with the research activities and partners of others also impaired the development of potential ties that could enhance clinical practice through collaborations, or the implementation of new technologies.

4.4.6.2 Relationships

Relationships were seen as a necessary precursor of evidence sharing and evidence use. The absence of a communication channel between researchers and leaders was thought to restrict researchers from establishing the clinical sector connections required to initiate moving evidence into action. The presence of subgroups with poor connectivity was attributed to lack of success in forging strong relationships despite effort, as described by two researchers from distinct research fields who had hoped to collaborate with the clinical sector: “The relationships, I think, have been experienced as challenging on both sides, I’m not sure how come. We’ve made varying attempts to [connect]…” [28] “[I] pretty much gave up trying, because we never got anywhere.” [4] This unattained desire for relationship building was recognized between research and clinical sectors, as well as within teams and discipline groups. One clinician described how relationships between the administration and clinicians that lacked trust could interfere with the KT process:

Sometimes there might be a disconnect with the administrative wing and the clinical wing – a little bit of a polarizing of values and ideas, regardless any kind of research recommendations. Let’s say a program manager or professional practice leader obtains this knowledge, this evidence, and presents it to clinicians - it maybe rocks the boat a little bit depending on their perceptions, their relationship. [25]

In addition to effective communication, a transparent approach to collaboration with clinicians was seen by one participant as critical for leaders to be able to build the trust necessary to mobilize change. Trust was also perceived to restrict sharing behaviours by established network members, which left one newer network member feeling isolated:
I would imagine that it’s a matter of trust, [because] I’m relatively new here - the level of trust hasn’t been placed in me yet. I find there are a fair number of people who are not willing to share information or pass it on.” [14]

Similar to the non-directive communication style of leaders that was favoured by one clinician, effective communication was seen as vital in helping clinicians establish strong ties with children and families that would enable collaborative, evidence-informed decision-making. This communication was especially important to one clinician, given the reality that many families may be receiving conflicting messages from the various healthcare providers in their own networks:

So [the family] bought in to a particular philosophy that I don’t believe is evidence-informed, but that’s their personal choice. So that impedes their ability to listen to what I have to recommend. And then I also have to be very sensitive about how I approach that, recognizing where they’re from, so I can maintain the relationship. [2]

4.4.6.3 Common interests

Shared interests were a common path to connection among clinician sector staff, among researchers, and between researchers and clinicians for nine participants. One researcher explained this:

At least within clinical research, among clinical programs the opportunities for research and KT are forged when you’re doing shared clinical work or working with a shared clinical population. And there might be opportunities to look at that ongoing. [28]

One participant relied on and appreciated the organization’s infrastructure to facilitate these connections through its research group structure, whereas this clinician-researcher found them spontaneously based on shared interests: “Often the research institute, for example, people try to create groupings. Some of us think meaningful networks come about from the bottom up – they sort of find themselves, they create themselves organically.” [17]
The alignment of strategic objectives with KT goals was also important. One technical personnel member spoke of how natural alliances and opportunities for collaboration needed to be assessed in terms of whether the groups or programs were “both moving in the same direction, and where that synergy could actually benefit everybody, both in research translation and implementation.” [22] However, when the two parties lacked shared interests, or were not on the same page, establishing a meaningful connection was challenging. Finding these common interests could be difficult both within and across professions, as expressed by one participant who split her time between research and clinical practice:

I also tried to talk to other nurses and clinicians about research, and somebody else hadn’t read the research. It was like you were just talking off the top of your head about clouds. It was not relevant, it didn’t make any sense - it was like preaching to people that are not religious - it didn’t sit. [20]

4.4.7 Theme 3: Organizational/whole network context

4.4.7.1 Proximity

Five participants described the network as being disconnected by organizational walls (e.g. that defined the research institute and the health centre as distinct entities), which created physical separation, fewer opportunities for interaction, and decreased knowledge exchange, despite shared interests. One nurse described how being away from the “hustle and bustle of [others’ activities], you don’t necessarily hear about all of it or understand all of what’s going on.” [13] Two participants who carried out their roles outside of the organization also experienced more distance from other network members. Meanwhile, proximity made ties easier, as observed by one clinician-researcher:

That example I gave the other day about somebody from a different network completely coming over to talk to me probably happened because my office at [the hospital] was just across the corridor from them. I would like to think that people really do seek each
other out even at a distance, but there is something about proximity that does facilitate. [17]

4.4.7.2 Nature of the work

Reliance on external ties for specialized knowledge was suggested as a reason for small ego-network size, since the organizational walls bounded the network under study. One clinician explained the pointlessness of expanding his internal network from an information seeking perspective: “It wouldn’t benefit me to be reaching out to a lot of people, really, and there are only certain people that would come to me, because of the nature of the work.” [25] The tendency to form ties externally had the potential for greater KT impact, both in terms of knowledge sharing and capacity building outside of the organization, and was seen by six participants as the ideal scenario. However, the disadvantage of this outward orientation was less internal interaction, which, if present, could advance evidence use within the organization, and learning across subgroups within the network with respect to KT. One technical personnel member described this challenge:

“I think sometimes we are in our building and we are focused on our population, and the work we do draws us in lots of different directions outside the walls of this hospital…There’s not often time where folks within our programs can actually sit down together and raise up the conversation.” [22]

4.4.7.3 Mandates and priorities

One technical personnel member related that despite the motivation of staff to engage in KT, and the expectation that best practices would be achieved, KT was perceived by the organization to be “just not a priority right now.” [14] Fourteen participants reported limited capacity for KT-related ties and activities because of individual job responsibilities that fell outside of the scope of KT. These organizational expectations left them without the time, energy
or brainpower to consider and to implement changes in practice through KT network engagement. These demands influenced ego-network size, as expressed by one clinician-leader: “I tend to collaborate with a very tight group of people because I don’t have the time or space to do a lot. Or any FTE to do it.” [6] Clinical priorities trumped clinicians’ best intentions to learn about current evidence because of fixed amounts of time allotted by the organization for providing health services that were explained by one clinician to be “vital for the family in the moment.” [25] This sense of responsibility and urgency to focus on clinical service delivery over implementing best practices appeared to be driven by a deep desire to support families, many of whom were in crisis. Similarly, operational priorities and internal processes within an individual’s program hindered KT network size and the capacity to expand it. A technical personnel member, who was new to the network, expressed this barrier:

[My personal network] is more limited than I would like it to be. I know part of that is still getting started in the position, and there just hasn’t been a lot of organic opportunity to kind of branch out yet, just because there are a number of things we wanted to get settled on in terms of the operations. [22]

This constraint was also perceived by four participants to affect leaders who, faced with pressures from higher levels of leadership, were prevented from having the space to support staff to engage in KT. Provincial mandates on the clinical scope of programs (e.g. a focus on assessment or consultation over treatment) were also seen to hamper opportunities for greater impact in terms of external collaboration and practice advancement within the province. One research leader acknowledged this system-level constraint: “I really can’t put the blame on [the organization], because it’s also the way the system has been designed, that very much limits networking and cross-linking across the whole child development and rehab[ilitation] community.” [4]
4.4.7.4 Supports and resources

KT support services, such as the media or communications team, were seen by one clinician as a means of expanding one’s reach within and external to the network, particularly for researcher:

I think that they were involved in putting a number of websites together for families for the purpose of engaging families in doing the research, but then also they take the research results back out in terms of reporting and they contact the news. Every now and then you’ll see somebody’s research online. [2]

Access to KT support services, including the clinical librarian, varied across the network. Fifteen participants saw support with searching for evidence as an efficient way to bring in relevant knowledge and share it with key people involved in KT planning or decision-making. In fact, the clinical librarian had the highest centrality in the network for indegree information seeking, and for outdegree information sharing. One KT support person hypothesized that the lack of access to their services by nurses was related to the availability of nursing-specific supports, which left their discipline largely unconnected to the KT support personnel. Conversely, a lack of access to resources was seen by one technical personnel member to compel leaders to hold off on engaging the team in change: “If I were in [my manager’s] position, until I had those resources guaranteed, it would be hard for me to move forward with any of this stuff.” [22]

4.4.7.5 Logistics

Regardless of motivation level, or the perceived benefit of connecting, part-time work, conflicting schedules and varying routines within different teams resulted in challenges maintaining network ties. The nature of shift work, and the unavailability of nurse educators on
the weekend also posed a problem for fostering KT engagement and for preventing a sense of isolation and personal responsibility to initiate KT activities for one nurse. Each of these barriers prevented clinicians from engaging in KT capacity building and collaboration opportunities, from sustaining network ties and trusting relationships, and from accessing required knowledge. One nurse related her frustration with these experiences:

Sometimes some of us will sit together as nurses and we’ll have really good conversations, but then I’m off now for a week, so I lose that whole robust conversation. And I have to leave it to somebody else to pass it on or to continue the conversation, then I feel out of the loop. [13]

The coordination of KT networks within a research context, in particular, was described by two researchers as very time-intensive, but critical for sustainability. One researcher, a former KT network coordinator, related the importance of personnel support: “That coordinator role has to be someone who’s always available, who’s responsive to the emails coming in, who’s able to keep everything going.” [20] In a similar fashion, the absence of a team leader because of staff turnover or stepping away from the role was considered by three participants to leave a gap in the network in terms of advancing best practices.

4.4.8 Theme 4: Measurement error

The potential for measurement error in the network data was purported by two participants to be in part the result of missing data from survey non-respondents, and one from recall bias. Two participants raised workload constraints, lack of awareness of the survey, and concerns about sharing the relational data required to map out the network as leading to possible inaccuracies. One researcher shared this thought on the topic: “I don’t think that anybody in my
lab would have answered your initial survey, because they probably don’t have time. Maybe they didn’t get the invite…But I could be wrong.” [20]

Error may also have resulted from the way respondents interpreted the name generator questions. Whether respondents understood the concept of KT and could recognize their involvement in it was a question raised by three participants:

I think we do a lot of sharing, but I think it’s unofficial, or it’s just sort of on a day-to-day. I think we do it naturally every day but I don’t always think that we would think…[sharing evidence is] what we’re doing. [26]

4.5 Discussion

This study described two KT-related networks in a healthcare and research network, and served to validate the role of network structure in KT processes and outcomes from the perspectives of network members. This research also provided an in-depth examination of the perceived influence of network structure on KT processes, and the role of attribute, relational and contextual factors on KT network structure.

The SNA findings indicate that overall density was very low (≤0.9%). As a point of reference, the density values reported in the SNA publications reviewed in Chapter 2 ranged from 0.1% to 31%. The low density of both networks in this study is a reflection of the low mean ego-network size. These latter values suggest that individuals were connected to only one or two alters, on average with respect to information seeking. Mean ego-network size for information sharing was slightly higher, at two or three alters per actor. Because of this low connectivity, the network can be thought of as a collection of fairly independent subgroups that are joined to other subgroups by a high number of brokers. The relatively high mean betweenness centrality values for each network reinforces this interpretation. This structural pattern is considered to be
inefficient in terms of accessing or spreading information, because of the reliance on brokers to bridge the information flow between subgroups. Greater density would allow the flow of information to travel along multiple paths to a given individual. However, boundary spanners that link the network to external individuals or organizations can have a key role in introducing innovation and helping it to spread within the network, consistent with Granovetter’s strength of weak ties theory. Leveraging these external ties may augment access to specialized knowledge when internal knowledge has been exhausted. These findings can be applied to design tailored network-driven KT interventions that target network gaps or weaknesses, while considering the mechanisms of action by which individual, relational or organizational strategies may be effective.

Finally, comparative gender research indicates that women tend to be drawn to a greater extent than men to people-focused occupations, and to score higher than men on personality profile subscales related to sociability, warmth and agreeableness. The general (but not universal) tendency for gender-related tie homophily documented in the SNA literature may also contribute to the structural broker positions of the preponderance of female brokers identified in this case study, given the overrepresentation of women in the healthcare workforce and therefore in the sample. Because the inclusion criteria for this study (i.e. focus on child development and rehabilitation only) prevented a comprehensive analysis of the full research institute network, future research can delineate the gender dynamics in this setting with more clarity.
4.5.1 Strategies for ensuring rigour

In support of objectivity of the findings, the research methods, including the steps involved in data gathering, analysis and presentation were described in detail. Transparency about information sharing and separation between me and the organization and its leaders was established to maintain independence in the research. Interview questions were ordered so as to gather participant perceptions of the network first, and subsequently, to explore congruence with the SNA findings.

As a KT practitioner, a researcher and a health care professional familiar with the research setting, I was able to relate to the perspectives of these three stakeholder groups. This knowledge enabled me to draw out rich data within the context of a complex environment during data gathering, and to apply this data to test participants’ assumptions when interviewing other stakeholder groups (e.g. leaders). Given my relative expertise in SNA (and many cases, also in KT) as compared to the participants, the potential existed for social acceptability bias on the part of participants. However, the findings (e.g. related to participant reactions to the network - surprise, confusion, affirmation, disparity, curiosity) suggested candor, and demonstrated diversity in responses. Participants were encouraged to share their experiences without fear of judgment, and their variable familiarity and expertise with the subject regardless of their roles was recognized as natural and expected. My role as a research trainee may have produced a negative power differential in this respect with regard to researchers, possibly leading them to respond with greater candor.

Auditability was supported through consistency in the use of a single interviewer, a semi-structured interview guide, a coding list of network properties to guide the SNA-specific analysis of qualitative data, method (i.e. SNA and interview) and source (i.e. four stakeholder group
perspectives) triangulation, the demonstrated comparability of findings across these sources, and field note and analysis memo documentation. Credibility was augmented through triangulation, searching for negative evidence (i.e. observed network structures that did not resonate with participants’ experiences), and the linking of the findings to social influence and social capital theory. Transferability was facilitated by describing the sample and setting to aid comparisons, by employing theoretical sampling, by linking the findings to established theory, and by identifying research directions by which to test the findings further, as described below.

4.5.2 Implications for network intervention research

The proposed reasons for network structure identified by participants were in many instances based on an assumption that greater centrality, density or network size would augment KT capacity, and enhance KT processes and outcomes. No evidence exists to suggest that ideal network property values exist for optimizing KT. Further research will be required to examine this assumption in more detail. However, the finding that most network members desired to expand their networks in support of KT suggests that network-driven KT interventions are worth evaluating.

This research also provides insights into the proposed mechanisms of action by which networks influence KT. The qualitative component was particularly relevant to this outcome. For example, my researcher-centric analysis of the SNA data and network visualizations may suggest that a network intervention that connects peripheral subgroups to the network core may be a priority for strengthening the network. This connectivity may be hypothesized to improve social capital by bringing in more specialized expertise. However, interviews with a range of network
members identified the value of external ties for this purpose. Meanwhile, a reported lack of awareness of the existing expertise available in the network’s core may be targeted preferentially to improve access to expertise. Such an approach would circumvent the challenges associated with the lack of co-location of the health centre and research institute.

Based on further analysis, if the peripheral subgroups consisted primarily of researchers whose expertise and interests did not resonate with the clinical sector majority in the network’s core, the network intervention’s success in connecting the subgroups would not address the knowledge needs of the core. The identification of common interests, such as implementation-ready subgroup research that will benefit the clinical core, is required as a precursor to this type of approach. Alternatively, the development of ties to foster future stakeholder-engaged research of relevance to the clinical community may be a more appropriate network intervention for subgroup-core connectivity at this time. This example highlights the importance of identifying relevant goals for KT that can be appropriately targeted by the network intervention. The value of engaging stakeholder groups in examining the barriers and facilitators of KT and in formulating these goals is also highlighted as a means of increasing the likelihood that the KT intervention will be effective at advancing KT.

The SNA findings, such as the low density, small ego-network sizes, and reliance on brokers for the flow of information, validate the participants’ desire for greater connectivity. The evaluation of change in KT processes and outcomes following an intervention to increase connectivity may be a valuable starting point for the network. Useful metrics may include changes in ego-network size, receipt of useful knowledge, and the time demands for information exchange faced by structural brokers. Other implications for network interventions will be
addressed in section 4.5.3. In the next two sections, I will discuss the contributions of this study from theoretical and methodological perspectives.

4.5.3 Theoretical considerations

Theory can help explain some of the proposed reasons underlying KT network structure. Social capital theory purports that actors seek ties that facilitate certain actions, such as access to beneficial knowledge or resources. This social capital exists in the ties between individuals, such that the resources can be exchanged. In other words, the structure of the network is what functions to generate social capital. For example, the position of a broker affords him/her social capital to access multiple subgroups, and to act as the bridge or gatekeeper of information flow between them.

Participants’ accounts of the reasons for network structure appear to support the premise that they connect with others in the network to access expertise, resources or supports from others, as well as to connect with the power that is inherent in certain roles (e.g. leaders) that would enable engagement in KT. Network members leverage peers in their own networks to reach others with the capacity to facilitate KT (e.g. those with relevant evidence, access to stakeholder groups). In cases where participants had adequate access to information, supports or opportunities, they reported feeling more confident in the size or connectivity of their ego-networks. This confidence may reflect their awareness of the social capital they have. Organizational or whole-network supports may help to improve equity for network members with less social capital, by establishing a network structure that enables common pathways to resources and evidence, and by raising awareness of these routes to improve access to them by all members. However, in addition to these access channels, the development of trust,
expectations related to the flow of resources, and obligations to others are considered foundational elements of a social capital system. Both individual and organizational responsibilities to establish and support these foundations may facilitate a system by which social capital can be leveraged to facilitate efficient and effective KT.

A KT facilitator at the organizational level included the delineation of roles with responsibilities for KT and network development, whether or not these tasks were ascribed to formal job descriptions. While some individuals will continue to hold greater social capital than others as brokers because of the nature of their personalities, attitudes, expertise, experience or roles, for the most part, they possessed characteristics that drove them to share this benefit with others. Targeted strategies by both individual network members and the organization can be carried out to improve equitable access to social capital, and to leverage its potential to advance KT goals.

Social influence theory argues that actors’ beliefs and behaviours come about to some extent because of the interactions they have with others in their networks. For example, factors, such as colleagues’ attitudes and values, or their KT-related behaviours (e.g. participation in KT activities, championing change, creating or maintaining connections with others) may spread through diffusion to others. These influences may come from peers, leaders, KT support personnel, or other stakeholder groups (e.g. researchers, families). Individual actions, as well as organizational strategies to foster a culture of KT or to co-locate specific individuals to take advantage of this diffusion process may be valuable in augmenting and spreading social influence to enhance access and use of evidence within the network.

Several restrictions to network development or maintenance were also identified. These factors included logistics, such as incongruent staff schedules, the limited social capital within
the network with respect to specialized expertise, mandates and priorities that hindered engagement in KT processes, and inadequate resources. While proximity facilitated network development and maintenance for some subgroups (e.g. clinical programs or teams), it also appeared to interfere with heterophilous ties between stakeholder groups, as well as homophilous ties among discipline groups. The principle of homophily asserts that actors have a preferential tendency to form ties with peers who share similar characteristics. These characteristics include gender, age, education, profession, behaviours, attitudes and values, among others; their number and manifestation in tie formation tendencies within different environments create complexity in understanding their interplay in a given context. Nonetheless, these theoretical tendencies to connect with similar others can be factored into organizational decision-making with respect to the co-location of staff, while considering the real-world impacts of these decisions on KT processes and outcomes from the perspectives of network members.

4.5.4 Methodological considerations

Participants’ considerations of the accuracy of the network data were astute, given their lack of training in SNA methodology. Non-response, interpretation, social desirability, and recall biases are valid considerations in SNA research. The overview of frequently examined network properties, including network size, tie direction, centrality, density, subgroups and isolates, appeared to support them in understanding the concepts, and communicating effectively about network influences. Some participants drew on their knowledge of their own ego-networks as a means of considering how non-respondents and survey item interpretation may have influenced the structure presented to them visually.
The strong response rate paired with the capacity of name generator questions to yield data from survey respondents about non-respondents in the network strengthened the validity of the data set. Regardless of potential error from non-response bias, recall bias or misinterpretation, the nature of the research questions being answered meant that the integrity of the research was unlikely to be compromised by measurement error or response bias. Namely, participants were asked to describe the reasons for common network properties or positions (e.g. isolates, high centrality, subgroups) and their impacts on KT, which did not necessitate 100% accuracy in the whole network diagram.

Additionally, participants were afforded the opportunity to describe proposed corrections to their ego-networks during the discussion to clarify their experiences and perceptions. This discussion allowed me to reflect on the wording of survey items so as to capture more accurately the network’s structure in future studies. For instance, providing examples of the nature of the ‘evidence’ being shared or sought, and specifying the frequency of interactions (e.g. weekly versus once per month or less) may have contributed to a more consistent interpretation of the name generator questions. The use of network graphs may be helpful in future mixed-methods SNA research as a method of enriching the quality of the data to understand more clearly participants’ experiences within the network.

The exploration of the network maps during the interview process provided participants with the opportunity to conceptualize their roles or positions within the network, to gain a basic understanding of the potential structural significance of these roles, and to express their perceptions about the influence of the identified network properties on KT. Gaining interviewees’ insights about how well the quantitative results aligned with their experiences, and which factors influencing KT were not represented on the network map was critical for
understanding how best to support KT in these settings. The network map also stimulated questions and reflection from participants to aid their understanding of the boundaries of the network, their roles within it, and the implications of these roles. This learning may have enhanced their perceived capacity to access or to mobilize knowledge within the network, or encouraged reflection about how they might take steps to strengthen the network.

4.5.5 Ethical considerations

Although the topic of my research was not overtly sensitive in its nature, I did explore workplace attitudes, behaviours and relationships, which may have been seen as personal to some participants. The informed consent process ensured that participants understood that the information they shared would remain confidential, and that any identifying information from their statements will not be included in presentations or publications.

Informed consent in SNA research poses challenges because consenting participants are asked to name their own network connections, some of whom may not have consented to participate themselves. Similarly, people with knowledge of the network may be able to identify certain individuals in the network visualizations, because of their positions in the network or the structure of the relationships surrounding them. To mitigate these challenges, I coded each actor and alter prior to analysis, to help maintain confidentiality and privacy for network members. Only de-identified data are being shared during post-study KT activities. Participants were informed of the risks of participating and of the actions being taken by the research team to preserve their anonymity during the informed consent process.

Some participants may have perceived the potential for misuse of the information gathered during Study 3, because of its value to management. Management at the participating
research site may be interested in the data for its potential to be used as a measure of the contributions of individual staff members to KT and EIHC. This information could be used to influence performance reviews, resources allocation and human resource decisions. To mitigate this risk, I developed a knowledge-sharing contract with management prior to recruitment that outlined the specific information to which they will have access, and for what purposes. In the interest of transparency, this contract was made available to participants to assist them in making informed decisions about the consent process, as well as to feel comfortable sharing their experiences during data gathering without threat of recourse by their employer.

4.5.6 Future directions

Participant-generated hypotheses about KT and network influences can be tested to provide a greater depth of understanding about the role of network structure on KT. Supplemental survey data can be used to examine the relative influence of various attributes on network structure, including KT experience levels, confidence with KT, and tenure in the organization. Additional qualitative data will be analyzed to impart participants’ ideas about potential strategies to target the network influences on KT that were identified here.

The findings of this research can be applied to extend the nature of the barriers and facilitators to KT included in future studies. The methods, including the use of visualizations to support the interview process, can also be employed to achieve similar aims in other projects. Additional learning from engaging participants to support the identification of potential strategies for them to make changes to their individual and whole network through the reflective application of these visualizations, including the perceived utility of the visualizations in
supporting this process, and the research questions that emerged as the result of their guided reflections, will be presented in a future publication.

4.6 Conclusion

This is the first study to describe and to confirm the influence of networks on KT in paediatric healthcare and research organizations. The findings of this research support the notion that KT is a social process that involves individual, relational and contextual (in this case network) influences and determinants. These influences on network structure, and the corresponding influence of this structure on KT processes can be considered in the design of future KT research. Including network factors in the process of assessing barriers and facilitators of change, and designing network interventions to support implementation are two logical applications of this work. The qualitative processes used in this study offered a unique approach to network research that can improve the relevance and potential success of network interventions. The use of visualizations of the network can also support the gathering of valuable qualitative participant data from a network perspective in subsequent multi- and mixed-methods SNA research.
Chapter 5: Study #3b: Organizational network strategies for KT support

5.1 Synopsis

The perspectives I gathered from network members about the influences of KT structures on KT helped to reinforce the value of SNA for organizational KT research. The individual, relational and whole network factors that were proposed to influence a person’s network position augmented my understanding of the value of network-specific organizational KT supports, and their proposed mechanisms of action. Qualitative methods enabled the gathering of these insights, which can now be integrated with the findings of the environmental scan to inform the development of network-specific interventions to support KT. This final empirical chapter serves to present additional qualitative data focused on network-driven strategies to support KT. These strategies were drawn from the participant interviews described in the previous chapter. While the utility and effectiveness of these proposed strategies have yet to be tested, they build upon the strategies identified in Chapter 3. The addition of a network lens in the current chapter offers a unique approach to informing the development of organizational supports for KT.

5.2 Background

One of the primary considerations for effective KT between the research and policy contexts is ensuring effective interactions. The need to choose the right messenger highlights key relational factors at play between the parties, such as credibility, and individual factors, such as strong communication skills. However, when KT in the clinical context is discussed, factors, such as access to resources, time constraints, and positive attitudes prevail as the prominent considerations. In both instances, people are coming together, with at least one
party typically hoping to effect change. While the contextual factors may be different in these settings, social dynamics are embedded in the change process.

A network lens can be applied to any context in which a group of individuals or entities interacts. While SNA can be used to describe that context and to evaluate network properties as indicators of change, the approach also has a role to play in designing KT interventions. A common KT model in the policy sphere defines three types of interventions approaches, which aim to “push” knowledge out to end-users, “pull” knowledge in from researchers, or to encourage knowledge “exchange” through interactions. Knowledge of network structure can help to identify the best channels or groupings to facilitate these aims.

Similarly, traditional KT strategies, such as educational workshops, can be delivered to address the barrier of a lack of knowledge. However, SNA may be used to identify opinion leaders based on peer ratings, who collectively cover the breadth of the network, for a train-the-trainer approach. As a final example, a network perspective may be applied to a conventional KT intervention in such a way that its mechanisms of action are distinguished based on an understanding of the network dynamic. Restructuring the environment so that resources are accessible to network members with extensive reach may facilitate their effective distribution.

This type of divergent thinking is the focus of this chapter, which reports on additional findings from the qualitative interview data gathered during the SNA case study. The qualitative approach I used to gather this data is an unconventional way to facilitate the design of network interventions. However, this approach was powerful because it leveraged the contextual expertise network members have amassed through their lived experience of being immersed in the network. These individuals have spent months or years observing and experiencing their colleagues’ interactions, navigating the social dynamics, and facing the network’s challenges. By
affording them a network lens through the use of visual tools, they have the potential to offer valuable insights that can inform the design of appropriate and effective network interventions. Overlaying the existing organizational supports identified during the environmental scan enables an alternative, network-focused way of conceptualizing those strategies and their potential mechanisms of action.

The purpose of this study was to employ a network perspective, drawing on participant engagement during the interview process as described in section 4.3.1, to identify potential network interventions to support KT at the organizational or whole-network level.

5.3 Methods

This chapter describes qualitative findings of the mixed-methods SNA descriptive case study described in Chapter 4. Refer to the Methods in Section 4.3 to review the relevant qualitative methodology. I mapped the findings from the environmental scan reported in Chapter 3, with regard to existing organizational KT supports in place in paediatric AHSCs and their affiliated research institutes, a posteriori to the themes emerging from the qualitative data presented here. The environmental scan methods can be reviewed in Chapter 3, Section 3.3.

5.3.1 Research question

The research question that guided the study was:

1. What network-related strategies do network members propose at the organizational level to support KT?
5.4 Results and discussion

5.4.1 Participant demographics

Interview participant demographics are described in Chapter 4, Section 4.4.1. Environmental scan survey participant demographics are described in Chapter 3, Section 3.4.1. The estimated response rate of 47% was high compared to the mean organizational survey response rate in the literature of 35%. SNA research suggests that survey non-response is associated with underestimates of centrality (particularly indegree). However, for the analyses presented in this section, centrality was considered only as a means of recruiting people with diverse positions in the network (i.e. isolates, highest centrality, and mid-range positions). This method served to identify multiple interview participants from each category and allowed them to share their perceptions of KT network isolation or connectivity, and speak to their potential impacts. The relatively high response rate also augmented the accuracy of the network data. Interview participation across all roles and clinical programs, and nearly all professions yielded experiences originating from various disciplinary, clinical program- and research team-based subgroups within the network to promote diversity of perspectives.

5.4.2 Participant-proposed organizational strategies for KT

Multiple whole-network strategies were identified to strengthen the network in order to improve KT capacity and the organizational culture for KT. Six themes emerged that categorized the identified strategies that could be enacted at the organizational level to support KT. These themes were 1) Systematize; 2) Transmit; 3) Resource; 4) Invest; 5) Value; and 6) Evaluate. This proposed STRIVE model of supporting organizational KT is illustrated in Figure 10. These
strategies were seen as relevant in addressing individual, relational and organizational environment considerations.

Figure 10. The proposed STRIVE model of organizational-level network strategies to support knowledge translation

‘STRIVE’ is defined as “devoting serious effort or energy; to endeavour.” This definition reflects aptly the organizational commitment required to overcome the barriers of moving evidence into action. A network lens provided a novel way of conceptualizing KT supports by emphasizing the social mechanisms by which KT processes are enacted. These KT
interventions aim to increase ties, dialogue and trust between colleagues and stakeholder groups as a means of generating shared language and values, of promoting opportunities for access to research and for evidence use, and of strengthening a culture of KT. Longer supporting quotes for each theme’s subthemes are presented in Table 7.
Table 7. Supporting quotes for each STRIVE model theme

<table>
<thead>
<tr>
<th>Theme or subtheme</th>
<th>Quote #</th>
<th>Supporting participant quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Systematize</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Co-location</strong></td>
<td>1</td>
<td>…having [KT support personnel] very central and on-site is helpful, because quite often…I’d walk by the library and see them and I’m like ‘oh yeah - I wanted to go get that article,’ or ‘oh I wonder if they can help me with that.’ If I didn’t see them I don’t know that they would be on my mind as a resource to use, so having them visible and having them here and having them come to [program, department or site-wide meetings] where they’re letting everyone know [how they can help] on a larger scale. [26], clinician</td>
</tr>
<tr>
<td><strong>Frameworks</strong></td>
<td>2</td>
<td>[what’s needed is] a common framework, a common language - something that is simple. And even how to approach a piece of literature. If we all had that wherewithal, that would build confidence, too. And then it would probably precipitate more of that [KT] capacity. [29], leader</td>
</tr>
<tr>
<td><strong>Structured</strong></td>
<td>3</td>
<td>I wonder about linking people more - a way of linking people to each other rather than just word of mouth. Having more designated people that - it’s an expectation of their job, that they will answer questions like this and these are the people that you can go to if you have questions about X, Y and Z. Because I don’t ask people questions about areas until I’ve worked with them, and maybe we could make that happen a little bit more formally. [12], clinician-leader</td>
</tr>
<tr>
<td><strong>communication</strong></td>
<td>4</td>
<td>Yes, you can use the Internet, you can use the technology that we have, but there’s something to be said for being there in a room with people, and talking and reflecting and learning more. It’s just so much more powerful, for me, anyway. I’m of the older generation where I don’t do as well online and using technology. I do better with face-to-face. [13], clinician</td>
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<tr>
<td><strong>pathways</strong></td>
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<tr>
<td><strong>Forums</strong></td>
<td>5</td>
<td>I would rather see us all coming together for a consortium or planning day, and learn who we are, put the faces to the names, go around the table talk about the topics that are hot right now, and the linkages. So bring in the researchers, bring in professional practice, bring in the key leaders that would need to know that information. Linkage and exchange. [5], leader</td>
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<td></td>
<td>6</td>
<td>One of the things that we’ve lost [is] our huddles… I’ll walk down the hall and [a different clinical program] will have their group in front of their board, and I think ‘oh yea, that’s what they’re doing, they’re connecting up, they’re sharing information about what they’re each working on and how the program is going and what needs to be done, what’s worked and what hasn’t worked.’ And that’s meaningful. [13], clinician</td>
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<td></td>
<td>7</td>
<td>It’s only every second year that we have opportunities through the [KT support unit] to bring people</td>
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164
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<thead>
<tr>
<th>Theme or subtheme</th>
<th>Quote #</th>
<th>Supporting participant quotes</th>
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<tr>
<td>Theme or subtheme</td>
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<td>Supporting participant quotes</td>
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<tr>
<td>Support for team functioning</td>
<td>8</td>
<td>If you’re working within a functioning supportive team context, then that’s a place where you can share ideas, share things and they’ll look at how they’re clinically applicable in your area or how you could implement them as a team, and you can also support each other in that as well. [2], clinician</td>
</tr>
<tr>
<td>Transmit</td>
<td>Convey network structure, roles &amp; expertise</td>
<td>9</td>
</tr>
<tr>
<td>Communicate the availability of supports</td>
<td>10</td>
<td>I would have suggested that there’s a perception that a lot of our resources and our supports were more oriented to therapists, but I’ve just received anonymous feedback that suggests that they think it’s really more for physicians. So there may be differing perceptions on who uses the available supports. [1], KT support person</td>
</tr>
<tr>
<td>Transfer contextual knowledge</td>
<td>11</td>
<td>I would like to think that patients and families coming to [the organization] know about the [KT support unit] and use it. I’m not sure if they are using that to the full, so that it would be interesting to ask them how have they seen [the organization] and [its] resources as ways of getting information…They should be using the resources we have set up, but whether they are, I’m not sure. [17], clinician-researcher</td>
</tr>
<tr>
<td>Raise awareness of evidence and KT activities</td>
<td>12</td>
<td>I think [the knowledge brokers] have an essential role in [raising awareness of what is going on at the team/program or discipline level], and in facilitating that, and often can play a real role in bringing the right stakeholders together, in terms of assessing barriers and facilitators of change. [11], KT support person</td>
</tr>
<tr>
<td>Raise awareness of evidence and KT activities</td>
<td>13</td>
<td>I think [we need] more transparency around the work being done at each organization. There’s a lot of information on how clinical practice is being operationalized. There’s not a lot about how that’s being supported, like the infrastructure behind that and the infrastructure behind the research [institute]. So you might be able to see some of the products that come out of that and how the work is being done, but you don’t see how it has been brought to support that. [1], KT support person</td>
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<td>Supporting participant quotes</td>
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<tr>
<td><strong>Resource</strong></td>
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<tr>
<td>Library collection</td>
<td>14</td>
<td>I don’t know if they’ve done it yet, but for us even having the ability to access [the scientific literature] freely - like once upon a time we couldn’t even access [the affiliated university] library as an [healthcare centre] employee...I don’t know if we have that yet fully, because often I find myself still going to [the clinical librarian] for certain things. [29], leader</td>
</tr>
<tr>
<td>Knowledge products, tools and resources</td>
<td>15</td>
<td>We’re such a diverse group of people…[therein] lies the challenge of how you create a support for KT, when every single project looks so different in terms of what KT we need. I don’t know that there can be this standardized process, so I think probably the most important part is a bank of resources. And disseminating those resources so people know where they can go and they can cater to their specific needs of KT. [18], research trainee</td>
</tr>
<tr>
<td><strong>Invest</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Roles and personnel</td>
<td>16</td>
<td>[Our program] actually ha[s] a director of health literacy, we have a whole team that works on that, that’s their expertise, and we have benefited from that. And I say we, but the province has benefited from that because we have made resources available provincially, and we take that role pretty seriously. [28], researcher</td>
</tr>
<tr>
<td>Funding</td>
<td>17</td>
<td>In healthcare it’s really hard to find funding to support [relationship building for KT]. We have it here in mental health through provincial KT networks that we’ve developed, but they’ve been really hard to keep. And the supports – the people supports for those networks – have been trimmed, trimmed, trimmed over time. [28], researcher</td>
</tr>
<tr>
<td><strong>Food</strong></td>
<td>18</td>
<td>Ideally, if you buy them lunch or coffee and cookies, you will have attracted more people. [20]</td>
</tr>
<tr>
<td><strong>Roles and personnel</strong></td>
<td>19</td>
<td>I wouldn’t know how to start something like that [implementing evidence] or where to go from it. And then there also hasn’t been external interests coming in and going ‘hey, what about some support around our little inpatient unit to say, you know, ‘should we look at some other studies?’ And we have talked about it over the years with different managers, but we have just never had the time or the resources. [13], clinician</td>
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<td></td>
<td>20</td>
<td>I think if one wants to be a leader, [KT] needs to be embedded within that role. In this day and age, we cannot expect old fashioned-model leaders where they’re the expert in a specific area. They also have to be a connector for staff – especially in this type of organization where there are…layers from staff leaders to higher leaders to higher leaders. You have to have that – you have to be that connection – that mesh in between, that pulls people together. [5], leader</td>
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<tr>
<td>Capacity building</td>
<td>21</td>
<td>It does help when there is a champion for evidence and research. Often you will find that there’s an educator, say in a [discipline] group, whose job it is to come up with easier or better or knowledge-based ways to do things, and they will go and show the other [clinicians] how to do it…I do really see that having one person who’s job is dedicated to reading the new research and then simplifying it in such a way that everybody can understand it and then everyone gets paid to hear about it - that to me is my little shining light on the clinical side, and often it’s one of the only times that I see research being brought into the clinical skills. [20], researcher-clinician</td>
</tr>
<tr>
<td>Specialized KT initiatives</td>
<td>22</td>
<td>I don’t have the tools and don’t do really anything about that as a person, to change that or to improve that, so I think that would be one way, my own sort of lack of knowledge impedes me from being a better participator in it. [15], leader</td>
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<tr>
<td>Capacity building</td>
<td>23</td>
<td>On a most basic level, it’s that structure was put into place – that we were all given the titles of knowledge brokers. There was protected time. Because it has been - and I still feel now - it’s still valued. That has really encouraged me to try and do the best job I can – use the tools that are there, and continue to improve my abilities and develop new skills. [3], knowledge broker/clinician</td>
</tr>
<tr>
<td>Capacity building</td>
<td>24</td>
<td>She was here for many, many decades - had such a strong commitment to the kids and families that we serve…And so she was quite supportive of any initiative to expand [our] knowledge and expertise. When that role was eliminated, there was no one that filled that vacuum. It all has to be self-generated. [19], clinician</td>
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<tr>
<td>Value KT</td>
<td>25</td>
<td>Having leadership encourage there to even be connections and groups working together, that was a big shift for me, because I’d been working as a therapist for over 30 years. So in the past it, was very informal, and I think we would have broader goals, but it wasn’t as targeted in terms of knowing that what we’re doing is trying to move knowledge along and evidence along to inform best practice. So I think having the [KT support unit] and the tools there, and more important than the tools is the people that are part of the [KT support unit], supporting and mentoring both knowledge brokers and [clinicians] in general. [3], knowledge broker/clinician</td>
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<tr>
<td>Policies</td>
<td>26</td>
<td>I personally feel if the organization values evidence-informed practice that we should all have an earmarked amount of time - and I don’t know what that would be - to do things like work on specific projects, or have time where you are able to do a literature search or read articles. And that involves having a lower caseload, so more therapists in this particular context - or more technicians - so that you</td>
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<td>Theme or subtheme</td>
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<tr>
<td>Visible modeling</td>
<td>27</td>
<td>I think that number one, the leadership has to support it and also model it…And that takes time and money, and also buy-in. I think that people have tried to [make] evidence for practice [part of the culture], when everybody says its important and we should be doing it. But then there’s no real infrastructure behind that, and also there are no examples behind it for people to see, from leadership. [1], KT support person</td>
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<td>Recognition</td>
<td>28</td>
<td>I was involved in a couple of little research projects that we initiated all on our own, that we got no formal support for. That we got minimal acknowledgment or recognition for, going forward. And the system really didn’t convey much value or appreciation for it. [19], clinician</td>
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<td><strong>Evaluate</strong></td>
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<tr>
<td>Network structure,</td>
<td>29</td>
<td>I wonder if there’s a way to identify why people don’t have a broader list of people that they would approach. Is it that they don’t know who, or they think they’ll be bothering people, or that they’re not sure if they’re going to look like it’s a dumb question, and the person doesn’t have time? [12], clinician-leader</td>
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<tr>
<td>barriers and support</td>
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<td>And then…trusting and seeing the outcome – that is circles back. Because a lot of times you don’t see the monitoring and sustaining of evidence use…So then the next time something happens, you’re like ‘why bother,’ because nothing comes. So you start to lose trust in the whole process. [28], leader</td>
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<td>needs</td>
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<tr>
<td>KT evaluation</td>
<td>30</td>
<td>Maybe more polling of what people on the ground feel about what research should really be looking at or what is pressing at the moment. [For] example, do we need more [surveys] around whether the process for bringing in families to talk about their issues and get support and link to community? Should we see if that’s actually working?… I never know if what I’m doing is helpful. There’s no process to find that out. [27], clinician</td>
</tr>
<tr>
<td>Clinical evaluation</td>
<td>31</td>
<td>We need more communication between the network in a somewhat centralized way so it makes it more equitable because it definitely feels within this network that there are inequities in accessing resources, which then feeds into how knowledge translation can be operationalized. Because…if people don’t have access to the same things that others do, then you build walls. [1], KT support person</td>
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5.4.2.1 Systematize

The theme of ‘Systematize’ relates to establishing mechanisms by which the organization would champion network development to strengthen individual and organizational capacity for KT. One KT support person spoke of an ideal network in which all members were connected and engaged in KT: “We want to include everybody, ideally. So working on some kind of infrastructure in order to help that happen” [1] The proposed mechanisms by which the organization could facilitate network development included organizing processes and pathways for communication, collaboration and KT.

Previous SNA literature suggests that connections between subgroups (e.g. teams or departments) are influenced largely by the individual ties established by staff, the need for them to connect to carry out their roles, and processes and ‘control mechanisms’ driven by the organization. \(^{156}\) Links between subgroups may enhance performance, innovation, and sharing of complex knowledge. \(^{156}\) This research reinforces the role of organizations in actively changing network structure, to decrease the burden on individuals, and to stimulate network connections that otherwise may not be occur, given the pervasive lack of network awareness of the network.

The set-up of the physical environment was highlighted as a network-driven means of facilitating evidence use in the midst of high workloads and multiple demands. Ready access, and visual reminders of the availability of KT support personnel helped to cue one clinician to integrate seeking evidence and learning about KT into her daily work life [see quote 1, Table 7]. Steps taken by the organization to co-locate staff members within the organization were perceived as both facilitating and hindering KT. Co-location has been associated with enhanced trust and performance, knowledge sharing, learning, speed of decision-making, and innovation. \(^{157}\) A previous shift at the health centre from discipline- to program-based seating
arrangements was made to align with the service delivery model. This shift was reported by one clinician to have led to changes in network dynamics over time such that previous strong ties to colleagues from the same discipline were weakened. This change resulted in greater challenges in accessing clinical advice, expertise and evidence from a discipline perspective, but more opportunity to collaborate inter-professionally around specific client cases and operational processes. Four participants suggested the co-location of the health centre and research institute at the same campus to be a future potential facilitator for KT. One researcher also suggested exploring co-location options that could bring together researchers, family engagement personnel and decision-makers to facilitate stakeholder engagement for research and KT.

A sizeable body of research examines the influence of geographical proximity on tie formation. Of particular relevance is a study by Currie and White, in which co-location within an organization was mandated according to similarity in professional discipline rather than by inter-professional clinical program, demonstrated that knowledge sharing across the network (i.e. between disciplines) was still significant. Individuals appeared driven to seek out inter-professional contacts to meet their informational needs in this context, which was described as a ‘strong’ and interactive network. A comparative analysis of discipline- versus program/team-based tie homophily may be used to determine the extent to which this structural pattern exists in the current network. Because the generalizability of SNA case studies is limited, larger-scale research about the impacts of discipline- versus program-based co-location strategies on evidence uptake, as well as on stakeholder collaboration, is required for this purpose.

One of the precursors of ties across organizational boundaries (e.g. health centres and their affiliated research institutes) is organizational aims (e.g. to access resources, minimize uncertainty, boost perceived legitimacy, achieve shared goals). Although interview
participants identified learning opportunities that were accessible to both sites, other KT supports were accessible only to a single site. The extent to which discussions among site directors had taken place to explore opportunities and benefits of addressing collective aims through formal network ties and shared resources was not addressed in this research, as no directors engaged as participants. The environmental scan provides a starting point for further study of health centre-research institute dyads that share and do not share a campus to discern the relative influence of proximity on network structure, and the collaborative efforts in place to support inter-organizational KT.

Frameworks for KT and evidence-informed practice were also seen as valuable in facilitating consistency in shared processes and interactions. One knowledge broker mentioned the KT support unit-generated online resources for streamlining evidence-informed practice and KT processes, which she used with her clinical group. One leader identified the need for this type of resource, as well as for education to support its implementation across the network [see quote 2, Table 7]. KT and evidence-informed practice frameworks can support consistency in processes and interactions by affording a shared language, predictable steps, quality standards, and guidance for evaluation efforts.\textsuperscript{22,159}

A pervasive sentiment expressed by fifteen participants was the need for more communication, both within and between stakeholder groups (e.g. researchers, clinicians, leaders). Various methods of sharing evidence were reported by network members, including group presentations, discussions, and electronic messaging. For example, while one subgroup within the network already had an established point-person who compiled and shared evidence in-person or through email correspondence within her group, two clinicians expressed the need to have a way to organize this information, for example, in a central database, to support retrieval
as clinical need for it arose. This strategy may decrease burden on recipients to connect with others for information, thereby augmenting capacity for other ties.

This centralization of communication pathways was identified as a way to improve equity within the network with respect to accessing resources and operationalizing KT. One suggestion from a clinician-leader was for organizational support to identify key brokers for different subgroups, clinical topics or KT processes to strengthen the network and facilitate information flow. Building responsibilities and capacity into these individuals’ job descriptions and FTE was seen as a realistic way of enabling this function [see quote 3, Table 7]. Closeness centrality (i.e. actors positioned such that they are able to efficiently reach all others in the network) has been shown by Jippes et al.\textsuperscript{160} to be strongly associated with the adoption of new practices. The finding that closeness centrality appears to be more important than education and training in driving adoption supports the facilitating role network development can play in supporting KT at an organizational or whole-network level.

Although structured communication pathways can be valuable as a means of exchanging information, twelve participants identified the act of physically coming together to connect and to collaborate as an important process. For three participants, in-person networking was preferred over online methods, and was considered to enhance the ability to participate [see quote 4, Table 7]. The organization-led coordination and sanctioning of forums to support the network was suggested to address the lack of awareness network members had of who existed across organizations, and even within an organization. Social opportunities, meetings, workshops and regular research seminars were suggested as options to bridge researchers and clinicians, as well as to expand networks within each of these domains. The perceived benefits of these forums included reducing the time and effort currently required by individuals to have to seek out their
own connections, and exposing staff to individuals with whom they might not have had the opportunity to interact with in the course of their daily work. One leader shared her preferences [see quote 5, Table 7]. A small SNA study on single conference attendance by health professionals and researchers found no increase in individual network size, but maintenance of centrality six months post-conference.\textsuperscript{161} Network development patterns at these events may differ for individuals in specialized areas, who rely on external contacts to expand their knowledge base as suggested by twelve participants in this study. Event design (e.g. didactic nature hindering interaction and trust development),\textsuperscript{161} and the existence of shared goals surrounding research, clinical care or KT collaboration may be key factors in the carryover of ties.

One clinician described her program’s use of ‘Edu-Quick’ sessions to share knowledge, and the re-establishment of an education committee to address the knowledge needs of program staff. One of the roles of the committee was to gather evidence and to bring in experts on relevant topics. She also expressed a sense of loss at the lack of consistency of program huddles, which brought staff together on a scheduled basis for knowledge exchange [see quote 6, Table 7]. Another forum that was valued was a formal event coordinated by the KT support unit showcased current research, KT and innovation of relevance to network members. While this forum addressed these topics in a way that other site-wide meetings did not, one KT support person considered its infrequency a limitation [see quote 7, Table 7].

Once a subgroup in the network had been established, whether a clinical team or program, a discipline group, an implementation or researcher team or a group of stakeholders with shared goals, organizational support was desired to support group dynamics. One network member spoke of the erroneous assumption that effective collaboration was a given once
individuals came together. Conversely, one clinician pointed out the advantages of a functional team dynamic, which included open communication, collaborative actions to promote successful evidence implementation, and a sense of community [see quote 8, Table 7]. Cranley et al. described how a safe environment afforded a feeling of community and a shared understanding that was seen to strengthen the EIHC network in a long-term care setting. Subgroups throughout the network may differ in their collaborative skills and interpersonal dynamics, and therefore may have unique support needs.

5.4.2.2 Transmit

The ‘Transmit’ theme conveys the perceived need for the organization to communicate to the network its valuing of KT, the availability of supports, evidence and ongoing KT activities, as well as contextual knowledge that could support KT processes across sectors.

Seven network members identified a need to understand more clearly the network structure, and the roles and resources that were held within it. Five participants described the value of network-level information or pathways for accessing specific information, expertise or skills. This knowledge would allow network members to understand the sources of specific information that had been shared, as well as to seek out required resources. One leader suggested her work in directing families to the right people with the required knowledge would be easier “if I had access to the framework of where you can access information - so if there were a process chart, and [you] wanted to know this, you’d know who to contact or what the next steps would be.” [9] Another leader suggested an online module for staff orientation to the network. A research trainee also considered this lack of communication structure a gap, with respect to supporting stakeholder engagement and other KT processes within the network.
Five participants described how they or their colleagues either lacked of awareness of the available supports for KT, or lacked of awareness that they were eligible to access them, as observed by one KT support person [see quote 10, Table 7]. Similarly, questions arose around the availability of existing resources for families, such as a resource website, a website describing the clinical services, and awareness of or access to the services of the KT support unit. One clinician-researcher saw the value of access to the KT support unit for families [see quote 11, Table 7].

Identifying specific individuals or roles within network subgroups can assist in fostering the flow of information stemming from discipline groups, programs and teams. Transmitting this information between or to individuals charged with supporting or overseeing KT processes was seen as a way of supporting the streamlining of these processes, the reporting of outcomes, and the planning of KT interventions. One KT support person related the advantages to this approach [see quote 12, Table 7]. Optimizing this learning was also perceived to require working across the healthcare and research organizations.

Two clinical sector participants perceived that the staff was encouraged to communicate with their clients and families, and the organizations in the community. One participant perceived a huge emphasis by the organization on ensuring people were aware of operational processes and changes. However, one KT support person did not observe the same level of communication with respect to evidence-informed practice and KT [see quote 13, Table 7]. Nonetheless, another clinician appreciated the site-wide newsletters generated by the KT support unit: “The emails that come out are helpful, because [they] give you ideas about how you could access more evidence and more knowledge.” [26] Clearly, widespread communication campaigns are required to improve the efficiency and equity of access to network assets,
Including among teams, programs and organizations. Exchanging information, including contextual knowledge, processes being used, and activities being conducted, may enhance the quality and efficiency of KT. In addition to higher network density, the awareness of network expertise and resources was identified by Long and colleagues as a predictor of KT involvement.\textsuperscript{48} This finding lends support to organizational involvement in developing the network and in communicating about network structure to staff as a means of fostering KT engagement.

5.4.2.3 Resource

The ‘Resource’ theme highlights the perceived value of various resources offered or organized by the organization to support access to and use of evidence, and engagement in KT activities and competency development. In situations where these resources are not available from within the network, the organizational leadership could take steps to coordinate access through its external network.

Access to evidence was identified as a barrier to evidence use by eighteen participants, including two researchers, two trainees, four leaders, three KT support personnel, one technology support person, and six clinicians; poor access to evidence is a commonly identified barrier in the literature.\textsuperscript{163,164} Because of licensing regulations, staff at the organization, which was a teaching hospital affiliated with a large local university, did not have access to the university’s library collection unless they held academic appointments. A provincial resource through the health authority afforded them access to some health literature databases, but others were restricted. Access to the scientific literature has been confirmed by Ellen and colleagues\textsuperscript{36} as a foundational requirement for evidence use at the organizational level. In the absence of this resource, one
leader, had to rely on her network to make attempts to access the literature [see quote 14, Table 7]. Increased communication with network members about the available routes for accessing research findings appears to be warranted, based on the existing lack of awareness, and inconsistent access behaviours across the network of the available supports.

Knowledge products and tools were desired by ten participants to support KT within the health centre, in the community and for patients and families. Also of interest were resources to support learning about how to engage industry stakeholders, or to involve the media in KT. The desired content included how to begin these processes, and the best methods to use for any given project, as well as how to identify the personnel who could support each one. One trainee explained how this type of support would help build the KT network [see quote 15, Table 7]. One clinician identified the need for a family-based website so that all families would have access to relevant evidence regardless of the information-sharing behaviours of their assigned clinicians. Six participants valued the existing online resources to support evidence-informed practice, KT or research, while one researcher spoke of the provincial impact that organizational support for resource development had afforded her team [see quote 16, Table 7]. Collaboration with network members is recommended to ensure that their knowledge needs will be met through the tailoring of new resource development to address priority gaps. Additional transmission within the network about existing resources, and linking members to external resources may help to expand their use and address the capacity limitations described by KT support personnel.

Funding is required to enact the policies related to attending KT events, the hiring of support personnel, the creation of resources and other strategies described here. However, one researcher with experience fostering the development of a national KT network raised the need
for specific funding for this purpose, and the challenges the network has faced with respect to sustainability [see quote 17, Table 7]. The high need for personnel support to sustain a KT network was reinforced by another researcher, who had previously held the role of network coordinator. Her narrative made it clear that this position as the network hub was critical in moving KT progress forward. Funding limitations will necessitate careful prioritization. External sources, including those tapped in the past, such as the hospital’s charitable foundation, research funding or government support, may be required to enable a comprehensive KT support approach.

The availability of food at KT events, such as in-services, lunch-and-learn workshops, meetings and research seminars was identified by one participant as a strategy to attract more people (thereby expanding the network), and to engage them in KT planning, and learning about new equipment, best practices and current evidence [see quote 18, Table 7]. Food has been shown to improve attendance at medical Grand Rounds by physicians, and attendance and arrival promptness by medical residents; however, its impact on knowledge retention, behaviour change and network sustainability is unknown.\textsuperscript{165,166}

\subsection*{5.4.2.4 Invest}

The ‘Invest’ theme brings to the forefront the need to invest in people in order to enable their sustained participation in KT, and the integration of KT best practices. These supports may take the form of specific role descriptions and personnel charged with supporting KT, capacity building opportunities to help network members develop the competencies required for KT, specialized initiatives or services to support KT, and staff retention strategies to help maintain the network.
One clinician-researcher explained that network members wanted to have “more KT infrastructure - people that you can turn to, more transparency about who they are and what they do.” [17] This human resource support was needed to help staff understand the processes involved in KT, to provide guidance on how to develop high quality KT products, to appraise and implement evidence effectively, and to make effecting change feasible. One clinician explained how delegating leadership of the change to program managers, KT support personnel or others would help to address limited clinician capacity and help to maintain momentum [see quote 19, Table 7]. The environmental scan identified five sites with one KT support person, and six sites with teams of two or more staff. Limited information is available about the extent to which these individuals collaborated with others in supporting KT, or how many personnel are needed to meet demand. Future research on network dynamics among these key players could help to inform the design of formal KT support structures.

Defined roles that incorporate KT-focused responsibilities and mandates, and hiring personnel with specific competencies to carry out those roles, were considered by four participants to be critical investments. Key examples of these roles included KT support personnel, program-specific educator positions, and formal leadership roles. One clinician explained the value of efficient access to evidence that augmented her interactions with physicians in advocating for best practices: “[the librarian] has been the most valuable contribution to our ability to do evidence-based practice. Hands down.” [8] One leader described the ideal leadership role in the context of KT [see quote 20, Table 7]. In addition to leading change and guiding the KT process, sixteen participants saw the value in dedicated personnel to facilitate stakeholder engagement, search for, appraise and synthesize evidence, develop knowledge products for various audiences, and deliver training. One researcher-clinician used
the term ‘champion’ to describe this role [see quote 21, Table 7]. Contrary to the findings of Salsbury et al.,\textsuperscript{167} case managers were not identified as facilitators of clinician-family KT in the network under study. The only case manager respondent did not meet inclusion criteria. A closer look at how KT support is understood by healthcare providers, and the differences in job roles across organizations may clarify the reasons for this discrepancy.

In keeping with the prominence of lack of knowledge and skills as a barrier to evidence use,\textsuperscript{164} education represents the most common KT intervention approach in allied health.\textsuperscript{168} Four network members identified gaps in knowledge and skills that, if addressed, would enable their engagement in KT processes. Specific areas for growth included knowledge and skills for clinical practice, evidence-based practice, KT, stakeholder engagement, communication, collaboration, and team functioning. One leader recognized how her limited capacity in KT affected her behaviours [see quote 22, Table 7]. Although theoretical knowledge was helpful, one researcher-clinician also related the need for practical experience that was guided by mentorship or facilitation support as they ventured into KT activities or processes that were new for them. Research by Jippes et al.\textsuperscript{160} suggests that network structure may be more influential than education in supporting the adoption of new practices. A network-strengthening approach to educational interventions may augment their impact. For example, structural brokers could be selected from the network to participate in a train-the-trainer model, and use their central positions to support the spread of the new knowledge or practice. Future research is required to confirm the effectiveness of this approach.

Another organization-specific initiative to support KT was highly valued by seven participants within the network. These individuals related the benefits of a knowledge brokering initiative, by which clinicians were supported to take on the role of knowledge broker, to
facilitate evidence use within their inter-professional teams or discipline groups. These network members reported the knowledge broker roles supported coordinated KT efforts, and increases in knowledge, skills, confidence, access to evidence, and evidence use. One knowledge broker appreciated the opportunity for informal leadership roles, professional development opportunities and a sense of support from the organization [see quote 23, Table 7]. Specialized KT initiatives were also perceived to be of value in the national environmental scan, through the demonstration of organizational commitment, building capacity, and supporting specific KT processes.

Additional initiatives reported in the environmental scan, such as rapid review services, KT-related learning initiatives for students, funded research challenges, and organization-sponsored KT projects may also be worth examining in more detail for their value.

Staff turnover also limited the sustainability of the KT network. The retirement of two leaders who had championed KT within different disciplines left a gap that brought with it a sense of isolation for two participants [see quote 24, Table 7]. Careful selection of leaders that embody these values, the identification of other champions to fill voids, and time and resources put into a consistent process to ensure the hand-over of expert knowledge to colleagues, were discussed to prevent and to address such gaps. Also mentioned were policies and efforts by the organization to preserve the network’s specialized knowledge and skills. Retention strategies, such as flexibility in scheduling, strengthening team functioning, mentoring, leadership behaviour and practices, recognition, and comprehensive orientation may improve network maintenance.\textsuperscript{169} Staff cohesion is considered to influence organizational readiness for KT.\textsuperscript{170} Five participants in the current study who had been in the network or in their roles for periods of 6-18 months described themselves as ‘new’, and reported that this factor limited the size and
reach of their individual networks. Previously proposed Strategize and Transmit strategies may support more expedient integration of new staff.

5.4.2.5 Value

The ‘Value’ theme expresses the desires of network members to be immersed in a strong culture of KT and to experience this culture through the manifestation of leadership behaviours, such as modeling, and recognition for KT, as well as through organizational mandates, policies and strategic objectives that visibly demonstrate that the organization considers KT to be a priority. One newer employee expressed this appreciation for a culture of KT:

[Our former professional practice leader] was very enthusiastic and welcoming, and encouraging people to reach out and do research, and to be the best in their field, both at an academic level, but also at a very real practical level. Those are just stories I’ve heard, whether they’re true or not I don’t know, but I totally respect that, and when I came in, that’s part of what I was signing on to. [14]

Restructuring roles and work demands was proposed by thirteen participants to enable and to recognize the importance of research and KT. One participant highlighted formal and informal role descriptions and mandates as a means of supporting KT and research engagement. A mismatch of organizational and individuals’ professional goals has been identified as a having a negative impact on the use of evidence by staff. This discord is particularly relevant when the organization’s objectives are driven by financial and political considerations, require strict staff compliance to longstanding protocols that lack support from current evidence, and restrict staff autonomy and flexibility to explore new ideas. Operational processes were acknowledged as the current organizational priority by three clinicians, which limited capacity and leadership support for KT-driven goals. When the organization formally mandated and supported KT initiatives, these actions were well received by one knowledge broker [see quote 25, Table 7].
Workload is the most frequently reported organizational barrier to evidence use. Fourteen participants called for organizational policies that acknowledge the time required to access knowledge, and to develop a plan to translate it into practice. One clinician described her vision of a policy for allotted KT time – a ‘research block’ or portion of the FTE hours dedicated to KT [see quote 26, Table 7]. Identifying and fostering individuals’ strengths (e.g. searching for evidence, rallying support, evaluating outcomes, etc.), and infrastructure to help integrate the outputs of this work across the organization may be a consideration.

Policy change to improve access to professional development and continuing education was raised by six participants. This support was seen by one researcher-clinician as a transparent way of demonstrating the valuing of KT: “…you need the administration to be providing support for people to go and learn about [evidence].” [20] Scientific conferences, research seminars, collaborative forums within or across organizations, and professional development sessions provided valued opportunities to gain current evidence for implementation, knowledge and skills required for KT, and expanded networks to support KT.

Modeling of evidence-informed practice behaviours, and transparent discussions about evidence and how it is valued appear to augment the use of evidence use by staff. Twenty-two participants discussed the critical role leadership plays in fostering an environment that enables evidence uptake. Moving past written mandates to observable behaviours that demonstrated the commitment to KT of team leaders, professional practice leaders, program managers, senior leaders and directors was seen as paramount to feeling supported. One KT support person summarized this sentiment [see quote 27, Table 7].

Incentives and recognition delivered by management have been confirmed to reinforce behaviour change related to KT by staff. One clinician communicated a sense of
disappointment at the lack of recognition provided by the organization for the effort and outcomes of KT work, which resulted in lack of faith that future efforts would be treated differently [see quote 28, Table 7]. This lack of “fanfare”, as described by the participant, was most pronounced outside of her own discipline, by clinical program and organizational leaders.

### 5.4.2.6 Evaluate

The ‘Evaluate’ theme suggests a perceived benefit of organization-driven assessment of various phenomena in order to yield insights that can contribute to effectively supporting KT. These phenomena include evaluating network structure, KT support needs, and the effectiveness of KT supports and implementation efforts, as well as monitoring equity within the network.

Evaluating network structure affords network members an understanding of the strengths and gaps that may exist. This knowledge can help individuals access knowledge, resources, and support, and can help organizations take targeted actions within each STRIVE domain. However, the addition of a barriers assessment can provide insight into the factors influencing change (in this case, the reasons for this network structure), and the mechanisms by which they might be improved.26,29 One clinician-leader raised the merits of this process, and pondered how it might be carried out to determine what the barriers to more connectivity might be [see quote 29, Table 7]. Barrier assessments are a key step in the Knowledge to Action Framework.12 However, items in existing measures and frameworks for barrier assessments very rarely address network-related constructs, such as connectivity.172,173 The practice of KT network evaluation is likely as uncommon in healthcare settings, as supported by its absence in the environmental scan findings. Triangulating SNA findings from the perspectives of network members to inform network interventions for KT is likely even less common. This novel approach may be applied across
settings to extend our understanding of the social processes and relational support needs of stakeholders involved in KT.

The importance of measuring the success of KT and sustainability efforts and sharing it with network members was also highlighted by one participant [see quote 30, Table 7]. In addition to providing feedback to staff and leadership to validate their investments in the KT process, evaluation can inform the need to modify KT plans in response to new or persisting barriers to change or to discontinue KT efforts to preserve limited resources, while generating knowledge to inform future KT initiatives. This desire for structured evaluation extended to clinical service outcomes, as well. When a service delivery model implementation decision was made about how families would be supported, one clinician identified the benefit of seeking evidence from families about the merits of that decision, and of the services being provided [see quote 31, Table 7].

One KT support person saw equitable investment in KT resources, supports and access to evidence across the network as facilitating cohesion [see quote 32, Table 7]. Evaluation supports this equity by identifying gaps and localized strengths that can be leveraged more broadly. Prioritization of these activities will be necessary based on individual and organizational needs, cost-benefit analysis and support capacity.

5.4.3 Applying the proposed model

The organizational strategies for KT support that were drawn from the national environmental scan have been categorized according to the STRIVE themes in Table 8.
### Table 8. Organizational supports mapped to the STRIVE model themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Support categories and examples from the environmental scan</th>
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<tbody>
<tr>
<td></td>
<td>Co-location</td>
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<td></td>
<td>Frameworks</td>
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<td></td>
<td>Structured communication pathways</td>
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<td></td>
<td>Forums</td>
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<td></td>
<td>Support for team functioning</td>
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<tr>
<td>Systematize</td>
<td>Some research-health centre dyads share a campus</td>
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<td></td>
<td>Clinical practice guidelines</td>
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<td></td>
<td>KT planning procedures</td>
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<td></td>
<td>Care pathways</td>
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<tr>
<td></td>
<td>Evidence-informed practice process guides</td>
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<td></td>
<td>KT planning template</td>
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<td></td>
<td>Rapid evidence review protocol</td>
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<td></td>
<td>Environmental scan protocol</td>
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<td></td>
<td>Tele- or video-conferencing applications</td>
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<td></td>
<td>Research seminars</td>
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<td></td>
<td>Journal clubs</td>
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<td></td>
<td>Interactive meetings</td>
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<td>Workshops</td>
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<td>Webinars</td>
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<td></td>
<td>Courses</td>
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<td></td>
<td>Telehealth video broadcasts</td>
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<td></td>
<td>Research week or day event</td>
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<tr>
<td>Transmit</td>
<td>Convey network structure</td>
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<tr>
<td></td>
<td>Raise awareness of supports</td>
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<tr>
<td></td>
<td>Transfer contextual knowledge</td>
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<tr>
<td></td>
<td>Raise awareness of evidence &amp; KT activities</td>
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<tr>
<td></td>
<td>Unknown</td>
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<tr>
<td></td>
<td>Communications strategy</td>
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<td></td>
<td>Communications strategy</td>
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<td></td>
<td>Resource website</td>
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<td>Resource</td>
<td>Library collection</td>
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<td></td>
<td>Knowledge products, tools &amp; resources</td>
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<tr>
<td></td>
<td>Funding</td>
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<td></td>
<td>Food</td>
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<tr>
<td></td>
<td>Library services</td>
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<tr>
<td></td>
<td>Care pathways</td>
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<td></td>
<td>Clinical practice guidelines</td>
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<td></td>
<td>Research Challenge competition</td>
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<td></td>
<td>Project funding</td>
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<tr>
<td></td>
<td>KT/implementation grants</td>
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<tr>
<td></td>
<td>Unknown</td>
</tr>
<tr>
<td>Theme</td>
<td>Support categories and examples from the environmental scan</td>
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<td>-------------</td>
<td>-------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Roles &amp; personnel</td>
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<tr>
<td>Invest</td>
<td>Librarians or library technicians</td>
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<td></td>
<td>KT support personnel or teams</td>
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<td></td>
<td>Consultation support</td>
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<td></td>
<td>Care pathway committees</td>
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<td></td>
<td>Clinical practice guideline committees</td>
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<tr>
<td></td>
<td>Competency development pathways</td>
</tr>
<tr>
<td>Value</td>
<td>KT or evidence-informed practice build into organizational mission, vision, values and/or strategic objectives</td>
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<tr>
<td></td>
<td>Unknown</td>
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<tr>
<td>Evaluate</td>
<td>Network structure</td>
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<td></td>
<td>Barriers &amp; support needs</td>
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<td></td>
<td>Knowledge translation</td>
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<tr>
<td></td>
<td>Inequity</td>
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</table>
Each of the six themes of network-based KT support was represented in the environmental scan findings presented in Section 3.4 of the previous chapter. However, within each theme, novel strategies were brought to light through the use of a network perspective. These strategies included Support for team functioning, Convey network structure, Transfer contextual knowledge, Food, Staff retention, Visible modeling, Recognition, and evaluating Network structure, Knowledge translation and Inequity. Furthermore, limited representation of strategies was observed in the environmental scan data within the categories of Co-location, Structured communication pathways, Raise awareness of evidence and KT activities, and of supports. This finding suggests that a network lens may afford a more comprehensive set of strategies by which to support KT at the organizational level than a traditional contextual lens alone. Although many of these strategies may be in place within organizations, a network perspective assists in recognizing them as valued supports for KT, and in acknowledging their potential impact on KT processes and outcomes. However, a limitation of the environmental scan was that the survey did not elicit the level of detail that would be required to determine the extent to which the other proposed strategies had been employed. These network-driven strategies were not itemized specifically on the survey. Furthermore, respondents would have likely required an orientation to SNA and network dynamics, as was provided to interview participants, in order to be able reflect and comment on KT support from a network perspective.

Although the vast majority of interview participants indicated the desire to increase the size and reach of their individual networks, we must also keep in mind that an individual’s capacity for ties is ultimately limited. Individuals must prioritize their ties to retain the ability to maintain a functional network over time. Although higher density tends to be observed in smaller networks, SNA scholars continue to lack consensus on the ‘ideal’ density value for a
The nature of the defined KT network may influence this determination; for example, information sharing may allow for greater network size than more complex, time-intensive activities, such as KT planning and implementation efforts. Ultimately, network parameters in the quantitative phase of this study were measured in terms of information exchange. Although the interviews expanded this scope to any activity related to moving evidence into action, further examination of implementation network structure, specifically, and a comparison of network members’ perceptions of the need for change will provide greater insight into this question. In the meantime, organizations may need to be attentive to the response of staff with respect to the impact of network development initiatives.

This research demonstrated that a network lens helped identify KT support needs. Participants’ perceptions of the use of network visualizations during the interview process will be addressed more detail in a future publication. However, receiving feedback on the existing network structure was perceived to be valuable by most participants. A visual representation of the network assisted them in reflecting on potential network influences on KT within the organization, and on their own roles in KT processes. Using this type of feedback strategy may prove useful for organizations in demonstrating strengths, gaps and communication pathways to staff, and for eliciting their input on the network’s KT support needs.

5.5 Conclusion

Overall, the KT support strategies identified by participants appear to have support from the SNA, KT and EBP literature. The common thread that unites them is their aim of addressing network gaps and strengthening network dynamics to advance KT. By identifying socially based strategies to improve KT in paediatric healthcare, we have the opportunity to efficiently change
the structure of clinician-researcher networks in ways that have the potential to augment the
clinical implementation of emerging high quality research. These improvements will increase
access to the safest, most effective healthcare innovations for Canadian children and their families. Participants’ network-based support strategies impart the organization’s role in
establishing and maintaining organizational objectives, policies, processes, resources and
competencies by which staff can connect, share information and carry out KT activities, as well
as mechanisms for sharing and evaluating this infrastructure. Should they prove effective, the
socially based interventions proposed here, and the network dynamics principles that drive them,
can be tested in and transferred to other KT networks. In this way, the benefits of stronger
clinician-researcher networks can be extended across scientific domains to improve the clinical
relevance and implementation of health-related research to the benefit of all Canadians.
Chapter 6: Conclusion

This research confirms the role of networks in supporting and hindering KT processes and outcomes. The work also reinforces the role that SNA theory and methodology has in advancing the science and practice of KT. Structural properties are under-represented in the KT literature as determinants and outcomes of KT. SNA methodologies and theoretical perspectives have yet to be fully exploited to expand our understanding of the social factors underlying KT. This thesis provides a foundation from which to build this knowledge base.

6.1 Outcomes and significance

6.1.1 Goals and hypotheses

The goals, research questions and hypotheses addressed in this thesis, and their corresponding outcomes, are discussed below:

6.1.1.1 Study #1: Systematic scoping review of the use of SNA in KT science

Goals:

1. To identify the ways in which SNA methodology has been applied to study KT and EIHC processes and outcomes and can advance KT science

2. To describe the theoretical approaches employed in SNA-based KT research

These goals were accomplished by carrying out the prescribed scoping review methodology described in Chapter 2 Section 2.3. Section 2.4 presents the outputs.
Research questions and hypotheses

A1. How has SNA been applied to the field of KT/EIHC with respect to study aims, data collection methods, and populations, the KT process and structural properties under study?

This body of literature describes networks or tests hypotheses to explain the impact of social structure on KT outcomes, to evaluate differences between groups or time points, to examine associations between attributes and network position, or to explain the formation of ties based on attributes and network structure. Surveys were the most frequent method of data collection; interviews and document review were also employed. Physician-only networks were most prominently examined, while inter-professional researcher-clinician networks followed in frequency. Information flow was the most common KT process under study. Tie homophily, indegree centrality, whole network density, the presence of ties, and tie reciprocity were the most common network properties examined.

H_{A1}: Knowledge sharing will be the most common KT process under study.

This hypothesis was confirmed by the study.

A2. What are the primary theoretical underpinnings that explain the link between network properties and EIHC?

Diffusion of innovation, social contagion theory and social influence theory predominated in the included studies, although seven other theories were identified.

H_{A2}: Prominent theories in SNA (e.g. social influence, social capital) will be prevalent.
This hypothesis was confirmed by the study for social influence theory, which appeared in three studies, while social capital theory appeared in only one study. Diffusion of innovation was the most frequently applied, in seven publications.

**A3. What are the gaps in the literature that can inform future research directions?**

Few SNA studies examine healthcare and research contexts, particularly with respect to inter-professional networks. The majority of studies used cross-sectional designs. Longitudinal research that employs the SIENA framework, and in particular, examines the outcomes of network interventions is warranted. Computational models are also largely absent in the analyses, as is the use of interviews, observation and document review to collect SNA data. Qualitative methods can be employed for comparative analysis with quantitative data, to support SNA data interpretation, as well as to augment understanding about network dynamics. Because most studies were limited to examining information flow, opportunity exists to study other KT processes and phenomena. Studies examining multiple network properties may also be used to understand more clearly the complexity of network influences. In particular, centralization, subgroups and transitivity are relatively under-examined. The use of visualizations to their capacity to present network data was another identified gap. Finally, gaps exist in the application of prominent SNA and KT theory to guide SNA research.

**Hₐ₃:** A paucity of longitudinal and paediatric research will exist.

This hypothesis was confirmed in the study, as only two longitudinal studies were identified, and only one network existed in a paediatric healthcare context.
6.1.1.2 Study #2: Environmental scan of organizational contexts for KT support

Goal:

1. To identify existing organizational supports for EIHC/KT, clinical research integration and stakeholder engagement in research that exist within paediatric AHSCs and their affiliated research institutes across Canada

This goal was achieved, as described in Chapter 3 Section 3.4.

Research questions and hypotheses

B1. What organizational supports (e.g. personnel, resources, services, organizational structures/processes) are in place to support EIHC/KT, clinical research integration and/or stakeholder engagement in research in Canadian paediatric AHSCs and their affiliated research institutes?

Supports included library services, KT support personnel and teams, partnerships between research and clinical organizations, forums and communication strategies for sharing evidence, policies that supported engagement in KT, consultation services, education and training, the development of procedures and protocols to guide KT, targeted initiatives and funding.

H_{B1}: Formal KT support units will be established in fewer than one third of the organizations surveyed

This hypothesis was not supported by the findings, in that six of 18 surveyed sites (exactly one third) reported a KT support unit comprised of two or more KT support personnel.
B2. Who are the primary audiences for these organizational supports?

Audiences included healthcare professionals, organizational leaders, researchers, health professional students or residents, research trainees, children and families, KT support staff and research support staff.

H_{B2}: Most KT supports will target healthcare professionals or researchers

Healthcare professionals, leaders and researchers were the three most frequently identified audiences for the supports, which supports this hypothesis.

B3. What are the primary internal and external partnerships, collaborations or linkages that facilitate EIHC/KT?

Internally, collaborations were reported among KT support units, clinical teams, committees and departments, such as learning and development, research services and quality improvement. External links included provincial health authority departments, affiliated research institutes and university departments, clinical or research networks, and government-funded organizations.

B4. Which supports have been most successful in facilitating EIHC/KT?

Formal evaluation was uncommon; perceived success was reported about personnel supports, committees or teams with KT expertise and protected time, KT-specific initiatives, library services and leadership commitment, including resources, supports, funding and policies that enabled KT.
B.5 What are the challenges associated with providing KT supports?

Challenges included operational constraints, limited resources (including time), lack of competencies, the state of the evidence in the clinical area, lack of communication and sharing of learning across sectors, and the lack of strong support infrastructure for KT.

6.1.1.3 Study #3a: Mixed-methods SNA descriptive case study

1. To define the network of social relationships related to KT that exist within one AHSC and its affiliated research institute
2. To triangulate SNA findings through interviews to determine the extent to which observed network properties are seen as being influential on KT
3. To identify the reasons for the observed network structure from the perspectives of network members.

These goals were accomplished as described in Chapter 4 Section 4.4.

Research questions and hypotheses

C1. What structural network properties that may support or hinder knowledge sharing patterns and KT processes can be observed in the network?

Network properties, such as network size, centrality, density and subgroups (including isolates) were identified by participants as having the potential to help or hinder KT processes and outcomes. A detailed description of the information seeking and information sharing networks and their corresponding network properties is presented in Chapter 4 Section 4.4.2.
C2. To what extent did network members perceive the observed network properties to influence KT?

Participants acknowledged the social nature of KT, and reported using their networks to seek and to share information, to access resources and supports, to engage stakeholders, and to implement change. Higher connectivity was generally valued and desired.

H_C3: Participants will see the observed network properties as influential on KT

This hypothesis was confirmed by the study.

C3. What are the factors that network members perceive as explanatory for the specific structures observed in the network?

Explanatory factors emerged within four themes: 1) Individual attributes (i.e. expertise, experience, role, attitudes and values, personality, learning styles and preferences, socioeconomic vulnerability); 2) Relational considerations (i.e. who you know, relationships, common interests); 3) Organizational context (i.e. proximity, nature of the work, mandates and priorities, supports and resources, logistics); and 4) Measurement error (i.e. non-response bias, interpretation).

6.1.1.4 Study #3b: Organizational network strategies for KT support

Goal:

1. To identify potential network-driven strategies that can be implemented at the organizational level to support KT processes and outcomes

This goal was achieved as reported in Chapter 5 Section 5.4.
Research questions and hypotheses

**D1.** What network-related strategies do network members propose at the organizational level to support KT?

Six themes emerged that categorized network-related organizational support strategies. These were: 1) Systematize [network development through] (i.e. co-location, frameworks, structured communication pathways, forums and support for team functioning); 2) Transmit (i.e. convey network structure, raise awareness of supports, transfer contextual knowledge, and raise awareness of evidence and KT activities); 3) Resource (i.e. library collection, knowledge products, tools and resources, funding, and food); 4) Invest (i.e. roles and personnel, capacity building, specialized initiatives, and staff retention); 5) Value [KT through] (i.e. mandates, policies, visible modeling, and recognition); and 6) Evaluate (i.e. network structure, barriers and support needs, KT, and inequity).

6.1.2 Overall contributions of the research

The scoping review delivered a guide for KT researchers employing SNA as a means of examining social interactions and influences in the context of KT. From this work, the basis for a ‘lingua franca,’ or common language, has been initiated to bridge conversations and research about the social drivers involved in mobilizing change. The environmental scan was the first national survey to document the existing organizational supports for KT. These findings can assist KT plans in moving past educational and resource-based initiatives to target a more extensive array of barriers and facilitators of evidence use. The mixed-methods case study work was the first to apply a network lens to this breadth of KT determinants and support activities. Its incorporation of participant engagement, multiple stakeholder perspectives, and the use of visual
tools to support participants to comment on the data presents a unique approach to KT network research that added to the rigour of the research. The resulting summary affords healthcare and research organizations with tangible interventions to consider in advancing the practice of KT. I was also able to map out a framework for future KT research employing SNA, based on some of the questions that arose during the mixed-methods SNA case study.

This work brings to the forefront the network influences on KT that can be targeted through deliberate network-driven KT interventions to improve the effectiveness and efficiency of evidence uptake. The validation of network dynamics in KT has significant pedagogical applications for researchers and KT scholars and practitioners in terms of extending scope of training and professional development to include a network perspective. Also demonstrated was how the results of scholarship can find new applications across disciplines. In producing this work, I hope to have sparked future interest in an often-overlooked, yet significant topic.

6.2 Strengths

Study 1 followed robust, accepted scoping review methodology, drew from multiple academic databases, and included a second search of the literature prior to publication to ensure currency. The review also presented a novel approach to summarizing the SNA literature by focusing on the SNA methodological approaches employed, and their implications for advancing KT science, rather than by simply summarizing the findings of SNA research. Relating a wide variety of network properties to specific factors purported to influence KT (e.g. power, access to knowledge, social influence) was a valuable contribution for researchers without a background in SNA to understand more clearly the potential for SNA to apply to their own research endeavours. Furthermore, the inclusion of a theoretical perspective addresses a prominent gap,
and lays the foundation for KT researchers to approach SNA research using sound theory to
guide their work.

The relatively high organizational response rate was a strength of Study 2. The representation of all provinces with paediatric AHSC except one enhances the generalizability of the findings. Translation into both of the country’s official languages permitted equal access to English- and French-speaking respondents. The inclusion of multiple respondents, including health administrators, other leaders, educators and staff members at participating organizations allowed for a broader, and more complete reporting of the existing supports than may have been gathered by hearing only from a single high-level director without direct experiences of the supports. The veracity of this observation is reinforced by the general lack of awareness of existing supports by all categories of study 3 participants, including leaders.

The high survey response rate and willingness of participants to take part in the interviews were strengths of Study 3. This participation contributed to the accuracy of the network data, and the representativeness and range of perspectives gathered through the surveys and interviews, respectively. Employing mixed methods allowed me to move beyond descriptive reporting, to engage in the validation of observed network properties, to learn what factors were perceived to have led to them, and to account for their influences on KT processes and outcomes.

A network lens helped participants to draw links between existing KT support strategies and network dynamics, as well as to generate novel strategies that could be pursued by organizations to support KT. The use of network visualizations was reported to afford participants with a stronger understanding of the SNA terminology, network structure and phenomena of interest, and likely led to a richer data set. The interviews also helped to identify
participant-driven hypotheses that can be examined in subsequent data analyses to improve the relevance of the research outputs.

6.3 Limitations

The search and screening process used in Study 1 limited inclusion to studies involving quantitative analysis of SNA data; a greater depth of understanding about SNA’s utility for KT may also be gained from theoretical discussion papers and qualitative research. In addition, the scope of this paper prevented an in-depth discussion of the full breadth of theoretical perspectives represented in the SNA KT literature, which may warrant a separate review. Finally, because of the variability in study designs, the lack of inclusion of quality appraisals in scoping review methodology, and the inconsistency of network properties examined across the studies, results should be interpreted with caution until further research can evaluate their quality and generalizability.

The AIMD Framework was used in the analysis phase for Study 2, but not to design the survey items. As a result, some detail about the aims, ingredients and mechanisms of action of the KT supports was missing, making it unfeasible to document each AIMD element for each support identified. Further exploration into the characteristics of these supports, particularly in the context of empirical studies, would be beneficial in defining them further, and in evaluating their effectiveness at achieving their intended aims. This environmental scan and its analyses provide a foundation for this work. In some instances, the environmental scan survey yielded brief answers for which context and layers of qualitative richness were lacking, leading to the potential for misinterpretation or misrepresentation of the respondent’s intent. In-depth follow-up
interviews that can probe for context, personal meaning, emotional and social nuances\textsuperscript{136} will address these gaps and elicit further detail.

The name generator questions used in Study 3 yielded SNA data specific to information seeking and sharing networks. This relational definition fails to capture other KT-related ties, such as those involved in collaborating to determine the need for change, assess barriers and facilitators, and carry out implementation and evaluation activities. I made the decision to define the network in this way so as to offer a more concrete way to generate relational data by reducing interpretational ambiguity for increased network accuracy. While these maps do not integrate the breadth of ties required for KT, they did provide a tangible starting point for stimulating discussion about all aspects of KT.

Because the boundary of the network was defined by organizational membership, I did not control for or include external ties that may have displaced participants’ capacity for interaction within the network. These external ties were clearly key sources of knowledge and resources for several network members. Their inclusion would have provided a more accurate representation of the network. Additional research examining the structure, perceived value and impacts on KT of external ties may generate more in-depth insights. I did not interview all health care professionals (e.g. licensed practical nurses, dieticians). Their perspectives are therefore not represented, and may differ from those of the participants. The integration of children and family perspectives would also increase our understanding of KT networks, particularly with respect to information exchange between researchers or clinicians and families, as well as of stakeholder engagement in KT processes. In the absence of these perspectives, the impressions of KT dynamics presented by the participants in this study must be interpreted with caution.
6.4 Potential applications

Potential applications of the findings are presented in Table 9. For Study 1, these applications include targeted SNA research to advance the field of KT science. For Studies 2 and 3, the applications relate to the design of organizational KT support infrastructure. Although Studies 2 and 3 were conducted in the paediatric healthcare context, the findings may be generalizable to other AHSCs and research institutes. Administrators in any context considering their implementation will need to carry out their own evaluations and to consider their own contexts, resources and goals in their decision-making to select appropriate support strategies. Discussion is underway currently to develop a proposal to establish a tailored KT support model in one paediatric Canadian healthcare organization based on the findings presented in this work.
<table>
<thead>
<tr>
<th>Potential application</th>
<th>Knowledge users</th>
<th>Contributions</th>
<th>Support afforded</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Targeted SNA research to advance the field of KT science</strong></td>
<td>KT researchers</td>
<td>Informs the design of robust, theory-driven SNA research of KT processes &amp; outcomes</td>
<td>Examples to guide research question development, data collection, outcome selection and measurement, data analysis and theory application</td>
</tr>
<tr>
<td></td>
<td>SNA researchers</td>
<td>Supports research scope expansion to include KT-related questions</td>
<td>SNA applications to KT are synthesized; Collaboration between KT &amp; SNA researchers can leverage respective methodological &amp; substantive expertise to enhance research quality</td>
</tr>
<tr>
<td></td>
<td>Researchers conducting SNA-related literature reviews</td>
<td>Informs the design of SNA literature reviews, particularly with respect to methodological applications</td>
<td>Search strategy, inclusion/exclusion criteria and synthesis approach may assist in selecting appropriate approaches for other research questions</td>
</tr>
<tr>
<td><strong>Design of organizational KT support infrastructure</strong></td>
<td>Healthcare &amp; research organization administrators, leaders, KT support teams</td>
<td>Informs the development or refinement of organizational supports for KT</td>
<td>Inventory of support strategies, including personnel, department, procedures, protocols &amp; programs to consider, external resources, strategies to engage external clinicians, funding sources &amp; topics for KT-related professional development.</td>
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<tr>
<td></td>
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<td>Documented priorities &amp; successes to inform resource allocation decision-making</td>
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<td>Network-driven strategies for consideration</td>
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<td>邠Note: KT=knowledge translation; SNA=social network analysis邠</td>
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</tbody>
</table>
6.5 Future research directions

6.5.1 Literature review topics

A more detailed review of the use of theory in KT-related SNA research that encompasses a broader scope of populations (i.e. not solely health professional networks) may yield additional theories of relevance, their applications, strengths and limitations. This information will provide more choice for researchers seeking to integrate SNA into their research designs. Critical appraisal of the primary SNA research in KT, which may require the development of appraisal checklists specific for the field, can also be conducted to determine the quality of the identified studies. This information may afford researchers with more confidence in interpreting the findings of the research.

6.5.2 Organizational KT support models

In a follow-up project, interviews are underway to gain a greater depth of understanding regarding the KT supports identified through the environmental scan survey, including their AIMD components, who delivers them, how they are trained and supported, and the supports’ sustainability over time. This information can support their replicability, guide their implementation, and support the identification of appropriate evaluation methods. Further research can evaluate the effectiveness of the various supports in different settings and at different intensities.\textsuperscript{50} Realist evaluation may prove to be a useful approach for this purpose. Combining this work with economic analysis will help to determine cost-effectiveness. A comparative analysis of the KT support contexts in adult versus paediatric settings will apprise interested parties regarding the generalizability of the findings of Study 2.
6.5.3 Further KT network data analysis

KT network research is needed that encompasses a broader range of knowledge users, including extra-organizational ties to stakeholders, such as patients/families, individuals in other healthcare, professional or research organizations and networks, and policy makers. Considering KT influences from a network perspective served to underscore the role of structure on KT in response to its relative inattention in the broader KT literature. A systems perspective that includes SNA may be valuable in presenting a more holistic account in future research. A wider variety of theories than those presented may also guide the analysis of data emerging from network-driven KT research. The application of mainstream and less common theoretical approaches from the KT literature may generate alternative ways of considering the network influences on KT, and in structuring network interventions within KT contexts.

Supplemental data gathered during the course of this research affords additional mixed-methods directions, including a detailed comparative analysis of the observed network and participants’ perspectives of its structure, and participant-driven hypothesis testing involving attribute, relational and qualitative data. This attribute data includes demographic variables, such as gender, tenure, profession, and organization, as well as self-reported experience and confidence with KT.

6.5.4 Further qualitative data analysis

Planned qualitative research directions for supplemental data include reporting on the individual strategies for support KT proposed by participants from a network perspective, and on the experiences of participants in using network visualizations as an interview tool. Comparative analysis between stakeholder groups (i.e. healthcare professionals, leaders, researchers and KT
support personnel) of data related to perceived barriers and facilitators of KT within the network can also be examined. The analysis of data regarding the barriers and facilitators of stakeholder engagement in research can also inform the development of supports to facilitate the involvement of patients and families, policy makers, healthcare professionals and other stakeholders in child health research to improve its relevance. In addition, these barriers and facilitators can also be mapped to potential KT support strategies identified through the environmental scan to support the design of KT support infrastructure. Furthermore, a network lens can be applied during analysis to delineate those factors that may be responsive to network interventions.

6.5.5 KT network intervention research

This research provides a foundation for designing KT network intervention studies. Valente\textsuperscript{53} describes four types of network interventions aimed at generating influence, facilitating behaviour change or enhancing performance or impact. Examples from each of the categories\textsuperscript{175} drawn from the KT and organizational change fields, include: 1) identifying key individuals who can influence others (e.g. peer champions to lead behaviour change\textsuperscript{53}); 2) implementing a change initiative within a network segment (e.g. peer-driven education to enhance competency development and research awareness\textsuperscript{71,176–178}); 3) inducing peer-to-peer interaction within the network (e.g. the creation of communities of practice or support groups;\textsuperscript{32,179} interactive forums;\textsuperscript{161,178} and 4) purposely altering the network to impact desired outcomes (e.g. establishing mentoring connections;\textsuperscript{175} providing individual feedback on one’s personal network as a means of stimulating reflection and behavioural action to improve or to act on connectivity\textsuperscript{180,181}). Supplementary strategies that can be used during such interventions to
foster interactions, collaborations or exposure to specific types of network ties (e.g. individuals with similar or different attributes, geographic locations or roles)\textsuperscript{182} include the deliberate selection of small group members, engaging non-central actors to lead, supporting the development of group identity and shared goals among diverse members, and avoiding pairing central actors with isolates.\textsuperscript{182} SNA methodologies would allow for the evaluation of network properties over time, using multiple baseline measurement time points to help discern the impact of the intervention.

A KT intervention can be designed to expose participants to conditions that augment their valuing of ties that lead to improved social capital or influence, that alter the nature of those interactions (e.g. to focus on KT) or that increase the accessibility of ties. The ultimate aim may be to increase the strength (e.g. closeness, frequency of contact, trust), nature or number of ties to enhance KT capacity or behaviours. Studies can be designed to test one or both of these predominant theories using SNA; the direction of causality differentiates the two approaches.\textsuperscript{1} For example, social capital theory testing would involve a selection hypothesis, in which a monadic (or actor attribute) variable (e.g. attitude, KT knowledge or skill) causes the dyadic (or tie) variable (e.g. actors with high KT competency are sought for their social capital, resulting in their key network position [e.g. highly connected, or bridging subgroups]). Social influence theory testing (i.e. diffusion) hypotheses would reverse the order (i.e. an actor holding a broker position develops higher KT competency because of ties to others with high KT competency).

Research examining the impact of network-based interventions on researcher-clinician network structure and KT competencies has yet to be conducted. Although evidence suggests that network interventions are reasonably effective, outcomes vary based on local network and contextual factors.\textsuperscript{53} Nonetheless, any of these intervention options may be feasible in a pediatric
research-healthcare setting. Their selection should be based on the priority barriers and 
facilitators identified within the local context, desired outcomes, and network characteristics.\textsuperscript{53}
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Appendices

Appendix A  Scoping search strategy for research and grey literature on organizational supports for KT

<table>
<thead>
<tr>
<th>Proposed literature search methods</th>
<th>Research literature</th>
<th>Grey literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research question(s)</td>
<td>1. What KT supports do academic health science centres have in place for staff?</td>
<td>What examples or descriptions of EIHC/KT supports in academic health science centres are available?</td>
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<tr>
<td></td>
<td>2. What models, infrastructures, or partnerships exist that facilitate KT in academic health science centres?</td>
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</tr>
<tr>
<td>Sources of evidence (e.g. academic databases, types of websites, etc.)</td>
<td>MEDLINE, CINAHL, ERIC, Web of Science</td>
<td>Association of Academic Health Centers Google Scholar</td>
</tr>
<tr>
<td>Filters/limits (e.g. year/type of publication, etc.)</td>
<td>Not applicable</td>
<td>White papers, dissertations, theses, conference proceedings and presentations, information from Association websites</td>
</tr>
</tbody>
</table>
Appendix B  Organizational supports for EIHC identified during the environmental scan scoping literature search, mapped to barriers identified in the reviewed articles

<table>
<thead>
<tr>
<th>Support Domain</th>
<th>Supports</th>
<th>Barrier targeted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infrastructure or positions for encouraging and supporting evidence use</td>
<td>Poor culture/valuing of EIHC</td>
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<tr>
<td></td>
<td>and for ensuring accountability e.g. library, Health Technology Assessment, quality assurance, knowledge brokers, KT support unit</td>
<td>Lack of time to search for evidence, make decisions or participate in EIHC training</td>
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<td></td>
<td>Providing or enabling staff to participate in training programs</td>
<td>Frequent staff turnover</td>
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<td></td>
<td>Accreditation processes that value/monitor research use</td>
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<td></td>
<td>Mission, vision, values and strategic plans that explicitly reflect the</td>
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<td></td>
<td>valuing of EIHC</td>
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<td></td>
<td>Making explicit CEO’s commitment to EIHC</td>
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<td></td>
<td>Support from senior management</td>
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<td></td>
<td>Establishing clear internal points of contact for accessing evidence,</td>
<td>Poor resource capacity to engage in EIHC</td>
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<td></td>
<td>including librarians, epidemiologists, data specialists, KT support</td>
<td>Frequent staff turnover</td>
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<td></td>
<td>personnel</td>
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<td></td>
<td>Establishing formal and informal relationships external to the</td>
<td>Lack of existing relationships with researchers</td>
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<td></td>
<td>organization to enhance access to evidence</td>
<td>Lack of organizational structure that facilitates formal relationships between</td>
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<td>knowledge users and researchers/experts</td>
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<td></td>
<td>Recruitment and retention strategies that reflect the valuing of EIHC</td>
<td>Frequent staff turnover</td>
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<td></td>
<td>Employee recognition for EIHC</td>
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<td></td>
<td>Opportunities to participate in priority setting processes for research,</td>
<td>Poor relevance of research</td>
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<td></td>
<td>in order to meet decision-</td>
<td>Poor clinical applicability of the evidence</td>
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<tr>
<td>Support Domain</td>
<td>Supports</td>
<td>Barrier targeted</td>
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<td>-------------------------------------------------------------------------------</td>
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<tr>
<td>maker needs</td>
<td>Low credibility/perceived quality of the evidence</td>
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<tr>
<td>Engaging researchers in program redesign projects</td>
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<td>Producing and participating in primary research,</td>
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<td>reviews and research-derived products</td>
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<tr>
<td>Organizational willingness to partner (as decision makers) on research,</td>
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<tr>
<td>or to provide matching funding for priority projects</td>
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<td>Supervising students on priority projects</td>
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<td>Capacity to commission or to carry out high-priority research to address</td>
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<td>knowledge gaps</td>
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<tr>
<td>Organizational mechanisms of evidence surveillance and distribution</td>
<td>Poor access to evidence</td>
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<tr>
<td>e.g. knowledge intelligence service</td>
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<tr>
<td>Circulate current research of interest to research and clinical teams</td>
<td>Lack of time to search for evidence, make decisions or participate in</td>
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<td>EIHC training</td>
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<tr>
<td>Push efforts</td>
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<td>Lack of EIHC skills</td>
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<tr>
<td>Engaging knowledge brokers to share and implement evidence</td>
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<td>Publishing and sharing local research internally and to external organizations</td>
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<td>Personnel responsible for identifying teaching moments to profile evidence</td>
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<td>Facilitating pull efforts</td>
<td>Lack of time to search for evidence or make decisions</td>
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<tr>
<td>Enabling access to information technology systems e.g. databases that</td>
<td>Poor access to evidence</td>
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<td>enable easy and timely access to research, without staff restrictions e.g.</td>
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<td>through partnerships</td>
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<td>Easy access to journals and scientific literature</td>
<td>Lack of time to search for evidence or make decisions</td>
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<td>through bulk purchasing of subscriptions or promoting open-access resources</td>
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<td>Support Domain</td>
<td>Supports</td>
<td>Barrier targeted</td>
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<tr>
<td>Accessible and efficient systems to support the use of research in decision making (e.g. documentation and reporting tools, communication tools, decision support tools)</td>
<td>Lack of time to search for evidence or make decisions</td>
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<tr>
<td>Comprehensive library services</td>
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<tr>
<td>Increase internet speed and accessibility e.g. remove locks on websites, update software</td>
<td>Poor access to evidence</td>
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<tr>
<td>Intranet site or clear links to websites with relevant evidence</td>
<td>Poor access to evidence</td>
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<tr>
<td>Using colleagues’ external affiliations to increase capacity to log into research databases</td>
<td>Poor access to evidence</td>
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<tr>
<td>Quality resources that enable access to resources e.g. websites with optimally packaged reviews</td>
<td>Lack of time to search for evidence or make decisions</td>
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<tr>
<td>Providing or enabling staff to participate in training programs that are interactive and focus on the importance of EIHC, and how to carry it out (all steps of EIHC)</td>
<td>Lack of specific individuals within the organization to model valuing of and to support EIHC</td>
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<td></td>
<td>Lack of EIHC skills (acquiring, assessing, adapting and applying evidence)</td>
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<td></td>
<td>Poor culture/valuing of EIHC</td>
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<td>Frequent staff turnover</td>
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<td></td>
<td>Negative attitudes toward change</td>
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<td></td>
<td>Lack of time to participate in EIHC training</td>
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<tr>
<td>Pull efforts</td>
<td>Rapid response evidence service (syntheses and primary research)</td>
<td>Poor access to timely, relevant research</td>
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<td></td>
<td></td>
<td>Lack of time to search for evidence, make decisions or participate in EIHC training</td>
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<td></td>
<td>Establishing decision-making processes that promote research use</td>
<td>Lack of research use in decision-making</td>
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<td></td>
<td>Lack of time to make decisions or participate in EIDHC training</td>
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<tr>
<td>Self-assessment tools evaluating EIHC competencies</td>
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<tr>
<td>Training/continuing education on searching for and applying research</td>
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<tr>
<td>Support Domain</td>
<td>Supports</td>
<td>Barrier targeted</td>
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<tr>
<td>Formal and informal external ties to support the integration of evidence into decision making e.g. to researchers, knowledge brokers</td>
<td>Lack of time to search for evidence, make decisions or participate in EIHC training</td>
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<tr>
<td>Dedicated staff to pull research into decision-making</td>
<td>Lack of time to search for evidence, make decisions or participate in EIHC training</td>
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<tr>
<td>Building a network of formal and informal relationships between researchers/experts/knowledge brokers/opinion leaders and knowledge users</td>
<td>Lack of dialogue between researchers and knowledge users</td>
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<tr>
<td>Participating in outside groups e.g. regional, provincial, national networks</td>
<td>Poor access to research</td>
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<tr>
<td>Regular meetings highlighting relevant research e.g. journal clubs, medical rounds, quality meetings; may be facilitated by peers</td>
<td>Poor culture/valuing of research</td>
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<tr>
<td>Interactive workshops focused on EIHC</td>
<td>Research failing to address high-priority issues</td>
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<tr>
<td>Monitoring and evaluating EIHC support strategies (implementation and outcomes)</td>
<td>Poor use of research in decision-making</td>
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<td>Lack of understanding of language, values, reward systems between the two groups</td>
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<td></td>
<td>Lack of skill in appraising research</td>
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<td></td>
<td>Poor linking of research to action with respect to decision-making</td>
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### Appendix C  Environmental scan survey development and research questions

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Data Collected</th>
<th>Question #</th>
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<tbody>
<tr>
<td>What are the organizational and demographic characteristics of the respondents?</td>
<td>• Type of organization</td>
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<tr>
<td></td>
<td>• Size of organization</td>
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<td></td>
<td>• Titles, roles of participants</td>
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<td></td>
<td>• Physical proximity of research &amp; clinical organizations</td>
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</tr>
<tr>
<td>What personnel supports are in place to support EIHC/KT?</td>
<td>• Number of EIHC/KT support personnel</td>
<td>10b, 13</td>
</tr>
<tr>
<td></td>
<td>• Role of EIHC/KT support personnel</td>
<td></td>
</tr>
<tr>
<td>What resources exist to support EIHC/KT?</td>
<td>• Funding structure/source for EIHC/KT support</td>
<td>10-13, 15</td>
</tr>
<tr>
<td></td>
<td>• Internal resources used to support EIHC/KT</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• External resources used to support EIHC/KT</td>
<td></td>
</tr>
<tr>
<td>What EIHC/KT services are provided by the organization?</td>
<td>• Educational opportunities for EIHC/KT capacity building</td>
<td>10-13</td>
</tr>
<tr>
<td></td>
<td>• Services or supports available for evidence access, appraisal, adaptation,</td>
<td></td>
</tr>
<tr>
<td></td>
<td>synthesis, sharing, implementation or evaluation</td>
<td></td>
</tr>
<tr>
<td>What organizational structure or processes exist to support EIHC/KT?</td>
<td>• E.g. Support for research integration into clinical programs, forums for</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>sharing research, processes for adapting clinical practice guidelines or</td>
<td></td>
</tr>
<tr>
<td></td>
<td>identifying the need for behaviour change, etc.</td>
<td></td>
</tr>
<tr>
<td>Who are the primary audiences for these organizational supports?</td>
<td>• Direct recipients of identified supports</td>
<td>14</td>
</tr>
<tr>
<td>What are the primary internal and external partnerships, collaborations or</td>
<td>• Internal collaborations or linkages to support EIHC/KT</td>
<td>16-18</td>
</tr>
<tr>
<td>linkages that facilitate EIHC/KT?</td>
<td>• External partnerships or collaborations to support EIHC/KT</td>
<td></td>
</tr>
<tr>
<td>Which supports have been most successful in facilitating EIHC/KT?</td>
<td>• Successes and facilitators identified</td>
<td>19, 22</td>
</tr>
<tr>
<td>What are the challenges associated with facilitating EIHC/KT at the organization?</td>
<td>• Challenges or barriers identified, including resource constraints, individual,</td>
<td>20, 21</td>
</tr>
<tr>
<td></td>
<td>organizational and system-level barriers</td>
<td></td>
</tr>
</tbody>
</table>

Note: EIHC=evidence-informed healthcare; KT=knowledge translation
Appendix D  Environmental scan survey items

Thank you for participating in this Environmental Scan being conducted by staff at [Organization A]. Our aim is to understand the barriers and supports that exist within pediatric academic health science centres and their research institutes, with respect to evidence informed healthcare (EIHC) and knowledge translation (KT).

**Definitions:** EIHC and KT refer to the processes of moving evidence into action in healthcare. Evidence refers to research findings, as well as professional experience and patient/family perspectives, which are considered together in making informed decisions.

EIHC is typically carried out by healthcare providers, health leaders and policy makers during the decision-making and implementation processes involved in developing, delivering and making changes in health services. KT is usually understood to reflect the process carried out or facilitated by researchers and others to identify the need for evidence, to support the effective adapting/packaging and sharing of evidence, to identify and apply strategies that target barriers to implementation, and to evaluate evidence use in healthcare.

If you are not familiar enough with the specific EIHC/KT supports being addressed in a particular section of the survey, please feel free to provide the name and contact information of a colleague who may be able to respond in more detail.

**DEMOGRAPHICS**

**Your Organization**

1. Please select your primary organization from the drop-down menu, or start typing your response in the text box: [check one – text auto-completes]
   a. [All organizations listed here]
2. Please select your secondary organization from the drop-down menu, or start typing your response in the text box: (check one – text auto-completes)
   a. List all the organizations here
3. Please list any other organization(s) with which you are affiliated (if applicable):

**About you:**

4. What is the name of your home department/unit/sector at your primary organization?
5. What is your role/title within the organization? (Responses will be grouped in any reports of the survey)
6. How long have you been at the organization? ________________
7. With respect to my primary organization, I am knowledgeable about the following topics (check all that apply): (Check the topics about which you would like to respond on the survey)
   a. The number of staff/members
   b. Library services
   c. Other (non-library resources, personnel and services in place to support EIHC/KT
   d. Research/clinical collaboration and/or supports for research within clinical sectors
   e. Effectiveness of EIHC/KT supports
8. Please provide the email addresses of individuals at your organization with knowledge about these topics so that we may invite them to take the survey (optional):
STAFFING AND MEMBERSHIP

9. How many health professionals are employed at your organization?
10. How many researchers are affiliated with your organization?
11. Do the research institute and the clinical sector share the same physical site?
   (yes/no/unsure)

LIBRARY SERVICES

12. Does your organization have a library onsite? (yes/no/unsure)
   a. If no, is there a digital library or electronic resources available to staff online?
      Yes/no/unsure
   b. If yes, how is it staffed?
      i. No staff
      ii. Librarians
         1. How many full-time equivalent (FTE) librarians?
      iii. Library Technicians
   c. How many full-time equivalent library technicians?
      i. Unsure
      ii. Other (please describe): __________
         1. You selected ‘other’ – please describe staffing, including job title(s) and full-time equivalent (FTE) staff numbers):
   d. If yes, how are the library and its services funded? (Check all that apply)?
      i. Branch of the university library
      ii. Your healthcare organization
      iii. Your research institute
      iv. Unsure
      v. Other (please describe): __________

13. My organization is affiliated with a University library (yes/no/unsure)
   a. If yes, does the collection serve all hospital staff whether or not they have a formal University appointment (i.e. Affiliated status)? (yes/no/unsure)
   b. If no, does your organization provide a library collection (digital and/or print) for staff who are not affiliated with the University? (yes/no/unsure)

14. Which of the following library services are offered to all staff? Please check all that apply:
   a. Document Delivery and/or Interlibrary Loan
   b. Online reference (e.g. Library staff available to help with locating materials, assistance with literature searching, etc.)
   c. In-person reference
   d. Subject or resource guides
   e. Online tutorials
   f. Literature searching
   g. Education and training
      a. Please describe the education/training offered:
   g. Staffed library/learning commons space
h. Other
   a. You selected ‘other’ – please describe

15. Which department at your organization oversees library services?

*Please contact the following person(s), whose input/perspective would be valuable for this section (optional): _____ [Please enter an email address]*

---------------------------------------------------------------------------------------------------------------

NON-LIBRARY SUPPORTS FOR EIHC/KT

16. Resources, services, processes, personnel and/or infrastructure are provided by my organization to support the following aspects of EIHC/KT:
   a. Accessing/acquiring research evidence (yes/no/unsure)
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   b. Assessing/appraising evidence for its level of evidence (i.e. study design), quality and [clinical] applicability AND/OR adapting, packaging evidence for specific audiences/stakeholders (e.g. rapid reviews, clinician-friendly summaries of evidence, synopses of systematic reviews, infographics, handouts/pamphlets, videos, etc.)
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   c. Sharing/disseminating evidence with key stakeholders (e.g. clinicians, patients, health leaders, researchers, etc.)
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   d. Identifying the need for, and/or assessing barriers to evidence use/behaviour change
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   e. Developing [practice/policy change or KT] plans for moving evidence into action
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   f. Evaluating evidence use e.g. monitoring implementation/scale-up efforts and outcomes
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):
   g. Capacity building (e.g. training/educational opportunities/developing resources or tools to support individual competency development in EIHC/KT and/or organizational capacity for EIHC/KT)
      i. If yes, please describe these supports, including the role/title/department of support personnel (if applicable):

17. The following other organizational structure or processes exist at my organization: (yes/no/unsure):
   a. Departments/units/teams that support EIHC/KT
   b. Clinical practice guideline committees
c. Care pathway committees
d. Procedures or protocols
e. Journal clubs, interactive meetings or workshops to share new research evidence with staff
h. Other supports/resources
   i. Please describe these supports, including the role/title/department of support personnel (if applicable):

EIHC/KT SUPPORT RECIPIENTS

18. Who do your EIHC/KT personnel/resources support? i.e. what is the target audience for these supports? (Check all that apply)
   • Health professionals
   • Health professional students/residents
   • Organizational leaders
   • EIHC/KT support staff
   • Researchers
   • Research support staff
   • Trainees
   • Patients & families
   • Knowledge brokers
   • Other (please describe): ______

19. What activities to support EIHC/KT for your organization are provided by external personnel/organizations?
   a. From which organization(s) do you access this support?

Please contact the following person(s), whose input/perspective would be valuable for this section (optional): _____ [Please enter an email address]

PARTNERSHIPS AND COLLABORATION

20. How is research supported within clinical sectors/programs by your organization? e.g. what supports, resources and/or mechanisms exist to support research at the point of care?

21. What additional supports are needed?

22. How frequently does your organization do each of the following activities to produce evidence and/or move evidence into action? (never/occasionally/regularly/frequently/always/unsure)
   a. Formal collaborations between internal researchers and clinicians to conduct primary research and/or systematic reviews
   b. Formal collaborations with external researchers to conduct primary research and/or systematic reviews
   c. Formal invitations to or forums for internal researchers to share evidence with the organization’s clinical sector
24. Formal invitations to or forums for external researchers to share evidence with the organization’s clinical sector

23. My organization has processes in place to engage the following stakeholder groups to...
   (yes/no/unsure/not applicable)
   a. Share research questions of relevance with researchers
      a. Healthcare professionals
      b. Patients/families
      c. Policy makers/leaders
      d. Other stakeholders
      i. Which other stakeholders?
   b. Participate in prioritizing research directions within the organization
   c. Participate in research as research team members
   d. Collaborate with researchers on knowledge translation activities (i.e. strategies to share evidence with others or to move evidence into action)

24. How is stakeholder engagement in research supported by your organization?

25. What additional supports are needed?

26. What supports/processes are in place to engage health professionals who are not on-site (whether internal or external to your organization) in EIHC/KT?

Please contact the following person(s), whose input/perspective would be valuable for this section (optional): _____ [Please enter an email address]

SUCCESES & CHALLENGES

27. Which supports do you think have been the most effective at supporting EIHC/KT within your organization?

28. Which supports do you think have been least effective at supporting EIHC within your organization?

29. What barriers or challenges limit the delivery of EIHC/KT supports at your organization?
   a. What is the most significant barrier to EIHC/KT support?

30. What factors have facilitated the delivery of EIHC/KT supports at your organization?

Please contact the following person(s), whose input/perspective would be valuable for this section (optional): _____ [Please enter an email address]

ADDITIONAL COMMENTS

31. Please share any additional information about EIHC/KT supports for your organization that have not been addressed above: _______

Thank you for your time in completing the survey. We look forward to sharing the results with you!
Appendix E  SNA case study letter of introduction for prospective participants

Research Study: Strengthening networks to advance knowledge translation in pediatric rehabilitation

Dear [Prospective Participant Name],

We are writing to introduce a new research study being conducted at [Organization Name]. You are being invited to participate because you are involved in child development and rehabilitation research and/or health services delivery at [the Organization].

Purpose: The study examines the role of professional interactions in moving evidence (e.g. research) into action in clinical practice, health services delivery and research.

Study Procedures: This study has 3 phases. If you agree to participate, you will be asked to complete:

1) **Two 10-30 minute online surveys**, approximately 4 months apart. You will be asked about your role, and the types of interactions you have with colleagues related to evidence sharing and use. Your answers will be anonymized in any reports of the research, to protect your confidentiality.

Only a small number of participants will be invited to take part in one or both of:

2) **A 1-hour interview** to draw on your experiences, in order to help us better understand the factors that support or hinder evidence use in your personal context. The interview will be audio recorded with your permission and typed out for analysis. All responses will be anonymous.

3) **A small group activity** designed to target identified gaps or barriers to evidence use. Survey and interview results will inform the design of the activity (to be described in detail during the consent process), which may include training, planning, or participation in knowledge translation activities. Anticipated time commitment is one 90-minute session, and up to 1-2 hours of follow-up activities.

You will be given the opportunity to consent or to decline participation at each phase, and you may withdraw at any time. You are under no obligation to participate. Deciding not to participate will not affect your employment in any way.

The information gathered will be used to identify strategies to improve the efficiency of evidence use in child development and rehabilitation service delivery and research settings.

To take part in the online survey or to review the consent form, please visit: [survey url]

If you have any questions about the study or what is required should you choose to participate, please do not hesitate to contact us by telephone or email. If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the University of British Columbia Office of Research Ethics by e-mail at [email address] or by phone at [phone number]. We will send you this message two more times in case you miss this one. Thank you for your time and attention.

Sincerely, [Principal Investigator, Study Coordinator, contact information]

Letter of Introduction Version 02-11-2017  Ethics Approval #H17-01732
Appendix F  SNA case study survey consent form

Survey Consent Form

Research Study: Strengthening networks to advance knowledge translation in pediatric rehabilitation

Principal Investigator:  [Name] 
[Contact information]

Study Coordinator/Co-Investigators: 
[Names]  
[Contact information]

Purpose: This is a social network study in which we try to map out the communication network of the organization to examine the role of professional interactions in moving evidence (e.g. research) into action in clinical practice, health services delivery and research. Our goal is to identify strategies to move evidence into action more efficiently. You are being invited to participate because you are involved in child development and rehabilitation research and/or health services at [the Organization]. This research is part of [researcher]’s PhD thesis work.

Study Procedures: This study involves 3 phases.  
This consent is for the online survey phase only.  
If you agree to participate, you will be asked to complete two 10-30 minute online surveys – one now, and one in approximately four months. You will be asked about your role, and the types of interactions you have with colleagues related to evidence use. In order to map out who talks to whom, we will need you to give us your name when completing the survey. We will use the data to construct social network maps like the one shown above, with names removed. Our network may have up to 250 people or more, which decreases the likelihood of being able to identify individuals in the network map.

If you are selected to participate in the interview or small group activities, you will receive an email inviting you to review that consent form, and a follow-up email or phone call to coordinate scheduling should you choose to consent. Regardless of whether you participate in the interview or group activities, you will receive reminder emails in a few months when it is time to complete the final survey.
Potential risks: With all social network analysis studies, the information gathered about participants’ interactions with one another may enable you or others with knowledge of your group to identify individuals by virtue of the patterns of those interactions. If you choose not to participate, your interactions with other participants may still be included in the data set. In any visual representations of these patterns, individuals will be de-identified; in cases where identification is likely, subsections of the visual representation may be used to help preserve anonymity. Some of the information gathered about evidence sharing or usage practices may be of interest to your employer. In order to mitigate this conflict of interest and to protect the rights of participants, an information sharing agreement has been signed by the Senior Director at [the Organization] and the research team outlining which information will be disclosed to them, for the purpose of improving knowledge translation within the organization. This agreement is available for review here: [insert url].

Your confidentiality will be strictly protected by labeling all study documents by only a code number and by storing them in a locked filing cabinet. Electronic data will be stored on a password-protected computer. Only the Investigators and study coordinator will have access to this data, which will be stored for 5 years. Participants will not be identified by name in any reports of the completed study.

Potential benefits: We do not know if there will be any benefits to you as a result of taking part in this study. The results will be used to identify strategies to improve the efficiency of evidence use in child development and rehabilitation service delivery and research settings. You may gain insight into your own professional networks and how they influence the use of evidence by you and your colleagues.

Confidentiality: Your confidentiality will be respected. Your responses will be anonymized to protect your privacy and confidentiality. No information that explicitly discloses your identity will be released or published without your specific consent to the disclosure. The study coordinator will store the master list of participant code numbers on a password-protected computer in a locked office. The Principal Investigator will store a hard copy in a locked filing cabinet. Research records identifying you may be inspected in the presence of the Principal Investigator or her designate by representatives of Health Canada and the UBC Research Ethics Boards for the purpose of monitoring the research. However, no records that identify you by name or initials will be allowed to leave the Investigators' offices.

Withdrawal from the study: Your participation is voluntary and you may withdraw from the study at any time. Data collected up to the point of your withdrawal from the study must be kept for data analysis purposes under strict provisions of confidentiality.

Compensation for injury: Signing this consent form in no way limits your legal rights against the sponsor, investigators, or anyone else.

Reimbursement/Remuneration: You will not be offered reimbursement for any costs incurred to you as a result of taking part in the survey phase of the study. Participants will be entered into a random draw for one of: five $10 coffee shop gift cards and five chocolate gift packages. Winners will be contacted by email after the final survey.
Contact for information about the study: If you have any questions or would like more information about this study, you may contact the Principal Investigator, [Name], at [phone number]. You may print a copy of this consent form for your records.

Contact for concerns about rights of research participants: If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the University of British Columbia Office of Research Ethics by e-mail at [email address] or by phone at [phone number].

Consent: A ‘Yes’ response below indicates that you have had the chance to ask questions and to discuss this study with the research team and that your questions have been answered to your satisfaction.

You understand that your participation in this study is entirely voluntary and that you may refuse to participate or withdraw from the study at any time without consequence to your employment.

You understand that you will be contacted if selected to participate in subsequent phases of the study. You will be given the opportunity to consent or to decline participation at each phase.

You consent to take part in the online survey phase of the study:

☐ Yes  ☐ No

Survey Consent Form Version 02-11-2017  Ethics Approval #H17-01732
Appendix G  SNA case study information sharing agreement

Information Sharing Agreement

Research Study: Strengthening networks to advance knowledge translation in pediatric rehabilitation

A.1. About the study
This social network analysis study is being conducted by [researcher name] This research has not been requested by any organization, nor is it being conducted in partnership with or on behalf of any organization.

A.2. Rights of the researchers
The data – properly anonymized so that neither individuals nor the organization are identified – will form the basis of scholarly publications and other knowledge translation outputs e.g. conference and other presentations, video abstracts, infographics, etc.

A.3. Rights of the organization
In addition, the researchers will provide [the Organization] with a summary report that outlines general findings and recommendations without explicitly identifying individuals. Data analysis results that identify key actors in the network may be released to [the Organization] on request to inform the development of network strategies to improve knowledge translation. The Organization agrees that these data will not be shared among the employees and will only be seen by top management and knowledge translation support staff at [the Organization]. The Organization agrees that the data will not form the basis for evaluation of individual employees, but will be used in a developmental way to improve the functioning of the organization. No data or reports will be provided to other organizations within or outside of [the umbrella organization], including [the research institute], unless they are appropriate for and available in the public domain.

A.4. Rights of the participants
The participants of the survey – the people whose networks are being measured – shall have the right to request to see their own data to confirm correctness. They may also request a general report from the researchers that does not violate confidentiality of the other participants regarding what was learned in the study.

__________________________________________________________
Signature of Research Coordinator  Printed Name  Date

__________________________________________________________
Signature of Principal Investigator  Printed Name  Date

__________________________________________________________
Signature of [Organization] Director  Printed Name  Date

Information Sharing Agreement Version 02-11-2017  Ethics Approval #H17-01732
Appendix H  SNA case study survey items relevant to the thesis

Screening Survey
Thank you for your interest in the Pediatric KT Networks study!

The following questions will help us determine your eligibility for the study.

Please keep the following definition in mind when answering the next few questions:

Child Development & Rehabilitation (CDR) is defined as the health field related to children from birth to 18 years with:

- Developmental or behavioural conditions (e.g. attention deficit hyperactivity disorder (ADHD), developmental coordination disorder (DCD), autism spectrum disorder (ASD), fetal alcohol spectrum disorder (FASD), etc.)
- Neuromotor/neurological conditions (e.g. acquired brain injury (ABI), cerebral palsy (CP), muscular dystrophy, epilepsy, spina bifida, etc.)
- Physical disabilities (e.g. limb amputation)
- Musculoskeletal diagnoses (e.g. bone fracture, etc.) or
- Primary sensory impairments (e.g. visual or hearing impairment, complex/chronic pain, etc.)

that require health services, such as therapy, diagnostic assessments, consultations or other non-emergency patient care.

S1. I am involved in clinical practice (i.e. direct healthcare service provision to patients/families) related to child development & rehabilitation (CDR) at [the umbrella Organization]
   □ Yes
   □ No

S1a. Which, if any, of the following populations do you serve? Check all that apply:
   □ Developmental or behavioural conditions (e.g. ADHD, DCD, ASD)
   □ Neuromotor/neurological conditions (e.g. ABI, CP, muscular dystrophy, epilepsy, spina bifida)
   □ Physical disabilities (e.g. limb amputation)
   □ Musculoskeletal diagnoses (e.g. bone fracture)
   □ Primary sensory impairments (e.g. visual or hearing impairment, complex/chronic pain)
   □ Other
   You selected 'other' - please describe: ________________________________

S1b. Which type of health services do you provide? Check all that apply:
   □ Diagnosis and/or assessment
   □ Consultation
   □ Therapy/rehabilitation/treatment
   □ Emergency care services
   □ Acute care services
   □ Community health services (not including Outreach services addressed by the above categories)
S2. As part of my formal role, I am involved in supporting direct healthcare service providers and/or researchers involved in CDR at [the Organization] to develop and/or to execute and/or evaluate strategies for sharing and/or implementing research evidence

☐ Yes
☐ No

S2a. What support(s) do you provide? __________________________________________

S3. I am involved in research related to CDR at [the Organization] (including [the Research Institute].

☐ Yes
☐ No

S3a. Which, if any, of the following CDR populations do you address in your research? Check all that apply:

☐ Developmental or behavioural conditions (e.g. Attention Deficit Hyperactivity Disorder (ADHD), Developmental Coordination Disorder, Autism Spectrum Disorder, Fetal Alcohol Spectrum Disorder, etc.)
☐ Neuromotor/neurological conditions (e.g. acquired brain injury, cerebral palsy, muscular dystrophy, epilepsy, spina bifida, etc.)
☐ Physical disabilities (e.g. limb amputation, etc.)
☐ Musculoskeletal diagnoses (e.g. bone fracture, etc.)
☐ Primary sensory impairments (e.g. visual or hearing impairment, complex/chronic pain, etc.)
☐ Other CDR-related health condition(s) or diagnoses
☐ No specific population - I conduct basic science research
☐ No specific population - I conduct health services research
☐ No specific population - Other research

You selected 'other' - please describe: ___________________

S4. Which of the following describe your role(s) at [the Organization]? Check all that apply:

☐ Healthcare Professional
☐ Healthcare Leader Healthcare Professional Student/Trainee/Resident
☐ Educator
☐ Researcher
☐ Research Leader (e.g. Director; Theme or Group Lead, etc.)
☐ Research Trainee/Research Graduate Student
☐ Research Manager
☐ Research Coordinator
☐ Research Nurse
☐ Research Assistant
☐ Administrative Assistant
☐ Knowledge Translation (evidence sharing and implementation) Support Personnel
☐ Other
You selected 'other' - please describe: ________________________________

S4a. If more than one: Which is your primary role? Select one response only:
☐ Healthcare professional
☐ Healthcare Leader
☐ Healthcare professional student/trainee
☐ Educator
☐ Researcher
☐ Research Leader (e.g. Theme or Group lead, Director, etc.)
☐ Research Trainee/research graduate student
☐ Research Manager
☐ Research Coordinator
☐ Research Assistant
☐ Administrative Assistant
☐ Knowledge translation (evidence sharing and implementation) support personnel
☐ Other, as stated above: [role_other]

S4b. How many years have you been in this role?
☐ < 5 years
☐ 5-10 years
☐ 10 years

S5. With which organization(s) are you associated? Check all that apply:
☐ [Organization and affiliate names here]
☐ Other

You selected 'other' - please describe: ________________________________

S5a. If more than one: Which organization would you consider to be your primary organization?
☐ [Organization and affiliate names here]
☐ Other: [other_org]

Your email address will allow us to contact you when it is time to complete the follow-up survey and track our response rate, and to contact you if you are selected to receive an invitation to participate in the interview or small group activity phase of this study.

Please enter your email address: ________________________________ (Your email address will only be used to contact you about this study's next phases and will not be shared.)

Condition 1 __________________________________
Condition 2 __________________________________
Condition 3 __________________________________
Condition 4 __________________________________
Pediatric KT Networks Survey

Based on your responses, you are eligible to take the survey!
Please answer the following questions to help us understand more clearly how you and your colleagues at [the Organization] move evidence into action.

Please take the time to consider your responses carefully. The more complete your answers, the more accurate the study findings will be.

Start time __________________________________

1. Please provide your first and last name. __________________________________ (Example: Robert Smith)
   This information is required to link your responses to those of others, to help us map out a 'knowledge translation network'. To protect your confidentiality, names will be removed prior to analysis and will not be included in any reports of the research.

2. List the individuals (first and last names) at [the Organization] who are your key sources of Child Development & Rehabilitation (CDR) evidence: ______________________________
   (From whom within the organization do you usually seek evidence about CDR to inform your work?)

3. List the individuals (first and last names) at [the Organization] with whom you most frequently share CDR evidence: ______________________________
   (With whom within the organization do you share evidence related to Child Development & Rehabilitation?)

4. List the individuals (first and last names) at [the Organization] with whom you have collaborated on research over the past 2 years: ______________________________
   (With whom within the organization do you collaborate on research?)

---PAGE BREAK---

Integrated KT (iKT) is a research approach that engages stakeholders or 'knowledge users' (i.e. those who may benefit from the findings of the research) as equal partners throughout the research and knowledge translation (KT) processes. KT refers to moving evidence into action, e.g. in clinical practice, health care policy or further research.

For each step of the research and KT processes listed below, please indicate whether or not you have personally participated in the activity, by selecting 'yes' or 'no'.

5a. Defining the research question for a research study i.e. developing or refining high priority research questions that address a need for knowledge-users
   ☐ Yes [repeated for each of 5a through 5h]
   ☐ No [repeated for each of 5a through 5h]
Collaboratively with which stakeholder group(s)? [repeated for each of 5a through 5h]

- Health care professionals
- Health care leaders
- Health care students
- External policy makers
- Children & families e.g. patients
- The general public
- Researchers
- Industry
- Other
- None of the above (i.e. alone)

You selected 'other' - please describe: __________________________________

5b. Selecting the research approach i.e. choosing the methodology and outcome measures, and developing tools for a research study

5c. Conducting the research i.e. recruitment, data collection, data analysis and the interpretation of the findings  *Do not indicate the research participants, but rather the research partners

5d. Identifying a need for evidence or behaviour change i.e. determining the need for action based on the scope of the gap in what is known (the research findings/recommendations) and what is done (actual behaviour related to carrying out those recommendations); selecting the key messages for action to share or implement

5e. Adapting evidence to the local context i.e. crafting messages for the target audience (e.g. health professional, policy maker, patient/family, researcher, etc.), modifying an intervention for feasibility in the local context, adapting clinical practice guidelines, etc.

5f. Assessing barriers and facilitators i.e. identifying the factors that support/hinder evidence use/behaviour change

5g. Selecting, tailoring and implementing KT interventions i.e. choosing, adapting and applying strategies to share and/or to implement evidence (Examples: Writing publications, giving presentations, providing education, developing resources, implementing guidelines, monitoring behaviours, commercializing products, etc.)

5h. Monitoring, evaluating and sustaining knowledge use i.e. selecting and implementing methods to evaluate the process, outcomes/impact and sustainability of the KT interventions

6. I have carried out the following knowledge translation (KT) interventions/activities: (Yes/No)

- Writing manuscripts for publication
- Giving presentations (in-person, online)
- Circulating written materials
- Social media dissemination
☐ Providing education/training/workshops
☐ Delivering continuing professional development/medical education sessions
☐ Developing e-learning courses
☐ Writing plain-language or tailored summaries for specific audiences, including blog posts, policy briefs, clinician-friendly syntheses, executive summaries
☐ Facilitating discussions or consensus processes; public forums
☐ Working with or acting as a knowledge broker, champion, opinion leader to share evidence
☐ Media releases or engagement
☐ Television appearances, TEDTalks
☐ Social marketing e.g. public education campaigns
☐ Creating patient information resources
☐ Writing books
☐ Engaging patients and/or families to improve their knowledge or health behaviour, using or advocating about evidence
☐ Creating decision support tools or other resources for health professionals or patients/families
☐ Facilitating communities of practice
☐ Arts-based messaging (videos, art, theatre, music, etc.)
☐ Commercializing products or processes
☐ Consulting with government
☐ Advocacy work
☐ Developing policy
☐ Establishing external partnerships to move evidence into action
☐ Changing own behaviour
☐ Facilitating behaviour change in others
☐ Establishing/adapting/implementing procedures/protocols, methods or guidelines
☐ Acquiring required equipment/resources and supports to enable change
☐ Establishing financial incentives for evidence use
☐ Establishing/providing mentoring support for evidence use
☐ Monitoring behaviours, including providing reminders, audit and feedback, performance feedback Integrating evidence into the design of subsequent research
☐ Other KT intervention(s)
You selected 'other' - please describe: _____________________________

----------------------------------------------PAGE BREAK----------------------------------------------

7. Please rate your confidence in carrying out the following aspects of iKT, in collaboration with stakeholders? Select the number that best reflects your confidence for each iKT step below: (Likert scale: 1=Not at all confident; 7=Extremely confident)

a. Defining the research question (i.e. developing or refining high priority research questions that address a need for knowledge users)

b. Selecting the research approach (i.e. choosing the methodology and outcome measures, and developing tools)

c. Conducting the research (i.e. recruitment, data collection, data analysis and the interpretation of the findings)
d. Identifying a need for evidence or behaviour change (i.e. determining the need for action based on the scope of the gap in what is known [i.e. the research findings/recommendations] and what is done [actual behaviour]; selecting the key messages for action)

e. Adapting evidence to the local context (i.e. crafting messages for the target audience, modifying an intervention for feasibility, etc.)

f. Assessing barriers and facilitators (i.e. identifying the factors that support and that hinder evidence use/behaviour change)

g. Selecting, tailoring and implementing 'diffusion' ("let it happen") KT interventions (i.e. information is communicated using delivery methods for which little customization is required to reach target audiences that typically seek out research evidence Examples: Writing publications, giving presentations, presenting at conferences, blog or web posts, podcasts, circulating articles, etc.)

h. Selecting, tailoring and implementing 'dissemination' ("help it happen") KT interventions (i.e. the communication method and messaging are adapted to the specific audience and/or context in which the knowledge will be used Examples: Social media, education, plain-language summaries, resources, small-group meetings, engaging patients, audit and feedback, communities of practice, arts-based messaging (e.g. videos, art, theatre, music), etc.)

i. Selecting, tailoring and implementing 'application' ("make it happen") KT interventions (i.e. Key messages are identified and moved into action using tailored strategies that consider barriers and facilitators to knowledge use Examples: Commercialization, facilitating behaviour change, establishing procedures or protocols, implementing adapted practice guidelines, etc., integrating evidence into future research, etc.)

j. Monitoring, evaluating and sustaining knowledge use (i.e. selecting and implementing evaluation frameworks and methods to evaluate the process, outcomes/impact and sustainability of the KT interventions)

Please tell us a little bit about yourself:

9. In which clinical program(s) do you currently work? Check all that apply:
   - [List clinical program names]
   - Other
   - None
You selected 'other' - please describe: ______________________________

9a. In which other clinical program(s) have you worked in the past? Check all that apply:
   - [List clinical program names]
   - Other
   - None
You selected 'other' - please describe: ______________________________

10. What is your job role/title at [the Organization]? ______________________________
Respondents will be grouped into job categories in reports of the research to help protect confidentiality.
11. What is your health professional designation?
☐ Aquatic therapist ☐ Psychologist
☐ Dietician ☐ Recreation therapist
☐ Engineer ☐ Registered nurse
☐ Licensed practical nurse ☐ Rehabilitation technologist
☐ Music therapist ☐ Rehabilitation assistant
☐ Nurse practitioner ☐ Social worker
☐ Occupational therapist ☐ Speech-language pathologist
☐ Pharmacist ☐ Vision consultant
☐ Physician ☐ No health professional designation
☐ Physiotherapist ☐ Other
You selected 'other' - please describe: __________________________________

12. Do you have a formal appointment with a university?
☐ Yes
☐ No

12a. What is your highest affiliation title at the university/ies?
☐ Instructor ☐ Adjunct Faculty
☐ Clinical Instructor ☐ Affiliate Faculty
☐ Clinical Assistant Professor ☐ Lecturer
☐ Clinical Associate Professor ☐ Senior Lecturer
☐ Assistant Professor ☐ Associate Faculty Member
☐ Associate Professor ☐ Fellow
☐ Professor ☐ Other
You selected 'other' - please describe: __________________________________

13. Please indicate your gender __________________________________

14. Years clinical experience __________________________________

15. Years research experience __________________________________

16. Years with [the Organization] __________________________________

17. Current Research Institute group
☐ [List groups organized by the research institute]
☐ Unsure
☐ None

17a. Previous Research Institute group with which you were affiliated:
☐ [List previously existing research group names]
☐ Unsure
☐ None of the above

End time ________________________________
Interview Consent Form

**Research Study:** Strengthening networks to advance knowledge translation in pediatric rehabilitation

**Principal Investigator:** [Name, contact information]  
**Study Coordinator/Co-Investigator:** [Names, contact information]

**Purpose:** This study examines the role of professional interactions in moving evidence (e.g. research) into action in clinical practice, health services delivery and research. You are being invited to participate because of the nature of your clinical and/or research work, and your experiences working with colleagues to move evidence into action. Prospective interview participants have been selected to represent people within the organization who are very connected, not very connected, and who have average connectivity with others in their knowledge translation (KT) activities. This research is part of [name’s] PhD thesis work.

**Study Procedures:** This study involves 3 phases. **This consent is for the interview phase only.** You may agree or decline to participate in any phase of this research. If you agree to participate, you will be asked to take part in a 1:1 interview lasting approximately one hour. This interview will be audio recorded with your permission and later typed out for analysis. First you will be shown a diagram depicting your position in the KT network within the organization. You will be asked about the extent to which the configuration of this network (i.e. the patterns of interactions reported by you and your colleagues) affects research use, in your experience. You will then be asked about the factors that support or hinder evidence use by researchers, health professionals, leaders and patients and families within the organization, and the outcomes and impacts of KT activities and supports within the organization.

**Potential risks:** The main risk to you stems from the possibility that you may disclose sensitive information. Risks could potentially arise if you were to identify individuals to whom you have provided clinical care, by their real names. In cases where you discuss real clients and a risk of disclosing sensitive information exists, we ask that you please use pseudonyms in order to protect their identities. We will replace any real names that you have mentioned with pseudonyms in the interview transcripts.

Your confidentiality will be protected by labeling all study documents by only a code number and storing them in a locked filing cabinet. Electronic data including audio recordings and interview transcriptions will be stored on a password-protected computer. Only the Investigators and study coordinator, and a professional transcriptionist who has signed a confidentiality agreement, will have access to this data, which will then be stored for 5 years by the research team. Participants will not be identified by name in any reports of the completed study.

**Potential benefits:** We do not know if there will be any benefits to you as a result of taking part in this study. The results will be used to identify strategies to improve the efficiency of evidence use in child development and rehabilitation service delivery and research settings. You may gain insight into your own professional networks and how they influence the use of evidence by you and your colleagues.
Confidentiality: Your confidentiality will be respected. No information that discloses your identity will be released or published without your specific consent to the disclosure. The study coordinator will store the master list of participant code numbers on a password-protected computer in a locked office. The Principal Investigator will store a hard copy in a locked filing cabinet. Research records identifying you may be inspected in the presence of the Principal Investigator or her designate by representatives of Health Canada and the UBC Research Ethics Boards for the purpose of monitoring the research. However, no records that identify you by name or initials will be allowed to leave the Investigators' offices.

Withdrawal from the study: Your participation is voluntary and you may withdraw from the study at any time. Data collected up to the point of your withdrawal from the study must be kept for data analysis purposes under strict provisions of confidentiality.

Compensation for injury: Signing this consent form in no way limits your legal rights against the sponsor, investigators, or anyone else.

Reimbursement/Remuneration: You will not be offered reimbursement for any costs incurred to you as a result of taking part in the interview phase of the study.

Contact for information about the study: If you have any questions or would like more information about this study, you may contact the Principal Investigator, [name], at [phone number]. You may print a copy of this consent form for your records.

Contact for concerns about rights of research participants: If you have any concerns or complaints about your rights as a research participant and/or your experiences while participating in this study, contact the Research Participant Complaint Line in the University of British Columbia Office of Research Ethics by e-mail at [email] or by phone at [phone number].

Consent: Your signature below indicates that you have had the chance to ask questions and to discuss this study with the research team and that your questions have been answered to your satisfaction.

You understand that your participation in this study is entirely voluntary and that you may refuse to participate or withdraw from the study at any time without consequence to your employment.

You understand that you will be contacted if selected to participate in subsequent phases of the study. You will be given the opportunity to consent or to decline participation at each phase.

You consent to take part in the interview phase of the study and have received a signed and dated copy of this consent form for your own records.

<table>
<thead>
<tr>
<th>Signature of Participant</th>
<th>Printed Name</th>
<th>Date</th>
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Signature of Principal Investigator or Designate    Printed Name    Date

For a report on the findings of this study please provide your mailing address (optional):

<table>
<thead>
<tr>
<th>Street Address</th>
<th>City</th>
<th>Province</th>
<th>Postal Code</th>
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Interview Consent Form Version 17-10-2017    Ethics Approval #H17-01732
Appendix J  SNA case study interview guide

Strengthening networks to advance knowledge translation in pediatric rehabilitation

QUALITATIVE INTERVIEW GUIDE

Interviewer: _______________________   Date and time: _____________________________
Participant code: _______________  Audio recording filename: _______________________

DIRECTIONS

As outlined in the consent form, this study aims to identify and explore the factors that influence how evidence is moved into action to inform clinical practice, health policy and further research. The interview will last about 1 hour, and it will be audio recorded.

Before we begin, please remember that everything that you share with us is confidential, and your information or identity will not be shared with anyone unless required by law. Also, please keep in mind that there are no right or wrong answers to these questions, and you do not have to answer any questions that you are not comfortable answering.

SECTION 1: IMPRESSIONS OF NETWORK PROPERTIES

“We are interested in learning about knowledge translation (KT) within the network of professionals involved in child development & rehabilitation (CDR) work at [this organization]. We’ve defined knowledge translation (KT) as the process of moving evidence, including research, into action in clinical practice, policy and research.

You took part in a survey for this project, and I used the data to create a visual representation of the patterns of connections among staff, related to evidence sharing and use, which were reported by you and your colleagues. I’m going to show you the network diagram, and I’d like to hear your impressions about what you see.”

Before we look at the diagram, I would like to go over some cautions about interpreting network diagrams. Firstly, the accuracy of the diagrams is a function of who responded to the survey, their interpretations of the questions, and their recall and reporting of their interactions with others. You may see some people who are highly connected and others who are less, or even unconnected. These connection patterns only depict KT-related interactions (e.g. in activities related to producing the evidence, sharing it, applying it and evaluating its implementation). The diagram does not depict friendship ties, or other patterns of social or professional connections outside the context of KT; seeing that one person is isolated on the network diagram only means that they did not interact with others during KT activities, but says nothing about any other range of interactions they may have within the network. Finally, the network properties that I’ve calculated from the data were chosen because of their theoretical significance, but their practical significance in this network is unknown. The purpose of the first set of questions is to get a sense from you about if and how these findings may or may not be significant to KT in your experience within the organization.

• Review definitions of the network, network properties.
• Ask what their impression of the network structure is
**IN-DEPTH INTERVIEW – START RECORDING**

My analysis of the data suggested that the network [e.g. is not well connected; many subgroups; not a lot of reciprocity; has brokers (bridgers); etc.]. "Who might these people be?"

<table>
<thead>
<tr>
<th>Research Q addressed</th>
<th>QUESTIONS</th>
<th>PROBES</th>
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</table>
| 2a                   | How well does this finding resonate with your experience in the network? | • Does this sound like an accurate assessment, from what you have experienced?  
• How would you have described the network? |
| 2b                   | **How important** do you think [the given network property] is in facilitating or hindering KT in this network? | • **How much does it play a role** in how well evidence is used within the organization?  
• Do you see it as a facilitator, or a barrier? Neither? Both? |
| 2a                   | **How would you describe the extent of your connections** with others involved in CDR within the organization, with respect to accessing, sharing or implementing research evidence? | • Do you feel you are well enough connected?  
• How well does the extent to which you are connected to others enable you to participate in or be effective at KT?  
• With whom would you benefit from being more connected when it comes to KT? |
| 2b                   | To what extent do you think this [network property] influences your access to, sharing or implementing of evidence? | • **How important is it** in your KT work? |
| 2c                   | What do you think led to you having the value you that you do for this network property? | • **What factors influenced your** [network property]? |
| 2b                   | What are your impressions of the network diagram? | • What do you see in the diagram that pops out at you? Why? What impact do you see that having on KT? |
| 2d                   | What **changes to the network**, if any, do you think may be helpful to improve KT capacity? | • For you?  
• For the organization? |
| 2d                   | **How might you go about making changes** to the network to improve your capacity for KT? | • Your network?  
• The whole organization? |

This circle represents your position in the network [show diagram]. The lines that connect you to other circles show the nature of your interactions with other people within [the Organization] and [the Research Institute], in the context of KT. Your personal KT network [property e.g. density] was calculated to be [insert value], which is [above/below/average in the network]. [Network property X] is often used as an indicator of [e.g. the efficiency of information flow].

Interview Guide Version 13-09-2017
### SECTION 2: PERSPECTIVES ON THE CDR KT NETWORK

“We are interested in learning about how evidence is shared and put into action in the organization.”

#### KEY INDIVIDUALS

<table>
<thead>
<tr>
<th>Research Q addressed</th>
<th>QUESTIONS</th>
<th>PROBES</th>
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<tbody>
<tr>
<td>3a</td>
<td>Whose involvement is key in getting evidence into action, and what are their roles?</td>
<td>• <em>Who else</em> is involved? How are they involved</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• <em>What contributions do they make</em> to bring the policy/practice/research changes into effect?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• *Who could or should be more involved? How should they be involved more?</td>
</tr>
</tbody>
</table>

#### BARRIERS AND FACILITATORS OF KT WITHIN THE NETWORK

| 3b 3c                | What conditions or factors support the sharing or uptake of evidence within the CDR network at [the organization]? | Organizational factors?                                               |
|                      | To researchers? To health professionals? To leaders? To patients and families?                        | • Hired personnel?                                                     |
|                      |                                                                           | • Resources?                                                          |
|                      |                                                                           | • Infrastructure (i.e. established systems or processes)?              |
|                      |                                                                           | • Other supports?                                                     |
|                      |                                                                           | • How ready is the organization to engage in KT?                      |
|                      |                                                                           | • Are you aware of any ways in which KT is encouraged or rewarded?   |
|                      |                                                                           | • Are you aware of any goals the organization has set for KT?         |
|                      |                                                                           | • How important do you think KT is for the organization? For you personally? For patients & families? Other stakeholders? |

Social factors:

• Are there people that support or hinder KT processes in the network?
• To what extent do the people with whom you work see KT as part of their role?
• Which people influence your decision to access, share or implement evidence (e.g. team members/leaders/patients)?
• Have you experienced power dynamics playing a role?
• To what extent would you say that your views of KT are shared by your colleagues within the organization?

Individual factors:

• Competencies?
• Are KT activities automatic for you, or do you need to remember or to be reminded to do them?
• Do your emotions or mood ever influence whether you engage in KT, or how you engage in it?
• Is KT something you would prefer to avoid?
• What are your intentions with respect to whether or how you will engage in KT in the future?

Interview Guide Version 13-09-2017
### Questions and Probes

#### Barriers and Facilitators of KT within the Network

<table>
<thead>
<tr>
<th>Research Q addressed</th>
<th>QUESTIONS</th>
<th>PROBES</th>
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</thead>
<tbody>
<tr>
<td>3b 3c</td>
<td>What currently makes it difficult to get evidence into action?</td>
<td>• What are some of the challenges you or others in the network have faced when trying to support evidence use or to use evidence? [repeat above categories &amp; stakeholder groups]</td>
</tr>
</tbody>
</table>
| 3b 3c                | What factors support or hinder integrated KT (i.e. engagement of stakeholders throughout the research process) within the organization? | Prompt with iKT process steps:  
  • Defining the research question  
  • Selecting the research approach  
  • Conducting the research  
  • Identifying a need for evidence or behaviour change  
  • Adapting evidence to the local context  
  • Assessing barriers and facilitators of change  
  • Selecting, tailoring and implementing KT interventions (diffusion, dissemination or applications strategies)  
  • Monitoring, evaluating and sustaining knowledge use |

#### Section 3: Perspectives on KT Supports

“We are interested in learning about your views on KT support needs within the organization.”

<table>
<thead>
<tr>
<th>Research Q addressed</th>
<th>QUESTIONS</th>
<th>PROBES</th>
</tr>
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</table>
| 2d                   | What should be taken into consideration when planning supports for KT? | • Where do you think KT supports are most needed in the network?  
  • Who should be consulted when planning supports?  
  • What kind of evidence should be taken into consideration? |
| 2d                   | What differences are you aware of in terms of how KT is supported in different sectors of the organization? | • What kind of variations are you aware of in:  
  o The resources?  
  o Support personnel?  
  o The location?  
  o Integration with other services?  
  o Patient and family involvement  
  • How do you think services in other organizations compare to those at [this organization]?  
  • How do you think supports have changed over time? |
| 4                    | What impact do you think internal KT supports are making? | • What do you think are the main objectives of KT supports?  
  • To what extent are these objectives being met?  
  • Who do you think KT supports most benefit? (population)  
  • Who do they least benefit?  
  • Why do you think that is?  
  • How do you or your colleagues monitor KT processes & outcomes? |
<table>
<thead>
<tr>
<th>Research Q addressed</th>
<th>QUESTIONS</th>
<th>PROBES</th>
<th>What supports exist?</th>
</tr>
</thead>
</table>
| 2d                   | What do you feel are the **most important changes** that could be made to improve or to facilitate KT? | • **What changes** would you like to see?  
• **What additional supports** are needed? (prompt with each iKT phase: Defining the research question, selecting the research approach, conducting the research, identifying a need for change, adapting evidence to local context, assessing barriers/facilitators, selecting/implementing interventions, evaluating/sustaining change) |

**WRAP-UP QUESTION**

“Thank you for sharing your experiences with us. We have one final question.”

| Any | Is there anything we haven’t discussed about KT, evidence sharing or use within the network that you feel is important for us to know about? |

- **Is it alright to contact you for a ~10min follow-up** if important topics arise in other interviews, that we haven’t discussed?
- **What are your preferred methods/formats** of hearing about key messages for action emerging from this research? e.g. articles, conference presentations, presentation on-site, infographics, video abstract, website with audiovisual summary of the findings, executive summary, policy brief, etc.
- What were your thoughts about the use of the network maps?

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