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debate

Connecting knowledge and action in complex health systems: examples from British Columbia, Canada

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Health systems are comprised of networks of people connected by complex pathways between care delivery, programming, planning and policy (Riley et al, 2015). Every day, people in these networks navigate service needs while facing ever-changing circumstances. Using research evidence to inform how we navigate these demands is essential to finding and testing responsive solutions that promote health (Global Ministerial Forum for Research on Health, 2008). Despite the value of evidence to improve health outcomes and meet needs, a gap between knowledge and action persists (Morris et al, 2011). Bowen et al (2019) reveal that health systems leaders perceive researchers and research as irrelevant and disconnected from their realities.

Table 1: Definitions of key terms

Complexity	Continuously moving, interacting sets of processes, objects, and people that are inherently intertwined and interactive (Cohn et al, 2013). In health systems settings, complexity is a core characteristic of systems – such that any intervention or change requires adaptation from many dynamic parts (Greenhalgh and Papoutsi, 2018; Braithwaite et al, 2018).
Co-production	A collaborative model of research where multiple research user communities are actively engaged in creating and making sense of the process of generating and applying knowledge (Rycroft-Malone et al, 2016; Graham et al, 2019).
Knowledge translation (KT)	'The exchange, synthesis and ethically-sound application of knowledge – within a complex system of interactions among researchers and users – to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and products, and a strengthened health care system', Canadian Institutes of Health Research (http://www.cihr-irsc.gc.ca/e/29418.html (Accessed: 17 February 2020).
Knowledge-to-action (KTA)	A complex set of processes involved in connecting knowledge creation (through inquiry, synthesis, refinement) to policy, practice, decision making, or planning, in collaboration with various users (through action cycles of adaption and application or implementation) (Graham et al, 2006). KT practices and/or science may be integrated in the KTA process.
Knowledge-to-action champions	People who work in or with health systems to support processes of KT or KTA, either in a dedicated role (for example, knowledge broker, research facilitator) or as an ally whose commitment to KT is integrated into their portfolio (for example, directors or managers).

Amid intensely complex health systems and health problems, long-standing research tendencies toward linear approaches and reductionism (Jayasinghe, 2011; Rogers et al, 2013) may contribute to this perception. For research and researchers to contribute meaningfully to knowledge generation or implementation, they must do so in ways that reflect deep understanding of the inherent complexity of health systems (Plamondon, 2020). When people do research with people who use it, reciprocal, balanced, and responsive relationships can adapt to this complexity.

With an emphasis on relationships, knowledge translation (KT) actively guides science, theory, and practice to reduce the gap between what is known and what is done in health care systems (Graham et al, 2006; Kothari and Wathen, 2017). KT is critical in promoting the use of evidence to improve functioning in health systems (Straus et al, 2013), yet much of the KT literature highlights 'successes' in ways that render invisible the challenges of connecting knowledge and action. Publication bias in the peer-reviewed literature (Viswanathan et al, 2018) further obscures the real 'messiness' of KT.

In this article, we argue that a variety of complexity-informed and relationally-centred KT approaches effectively respond to this disconnect and provide examples from several settings (see Table 1 for key definitions). We draw on six instrumental ways that 'champions' can cultivate knowledge-to-action (KTA) in complex systems advanced by Holmes et al (2017): co-produce knowledge, establish shared goals and measurements, enable and support leadership, ensure adequate resourcing, contribute to the science of KTA, and be strategic with communications. These authors called for greater attention to the supports, expertise, and resources needed to support KTA champions in complex health systems. As KTA champions working in a variety of settings, we evolve this debate about research relevance in health systems settings

by arguing for service-orientated and responsive research. We illustrate complexity-informed approaches to health systems improvement and we invite readers to consider embracing complexity in their KTA efforts for better health and care.

Embracing the inherent complexity of health systems

Healthcare and health research systems each come with their own cultures and sociopolitical histories, and all are irreducibly complex (Holmes et al, 2017). In the absence of a single point of control, people working in these systems constantly navigate the implicit and explicit rules of massive and often fragmented bureaucracies. Navigating health systems requires frequent turns in direction, shifting priorities, scrutiny, and public pressure. People working within health systems around the world face exceedingly complex problems that require rapid solutions for which the use of evidence may seem untenable. Overcoming fragmentation is often expected of health leaders, who must negotiate competing demands and respond to shifting, top-down priorities. Change in complex health systems is emergent, unpredictable, uncertain, and urgent; people across the system may be required to change at a moment's notice, and change fatigue can accumulate, especially during shifts in political environment or crises (Hunsaker et al, 2015). A health system's capacity to respond to these shifts demonstrates that *change is always possible, but never guaranteed*.

Within complex health systems, KTA needs to be adaptive, responsive, and flexible (Riley et al, 2015; Holmes et al, 2017). However, inherent complexities can be overlooked, resisted, or even entrenched through dominant discourses that privilege reductionist, linear conceptualisations of problems (Jayasinghe, 2011; Rogers et al, 2013). Although theories of change can guide some of the processes of KTA work (Graham and Tetroe, 2007), they do not always reflect the messy, invisible diplomacy required to cultivate change in fragmented and rapidly shifting systems. Though the bureaucracy of health systems may move slowly at times, it can be extraordinarily nimble, and KTA support must also be nimble to enable the uptake of evidence during these rapid turns (Ellen et al, 2013). The challenge of complexity thus presents an opportunity that, with appropriate responsiveness and the right mix of supports, can be harnessed to narrow the gap between knowledge and action.

In an effort to understand our contribution to narrowing this gap as KTA champions, our arguments draw on our collective reflection on these issues and our distinct positions, roles, and contexts across British Columbia (BC), Canada. Through shared reflection, we discovered common experiences of navigating health systems bureaucracies with a particular kind of diplomacy to cultivate cultures accepting (and expecting) of relevant, validated evidence. Whether in formal or informal leadership roles, or as part of health research or health care systems, we found that each of us supported *people* in broader networks to consider the relationship between what they know, what is more broadly known, and what is being done in practice, process, or policy.

In our roles across different health authorities and funding agencies, we support people to de-implement obsolete practices. We foster innovation. We support decision making. We share a commitment to building strong connections between knowledge and action. And we do it all by embracing the inherent complexities of the systems in which we work. Moving beyond acknowledging complexity in health systems, below we explore strategies and examples from our own experiences as we navigate that complexity. We believe our reflections will resonate across a broad range of

settings, including those where resources are constrained or where research and KT capacity are emergent. Though not every example will be taken up universally, the range we offer speaks to the realities of working *within* health systems to overcome anti-evidence, anti-research or anti-researcher sentiments in ways that demonstrate the value of research and research use as practical tools to respond to complex problems.

How to navigate on-the-ground realities of connecting knowledge and action in complexity

In this section, we reflect on how our work responds to Holmes et al's (2017 six calls to action in the context of on-the-ground realities of our complex health care and health research systems. We offer these examples as a contribution to the debate and dialogue about the relationships (and relevance) of researchers and research in health systems settings. We place particular emphasis on co-producing knowledge because we consistently return to it as a critical pathway to other actions.

Co-produce knowledge

Co-producing knowledge means adopting a collaborative approach to research and KT, where researchers do research with people who will use it (Ottawa Hospital Research Institute, 2018). This approach reshapes traditional hierarchies that elevate the 'researcher' over others on a research team. Co-production explicitly values research *relationships* across a diversity of perspectives, expertise, and skills (Gagliardi et al, 2016; Kothari and Wathen, 2017). A commitment to co-producing knowledge situates the work of KTA as a public good, recognising that public investments in research come with responsibilities for research to respond to public interests. Co-production can be enabled through a variety of strategies across health care and health research systems, including, for example: being innovative about where and how research and KTA-focused positions are integrated (Pauly et al, 2018); universities adapting how academic success is measured (O'Meara, 2010); and funding agencies incentivising co-production through their grant programmes (Tetroe et al, 2008; Holmes et al, 2012). Embracing research *as a public good* requires reimagining the relationships and structures of both research and KTA, and we are encouraged by the many ways this can happen.

When research priorities are set by those who benefit from and use the results, the collaboration produces research questions that resonate with and facilitate engagement from those who deliver and receive care. In one BC health care organisation, researchers and research users co-create solutions through an annual (funded) research programme. In the Practice-Based Research Challenge (Black et al, 2014), problems are identified by point-of-care clinicians. Each team includes an academic mentor, and all teams include patient partners. The programme fosters collaborative relationships for co-producing knowledge (including knowledge about how to mobilise accepted evidence-informed practices) in responsive, applied ways (Black et al, 2015; Johnson et al, 2016). Among the positive impacts of this programme are sustained practice changes and improved care, publications, and conference presentations (Providence Healthcare, 2019). Another health authority holds annual strategic and seed grant competitions for point-of-care clinicians working in collaboration with academic researchers (Van Osch et al, 2018; Gu et al, 2019). These examples of incentives for

co-production drive research from within care settings in response to systems- and community-led questions.

Another structured support for co-producing knowledge is Canada's Strategy for Patient-Oriented Research (SPOR), which encourages partnerships across health systems, universities, and funding agencies to enhance care through research (Canadian Institutes of Health Research, 2011). Patient-oriented research emphasises co-production, with meaningful involvement of people who use and may benefit from the outcomes of research through the process of knowledge generation (Manafo et al, 2018). The BC SUPPORT Unit (itself a collaboration between universities and health authorities, see https://bcsupportunit.ca) is dedicated to advancing patient-oriented research, and has enabled a number of funding opportunities to bring different partners together to develop research through co-production. These include small team grants that require care providers and a clinical or academic researcher to apply with community or patient partners in order to catalyse future research.

Set shared goals and measurement

Extending from co-producing knowledge is the co-definition of goals and metrics used to monitor progress. People need time and opportunity to weigh priorities and articulate goals together. One way this is championed in BC is through a health-system led conference on rural health services research. The biannual event focuses on exploring implications of research in local contexts, and on fostering relationships. The conference features balanced participation from researchers/academics, community and patient partners, point-of-care health professionals, Indigenous leaders, students, municipalities, and other rural government representatives. This gathering place gives people the time and opportunity to develop and sustain relationships that enable people to be responsive partners in doing and using research. As a result of this conference, rural communities in the southern interior of BC are actively engaged in setting shared goals and designing shared processes for measurement in response to rural needs. Though the relational environment of this conference is not easily 'measured', attendees frequently comment on the impact and value of the connections they make there.

Another example of creating time for people to engage in KTA is through annual 'research weeks' that bring together people focused on key health system and community priorities. In one example, people were invited to reimagine the relationship between acquired brain injury and mental health. This KT event framed mental health and brain injury as holistic and concurrent, counter to the current bureaucratic separation of mental health and rehabilitation. Complexity within the individual and complexity in the system were embraced in order to break down silos that themselves separate people into their component parts or needs. By creating platforms (time, place, relational facilitation) for collaboration, these initiatives open possibilities for setting shared goals and measurement.

Another innovation focused on shared goals and measurement is supported by the Michael Smith Foundation for Health Research (MSFHR), BC's provincial research funding agency. MSFHR created a set of evidence-informed KT competencies based on a scoping review. This initiative brought together unlikely partners to generate accessible language and create a digital tool that supports people across diverse settings to develop competencies for doing and using research. The resulting web-based

learning and assessment tool, called 'KT Pathways', allows knowledge producers, users, and brokers to rate themselves on a series of competencies to identify areas of strength and areas for further professional development. KT Pathways administrators can also provide organisation-wide aggregate data on the KT competency levels of its users. This monitoring system will help to target specific areas for growth and training in KT, and can provide data to evaluate change in skills and knowledge over time. Taking the pulse of an organisation's interests and areas of strength overall can inform the design of events that will engage in relevant areas to advance the culture of KT.

These examples demonstrate a wide range of possibilities available for challenging norms in monitoring and reporting on the breadth and scope of KT work across multiple systems. In particular, they demonstrate the need to challenge what 'counts' as success in academia, where individual competition is celebrated and 'excellence' narrowly defined, especially in tenure and review processes that rely on simple counts of publications and grant dollars. Though these may be easy to measure, they do not address complexity or inspire responsive, applied or relational approaches to research. We believe there is opportunity to draw on experiences of KTA champions to identify innovative metrics that reflect complexity. We could pay attention to the number and depth of research relationships, for example through social network analysis (Cvitanovic et al, 2017) and qualitatively monitored metrics in repeated time intervals. We could do more in event evaluations to ask about impacts on practice, policy, and quality of work experience. Such a transformation toward shared goals and measurement suggests a need for inclusivity in defining goals and greater infrastructure and resources to measure and monitor KT. Together, these efforts to create shared goals (and metrics to accompany those goals) that can support more meaningful attention to the value and impact of KTA work.

Enable and support leadership

In 2018, the BC Ministry of Health released an explicit strategy to 'co-develop solutions to health care's toughest challenges' through research and knowledge management (BC Ministry of Health, 2018). Each of our roles as KTA champions demonstrates how health care and health research systems can enable and support the *relational* leadership needed to mobilise this strategic plan. KT is part of all of our job descriptions. We all hold leadership roles, positioned horizontally (that is, with the ability to work across hierarchies in our organisations) so that we can act in service. Most of us hold adjunct academic appointments that enable relationships with universities and other researchers in our province. Many of us are also involved in leadership roles with professional bodies and associations, extending our networks further. We have the privilege of working in collaboration with people from across our entire system, from point-of-care to senior executive teams and everything in between. Working in these horizontal positions enables us to identify influencers whose leverage within their organisation (or across the province) can cultivate a culture of KTA. And importantly, all of us work toward strengthening the relationships between people, groups, and organisations involved in using and doing research.

A few dedicated positions provide especially interesting examples of how health systems in BC are developing KTA leadership. One health system created a Director for Research and KT, as well as a university-appointed Professorship in Cardiovascular Nursing, which is jointly funded by academic and clinical stakeholders with the

support of non-profit agencies. The goal of the Professorship is to foster a highly productive hub of research, education, and practice to improve outcomes and health service delivery – and after just a short time, evaluation is demonstrating significant outputs in each of these areas (Lauck, 2019). Other positions we find promising include embedded KT specialists in specific departments. All of these positions serve to break down silos and enable more nimble navigation of the complexity within our systems. Another exemplar is a dedicated knowledge broker position that spans (and is jointly funded by) a health care system, university, and practice association. This position enables linkage and exchange between research and practice (Hoens, 2019) by providing KT guidance and training, and linking stakeholders to undertake projects of shared importance. Even the use of more traditional measures shows this work to be impactful. The almost 50 projects supported have fostered partnerships between approximately 400 researchers, clinicians, decision makers and patients in clinically relevant research (Hoens et al, 2013; Hoens and Li, 2014), leveraged over 14 million dollars in research funding, and resulted in tools and resources that have been accessed more than 300,000 times worldwide. Collectively, these strategies enable people to engage in the KTA process with meaningful supports that acknowledge the on-the-ground realities of working within large and complex systems.

Ensure adequate resources

Holmes and colleagues discussed the importance of leveraging existing resources in new ways. An example of this is one health authority's launch of an evidence service. BC's health systems are supported by an integral network of embedded librarians and library services, providing access to literature and evidence-informed best practice guidelines. To build on this resource and leverage evidence synthesis resources (for example, SPOR Evidence Alliance*, Canadian Alliance for Drugs & Technology in Health*), the knowledge broker in the research department curates and summarises literature searches requested by programme planners and decision makers. Further, while Holmes et al (2017) note that dedicated KT funding does not encompass the entirety of resourcing KT, it can legitimise its practice, particularly within academic settings. To this end, KT funding that is contingent on engaged and active relationships between researchers and research users in the co-production, implementation, and sharing of knowledge is an important way to encourage and support the development of health system partnerships.

With this goal in mind, health authorities and MSFHR launched designated KT awards. Several health authorities offer small KT-specific grants, and MSFHR offers three opportunities: the Convening and Collaborating grant facilitates relationships between researchers and users as they come together to plan research; the REACH award supports dissemination to appropriate research users; and the Implementation Science teams award supports the implementation and adoption of evidence-based interventions to improve the quality and effectiveness of health, health services and care. These awards provide funding for teams of researchers and research users to study which health system interventions work (and why), and how they could be implemented or scaled up. The granting process is designed to facilitate strong relationships by encouraging intentional team building, capacity building, and training, and by inviting the team to reflect on what facilitates change in practice. In

each granting opportunity, MSFHR incentivises partnership assessment by asking researchers and research partners to complete separate evaluations of experiences, outputs, and impacts.

Advance KT science

Despite rapid growth in the field, and despite the value of doing research with people who will use it, KT science lacks enough evidence to guide practice and inform theory (Kothari and Wathen, 2013; 2017). We embrace complexity through specific initiatives that enable and advance KT science, and we support their rigorous evaluation. For example, the Practice-Based Research Challenge described earlier is being studied for how the model influences and sustains change. We are also using and evaluating methodological innovations around inclusion and relational dialogue. By conducting research-on-research, we're exploring how deliberative dialogue can enable relationality, where mutual understanding and contextualisation (Plamondon and Caxaj, 2017; Plamondon et al, 2015) occur in real time, enabling people to navigate through the quick turns in the health system.

Additionally, the aforementioned knowledge broker position – a unique bridge between academic, professional and practice domains – has enabled a fertile environment for advancing the science of KT. Being embedded in each of these worlds permits 'cross-fertilisation' between policy, research, practice, and education, thereby creating opportunities to build on the existing science and practice of KT. One recent example is a partnership to co-develop a model to describe the role domains of knowledge brokering in health care (Glegg and Hoens, 2016). Although our tacit and experiential knowledge affirms the impact and potential of such a position, current data systems restrict our ability to make explicit links between this commitment and larger-scale outcomes such as improved patient care or population health.

Finally, the national initiative for fostering patient engagement in research enabled the BC SUPPORT Unit to develop infrastructure and dedicate resources to the advancement of the science of KT. The KT/Implementation Science Methods Cluster (https://bcsupportunit.ca/kt-is-methods-cluster) has brought together KT methodologists with patients, health care providers, and health care leaders to undertake collaborative projects that can address gaps in methods from a patient-oriented lens. Current projects include: a comparison of different methods for consensus building; the use of documentary for dissemination; the creation of tools to support systems thinking; an exploration of an approach to implementation science that draws on philosophical hermeneutics; and the development of a new web-based platform based on citizen science, which will transform how patients and the public are engaged in generating research questions.

Communicate strategically

Strategic communication requires diplomacy and organisational facilitation to advance KT. Actors within systems must 'play their part' (Holmes et al, 2017). Yet some built-in barriers exist, particularly when academic merit structures restrict the relationships that researchers can pursue. Further, research and KT roles are not necessarily considered core to health systems. As a result, many of our positions face a degree of uncertainty and can be perceived as a 'nice-to-have' rather than a 'need-to-have'. Few research

positions are integrated into health systems, but when the role is situated between academy and health systems, evidence suggests that KTA processes work better, are adaptive and nimble, and are more aligned (Bornbaum et al, 2015; Cvitanovic et al, 2017). One encouraging way this alignment is being made visible to health systems leadership is through regular briefing notes provided to health authority senior executive teams and boards. Two health authorities use this strategic communication tool to raise awareness about how research and KTA can contribute to understanding and improving our health systems to better serve communities.

Conclusion

Leadership in complex health care and health research systems involves navigating on-the-ground realities. Cultivating a culture of curiosity, learning, and evidence-informed thinking requires attentiveness to leadership, organisational facilitation, change, and the co-production of knowledge. We share Holmes et al's (2017) assertion that research needs to be fully integrated with structure and processes in health authorities. At a time when the relevance of research in health systems settings is debatable, we believe our examples of working as KTA champions offer important insights. We extend Holmes and colleagues' suggestions for co-development and KT in health systems, making visible the many ways that KTA can be enabled in these complex settings. Connecting knowledge with action requires resources, tools, expertise, and time, and invites us to reimagine how we monitor and evaluate impacts. The absence of a single point of control in health systems has specific implications for KT, necessitating diplomacy. Paying attention to both central and distributed leadership, for example, is part of the complex diplomacy needed to cultivate stronger connections between doing and using research.

Importantly, navigating complexity requires overcoming linear thinking and approaches to working through research and KT. Long-standing traditions of linear, reductionist approaches in research can make it hard for researchers to reposition themselves in more adaptive ways. The strategies we present are not *de facto* better for complexity, but they are more suited to it in the *way* they are put into action: with a service orientation focused on what's useful for knowledge users (decision makers and practitioners/care providers) actively working *within* health care systems. Health systems are not sentient entities in and of themselves; rather, they are made up of thousands of people, the vast majority of whom pursue this work because they want to make meaningful contributions to society. Thus, health systems are made up of an extraordinary collection of people who act as leaders on a daily basis, whether they are formally recognised as leaders or not. Understanding the ways in which leadership works, how it is distributed, and how it can be cultivated and supported is critical for shifting the relationships between research, evidence, and health systems. Our experiences illuminate ways in which we can embrace complexity to cultivate relationships that allow KT to occur across health care and health research systems.

Research ethics statement

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KP facilitated group dialogues, organized collective points into early outlines of arguments, and prepared drafts through multiple iterations of the paper. All authors attended group dialogues, contributed to the substantive ideas, and wrote draft examples from their settings. All authors reviewed drafts and approved the final manuscript.

Conflict of interest

The author declares that there is no conflict of interest.

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