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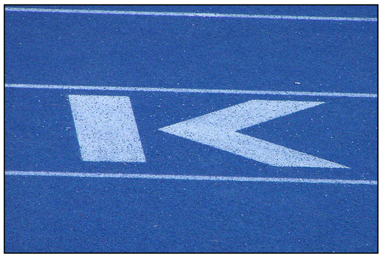

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Knowledge Mobilization

Welcome to the September issue of the *Technology Innovation Management Review*. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

Contribute

Contribute to the TIM Review in the following ways:

- Read and comment on articles.
- Review the upcoming themes and tell us what topics you would like to see covered.
- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
- Give feedback on the website or any other aspect of this publication.
- Sponsor or advertise in the TIM Review.
- Tell a friend or colleague about the TIM Review.

Please contact the Editor if you have any questions or comments: timreview.ca/contact

About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Knowledge Mobilization

Chris McPhee, Editor-in-Chief

Welcome to the September 2016 issue of the *Technology Innovation Management Review*. This month's editorial theme is **Knowledge Mobilization**, and I am pleased to introduce our guest editors, **Cathy Malcolm Edwards**, Managing Director of 1125@Carleton (carleton.ca/1125/) at Carleton University in Ottawa, Canada, and **Kimberly Matheson**, Professor of Neuroscience and Director of Carleton's Canadian Health Adaptations, Innovations, & Mobilization (CHAIM; carleton.ca/chaimcentre/) Centre.

The issue focuses on health, although the insights are more generally applicable to other fields, with or without a technology focus. The emphasis is on the mobilization of the knowledge produced through research. In this way, the insights play an important role in bridging the gap between research and practice, which is the key reason for selecting this theme for the TIM Review.

The authors contributing to this issue represent a diversity of disciplines within the health domain, including child and youth health (Barwick), men's health (Moore et al.), industrial design and human factors (Trudel et al.), physical rehabilitation (Lemaire), older adults (Ysseldyk et al.), and public policy and social work (Braedley). They also bring a variety of perspectives from academia, hospitals, non-profit organizations, community-based researchers, and industry, and from the geographical regions of Australia, Canada, and the United Kingdom.

We hope you enjoy this issue of the TIM Review and will share your comments online.

In October, we feature articles selected and further developed from the 2016 ISPIM Innovation Forum in Porto, Portugal. ISPIM (ispim.org) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

Our other upcoming issues include the themes of Smart Cities and Regions, Innovation in Tourism, and Living Labs. We welcome your submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions.

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. He holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. Chris has over 15 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

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Keywords: knowledge mobilization, knowledge translation, healthcare, planning, research, design

Perspectives on Knowledge Mobilization: An Introduction to the Special Issue

Kimberly Matheson and Cathy Malcolm Edwards

> *“A few years ago I shared an academic journal article I'd written with a colleague who worked for a provincial government ministry and asked him, 'Do you think this article will influence the policy cycle?' He laughed and said, 'No – the decision makers above my level simply don’t read this kind of stuff.' That was a rude awakening! Since then my goal has always been to try and influence policy and practice more directly; that's not going to happen with journal articles alone.”*
>
> Rob de Loë
> Water policy and governance researcher

In this introduction to the *Technology Innovation Management Review's* special issue on Knowledge Mobilization, Guest Editors Kimberly Matheson and Cathy Malcolm Edwards share their different perspectives as an academic and a knowledge broker on the process of knowledge mobilization. Despite their distinctive points of entry into the knowledge mobilization field, they share a common perspective on the value of researchers and knowledge users learning from each other, working together to co-create solutions, and the importance of contributing back into the basic research and training of the next generation. They also provide the context of the authors' contributions to this special issue, noting that the articles are rooted in the authors’ experiences in the health domain, but that they help to understand some of the challenges and rewards of integrating knowledge mobilization into research approaches more generally.

Introduction

What is knowledge mobilization? From our perspective, simply put, knowledge mobilization helps make research useful to society, and does so in a way that solution seeking can itself inform the research agenda. If you were to look for a common definition, however, you could easily become discouraged by the different terms reflecting slightly different variations on the theme: knowledge mobilization, knowledge translation, knowledge transfer. A new term, K*, has been created to help communities focus more on what the nature of the efforts are rather than getting lost in the terminology. What term is used often depends on the discipline, as well as the phase of the exchange between what constitutes knowledge and what constitutes action. The methodologies also differ substantially, depending on the context. Knowledge mobilization can be knowledge-driven, wherein researchers recognize that their empirical findings can have useful applications for developing useful technologies, approaches, or interventions to address problems. Conversely, it can be problem-driven, wherein there is a motivation to collect empirical knowledge in order to identify a solution. Often these motives come from different communities of practice, and too often, there are few bridges between them. One of the goals of this issue is to begin building such bridges, and to contribute to an approach that is more integrative – where researchers and knowledge users both contribute to the knowledge creation process, and both understand the context in which problems exist.

We have used this opportunity to share how we are approaching the promotion of knowledge mobilization as an integral part of research. As an academic (Kimberly Matheson) and a knowledge broker (Cathy Malcolm Edwards), we have different perspectives on the topic of knowledge mobilization. In what follows, we share our different starting points, leading into how this special issue was shaped. The authors contributing to the issue have all framed their approach and what they have learned within the context of the various health case studies in which they played a role. This crossing of partnerships from different disciplines and sectors is never especially easy, and we anticipate that some of the experiences of the others contribute to a recognition that there are challenges, but that there also great benefits from working together to use research to address problems, and to learn for the development of solutions to shape our research directions.

In putting together this issue, we are hoping that the multiple knowledge mobilization efforts that have been implemented to address issues in the health domain raise as many questions for our readers as they provide answers. This approach is characteristic of the knowledge mobilization process – we are all learning. The process of going from knowledge to action is dynamic and is adapted to the social, cultural, political, and environmental contexts in which it is implemented. Sometimes it involves bringing together substantially different worldviews and taking the best from both (i.e., two-eyed seeing). Adapting solutions to a common problem in very different human contexts (e.g., the mental health of younger or older people) is a learning process that sheds light on our gaps of knowledge and unquestioned assumptions.

An Academic’s Perspective (by Kimberly Matheson)

As a Canadian academic (although I am certain that this phenomenon is not limited to Canada), I have seen the concept of "knowledge mobilization" dominate the rhetoric around funded scientific research for at least the past 10 years. This approach emanates, in part, from demands for accountability from those who are paid by the public purse (either in the form of salaries or grant funding) to produce scholarship. The accountability pressures are coming from politicians, government ministries, and funding agencies, and presumably the general public. Superimposed on this background is an increasingly vocal student "clientele" who expect value for their dollar, and in particular that their education will provide them with access to top-paying jobs. Even without the cynicism regarding this sense of entitlement, there is the belief that academic jobs are scarce for those who exit their educational career with doctoral degrees and even postdoctoral experiences, and that these highly skilled graduates need to be prepared to work in the "real world" or be creative and entrepreneurial in their ability to adapt their skills to meet a financially-sustainable social or market demand. In short, whether we have appreciated or resented the expectation that our research have an impact, knowledge mobilization has become an important tool in the academic toolbox.

As researchers, however, it becomes apparent that, if we are to participate in knowledge mobilization, we must go beyond simply doing basic research and then disseminating it by posting a description on our website with a link to the too-often inaccessible jargon-filled journal article that may or may not be behind a paywall. The alternative does not mean "selling out" to commercialize one’s intellectual property or becoming an expert consultant (although no doubt more than a few of us would not mind the potential financial benefits of such courses of action, if only we could figure out who would pay for it). Such approaches to end-state mobilization can (and do) work, but they are typically additional activities that are not integrated into the fundamental approaches we adopt as part of our research paradigms.

Just as many scholars have argued that working with students benefits their research, integrated knowledge mobilization can also be hugely rewarding and can have the capacity to transform our basic approaches. When we understand that there are significant health issues that cannot be solved by one person alone and therefore require teamwork, that even problems that seem to be singularly technical or biological are often determined and resolved as the result of an interplay of other forces (i.e., disciplines), the world becomes a fascinating, complex, and dynamically integrated organism that challenges us to go deeper or go broader, and fundamentally enriches our research and motivates us to keep digging. Integrated knowledge mobilization involves working with people who are not like "us" so that we can get a grasp on what the "big problem" is, and then much like putting together a puzzle without the picture on the box to guide us, we can work together to find a solution… only to discover that the puzzle we have been working on actually fits into another one that others have been working on. What could be more exciting to a scholar?

Sometimes we do not know where our research will bring us, but this is not inconsistent with integrated knowledge mobilization. To the contrary, in my own experience, the challenge of knowledge mobilization is that I do not see from the outset which line of research will hold the key and where the research will land in terms of outcomes, and I have to be prepared for adapting directions if original expectations are either not working or the results are altered (moderated) by other unspecified factors in the situation. The parallels with basic research are clear. But there are differences. As a researcher committed to knowledge mobilization, I no longer "own" the problem or the solution. I bring my own tools to the table and look to see what is called for and what I can contribute. I work with others to determine what problems we will address next – I might be the lead, and I might not. In effect, knowledge mobilization is as much about learning and understanding where there is a pull for your expertise as it is about application and pushing out what you have produced. These are the synergies that make knowledge mobilization a worthwhile challenge for scholars and partners alike.

A Knowledge Broker's Perspective (by Cathy Malcolm Edwards)

After 10 years in the private sector, I decided to come work at a university because I wanted to be a part of something bigger – to make a difference in the world. I always believed that research had the power to transform society but I became frustrated through my experiences in the private sector, where research impact was measured in dollar signs or the almighty patent. I was attracted to the knowledge mobilization space because of connectedness: connectedness between research and impact and connectedness between people, values, and social good. For years, I was acting as a knowledge intermediary or broker between research and industry or not-for-profit organizations without knowing that there was an actual name for what I was doing. This role became key to crossing the divides between academia and the rest of the world. Researchers needed to find a strategy for getting uptake for the findings that excited them – the world outside of academia needed the expertise to help them have a positive impact.

Given the novelty of the role of knowledge broker, establishing strategies for sharing best practices (i.e., mobilizing knowledge mobilization itself) is why a special issue like this one is so important. It allows us to learn from one another's experiences so that we can all do a better job of moving knowledge into practice and products. Building information-sharing networks is also important in this regard, and there are numerous examples of such networks in Canada and internationally. For example, ResearchImpact (RIR; researchimpact.ca) is a pan-Canadian knowledge mobilization network dedicated to maximizing the impact of academic research for public good in local and global communities (social, cultural, economic, environmental, and health). Development Research Uptake for Sub-Saharan Africa (DRUSSA) is a network of 22 African universities that are building capacity for universities to support knowledge mobilization (research uptake). Not only do networks connect knowledge brokers but they offer the supports for developing institutional capacities in knowledge mobilization by developing and sharing best practices, services, and tools.

As will be evident from some of the articles in this issue, it takes a willingness to let yourself be vulnerable to do meaningful knowledge mobilization. In order ensure that the relevant stakeholders get timely access to the information they need and for the “lived experience” of users/community to drive the project, you may need to put aside your personal agenda and to challenge your own disciplinary/sectoral approaches to become a part of something bigger. As noted earlier in this introduction, different sectors use different terms or may be focused on different elements of the K* spectrum and somehow, for the benefit of the project, you will be required to navigate through the unknown. This is no easy task. A lot of the projects that I have worked on are dealing with complex social issues such as poverty, inequality, and climate change. Not only do they require cooperation across disciplines, they fundamentally affect our lives. As a member of a project team, you are called to remain objective, especially when there is passionate debate and discussion. It is important to allow all participants to see their voice represented in the outcomes, or the whole exercise can backfire. This process is facilitated through practices such as participatory action research and processes/tools such as design thinking.

The next generation of leaders is demanding support in acquiring the skills and necessary worldview to make a difference. Currently, I have the pleasure of working with students who are motivated and determined to be change makers. Each student had an idea of the social change that they wanted to create in the world – they had their "why" but were missing the "how". With other non-academic partners, the students are learning entrepreneurial and critical thinking skills that will translate to starting up their own social enterprises, affecting policy change, or acting as intrapreneurs in organizations needing a culture shift. Each one of the students is ready to make change – they will become 21st century knowledge brokers, connecting ideas to practice and practice to impact. If we do this right, soon we will have as much to learn from this new generation as they have to learn from us today.

About This Special Issue

There already exist numerous broad-based publications regarding the process of knowledge mobilization, various templates and tools that can be used to set about incorporating knowledge mobilization into a research design, and case studies that describe the impact of research through the process of participatory research designs. This special issue is intended to complement existing research by pointing to some key elements that are sometimes overlooked in terms of their importance, or sometimes not talked about at all, resulting in a sense of disillusion among researchers and stakeholders alike. In this issue, we examine to the importance of systems-level thinking from different viewpoints.

In the first article, Melanie Barwick, Head of the Child and Youth Mental Health Research Unit at The Hospital for Sick Children in Toronto, Canada, describes the development and application of the Knowledge Transition Planning Template, which supports knowledge transition planning for scientists in health and other sectors. She discusses how the user-driven field of healthcare led to a change in frameworks for funding health research, which in turn, led to the change across government funding agencies wanting to see the direct benefit to everyday Canadians. She also highlights that, in order for this framework to be successful, capacity building is a must.

In the second article, Gabriel Moore and colleagues from the Sax Institute and Movember Foundation also represent the perspective of systems change within an organization. The Movember Foundation set out to facilitate knowledge translation/mobilization through their grants process in order to ensure that the knowledge generated through their funding reaches the appropriate knowledge users. These authors provide insights and resources for those who are trying to develop a strong knowledge mobilization strategy.

It is hard to find a field where the importance of the end user is more prevalent than in health. Even when we think we have got it right, we sometimes encounter challenges that are not addressed in knowledge mobilization templates or frameworks. As a strategy for anticipating the unanticipated, Chantal Trudel at Carleton University in Ottawa, Canada and her colleagues at the University of Nottingham, England, and the Ottawa Hospital in Ottawa, Canada, demonstrate the value of a human-centric approach throughout the research including in the pre-design phase. This approach enables better identification of what users actually need, in this case, to meet the requirements with respect to hand washing and attenuating spread of infectious disease in neonatal units. Trudel and colleagues note that solutions that were "obvious" to designers were not perceived as viable, and that pre-design research helps anticipate when ready-made solutions are not going to work. They argue for a multi-method approach that provides rich data.

Another critical issue in the knowledge mobilization process is to provide timely information to end users. Edward Lemaire at The Ottawa Hospital Research Institute’s Centre for Rehabilitation Research and Development reflects on the pace of change for assistive devices and how current research methods cannot keep up. Using carbon-fibre ankle–foot orthoses as a case study, Lemaire introduces the challenges rehabilitation specialists face when confronted with trying to select from the almost 70 different devices on the market and to anticipate the expected clinical outcomes for a target population. New methodologies are needed to support evidence-based decision making that balances both the need for controlled research with the need for timely decision making.

Indeed, timing can be everything to researchers and developers too. Renate Ysseldyk and Angela Paric from Carleton University, together with Tracy Luciani from Artswell in Ottawa, Canada, share their insights regarding the process of applying evidence-based theory to develop interventions to improve the well-being of hospitalized older adults (some with dementia). Ysseldyk and her colleagues highlight how community-based research can benefit the participants, but benefits to the objectives of researchers and developers are sometimes slow in coming. In particular, the authors share their experience of trying to implement and assess an intervention within a complex care context, and the many challenges encountered, ranging from shifting institutional priorities to ethical considerations. These factors can require a considerable time investment at the front end of the process, and can even result in a shift in the objectives or scope of the research itself.

Perspectives on Knowledge Mobilization: An Introduction to the Special Issue

Kimberly Matheson and Cathy Malcolm Edwards

A readiness to reconsider one's research objectives might also be an inherent aspect of knowledge mobilization that attempts to address "hot" or contentious issues. Susan Braedley, at Carleton University shares her work in the highly politicized world of unionized and sectored emergency services and highlights the need for stakeholders to share common values that can guide decision making throughout the knowledge mobilization process. Braedley notes the need to talk about the potential flashpoints when providing training or encouragement in knowledge mobilization. Politics can result in partners having to compromise values or walk away, and diminishing the likelihood of such a choice being made points to the need to have a clear articulation of goals, engaging different perspectives, and sharing information throughout the process. No doubt Braedley's experiences will resonate with academic and stakeholder partners alike.

Conclusion

This issue is not intended to be a comprehensive template or guidebook to knowledge mobilization. Many of these already exist and are easily accessible online. Instead, we want to provide readers with a sense of optimism regarding some of the challenges others are encountering as they embark on the difficult task of transcending perspectives, paradigms, and sector-specific priorities to be able to come to a common understanding of what is needed to create solutions. How can optimism come from sharing challenges? Because it creates an opportunity to learn from each other, a recognition that these challenges are par for the course and not a function of our own abilities, and that when you come out the other end, the value of the effort was worth it.

About the Authors

Kimberly Matheson is the Joint Research Chair in Culture and Gender Mental Health at the Royal Ottawa's Institute of Mental Health Research and Carleton University. She is also a Professor in the Department of Neuroscience, and the founding Director of the Canadian Health Adaptations, Innovations, & Mobilization (CHAIM) Centre at Carleton University in Ottawa, Canada. She is a health psychologist that brings a recognition of the critical role that social determinants play in the health and well-being of disadvantaged or marginalized populations. Her recent work is in partnership with communities and organizations in Northwestern Ontario to promote resilience and well-being among First Nations youth.

Cathy Malcolm Edwards is Managing Director of 1125@Carleton and has an enthusiastic appreciation for the power that research has to improve lives and the world we live in. Her client-centric approach fosters open dialogue, promotes collaborative engagements and encourages successful relationship management practices. As Managing Director of 1125@Carleton, Cathy provides strategic direction as well as guidance to and opportunities for collaborative research and engagement. She is also cofounder of the Born Social Fellowship, a leadership program that inspires youth to create a more just and sustainable world through action and impact.

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Keywords: knowledge mobilization, health, partnerships, interdisciplinary

Building Scientist Capacity in Knowledge Translation: Development of the Knowledge Translation Planning Template

Melanie Barwick

> *A little knowledge that acts is worth infinitely more than much knowledge that is idle.*
>
> Kahlil Gibran (1883–1931)
> Poet, philosopher, and artist

The last fifteen years have seen a fundamental shift in the importance of knowledge translation in health research and clinical care. Health research funders have incorporated knowledge translation into their missions, strategic directions, and funding opportunities, encouraging knowledge translation and implementation science and requiring knowledge translation practice from researchers working across the health research pillars – basic, clinical, health services, and population health. Healthcare and research organizations have changed their landscape as well, hiring knowledge translation practitioners to bridge research and practice for a range of knowledge users. Universities are shifting criteria for academic promotion to incorporate knowledge translation. Growing attention to knowledge translation in research, practice, and scholarship has created a need for researchers and practitioners to develop knowledge translation skills and competencies related to their research, scholarship, and organizational activities. The Knowledge Translation Planning Template was developed to support knowledge translation planning for scientists in health and other sectors. This article provides an overview of the rationale for its development, introduces the tool components, and describes preliminary indicators of impact.

Introduction

Effective knowledge translation is viewed as essential for closing the research-to-practice gap in health research and clinical care (Balas & Boren, 2002; Morris et al., 2011) and ensuring a more efficient and effective use of research innovations in practice and policy. Knowledge translation is a global consideration (Tetroe et al., 2008). Health research funders in Canada, as elsewhere, have incorporated knowledge translation into their mission, strategic directions, and funding opportunities, thereby encouraging knowledge translation and implementation science and requiring knowledge translation practice from researchers working across the health research pillars – basic, clinical, health services, and population health (Ellis, 2014; Tetroe et al., 2008). Healthcare and research organizations have changed their landscapes as well, hiring knowledge translation practitioners to fulfill this responsibility (Barwick, Bovaird, & McMillen, manuscript in preparation).

The growing attention to knowledge translation in research and practice has created a need for both researchers and practitioners to develop new skills and competencies in knowledge translation practice, related to their research, academic, or to organizational activities. It is in this context that the Knowledge Translation Planning Template was developed to support knowledge translation planning. There is increasing expectation globally that researchers will be able to demonstrate the "real world" impact of their research, requiring them to think strategically about their work and how it can be applied in practice (e.g., Collie et al., 2016). The first step in achieving this aim is to consciously plan their knowledge translation activities. Few studies have explored the knowledge translation activities of researchers (e.g., Barwick et al., in preparation; Nedjat et al., 2014; Newton et al., 2007; Wilson et al., 2010), and we know of no other tools focused on supporting this important activity other than several that have been based on the Knowledge Translation

Planning Template. This article provides an overview of the rationale for the tool's development, introduces the tool components, and describes preliminary indicators of impact.

Shifting the Research Paradigm: Changes at the Funding Agency Level

The Canadian Institutes of Health Research (CIHR; cihr-irsc.gc.ca) has an explicit mandate to excel in "the creation of new knowledge and its translation into improved health for Canadians, more effective health services and products, and a strengthened Canadian health system" (Ellis, 2014). CIHR has targeted promotion of knowledge translation research through funding grants, including strategic initiatives; built knowledge translation networks that recognized collaboration by researchers and knowledge users; strengthened and expanded their internal knowledge translation capacity, which included advising CIHR on internal peer review for effective knowledge translation assessment in research application; and supported and recognized knowledge translation excellence through an annual award for excellence in knowledge translation. CIHR also instituted funding for Canada Research Chairs in Knowledge Translation, following in the direction of the Canadian Health Services Research Foundation (CHSRF) which had emerged several years earlier in 1997, although it is now the Canadian Foundation for Healthcare Improvement (CFHI; cfhi-fcass.ca). Further efforts to link knowledge translation activities to impact are evident in the knowledge translation section of the Canadian Common CV (CVV; ccv-cvc.ca), utilized by the three Federal funding bodies – the CIHR, the Natural Sciences and Engineering Research Council (NSERC; nserc-crsng.gc.ca), and the Social Sciences and Humanities Research Council (SSHRCC; sshrc-crsh.gc.ca), and in CIHR's final report criteria (CIHR, 2012), which request detailed information about the knowledge translation activities related to the completed CIHR funded project, including knowledge users, form of engagement, knowledge translation activities and deliverables, and impact (evaluation).

In Canada, CIHR and CHSRF have been instrumental in building knowledge translation science through new funding opportunities. Specific funding opportunities were directed at encouraging integrated knowledge translation, defined as "an approach to doing research that applies the principles of knowledge translation to the entire research process" and involving knowledge users as equal partners alongside researchers to lead to research that is more relevant to, and more likely to be useful to, the knowledge users (CIHR, 2004). In time, other Canadian research funders followed, including, but not exclusively, the Social Sciences and Humanities Research Council of Canada (SSHRCC), as well as provincial funders such as Alberta Innovates Health Solutions (AIHS), Nova Scotia Health Research Foundation (NSHRF), and Michael Smith Foundation for Health Research (MSFHR).

CIHR was among the first research funders to request a knowledge translation plan as part of the scientific proposal submission. They requested that researchers provide an account of how their research would contribute to the creation and application of health-related knowledge through a wide range of research and knowledge translation activities, including relevant collaborations and knowledge user partnerships. Researchers are permitted to budget for knowledge translation activities within the proposal submission, and this is a key facilitator for researcher buy in. Anecdotally, the request for a knowledge translation plan was met with some measure of alarm and confusion by the scientific community, likely because of a perceived lack of preparedness to address this demand. For the most part, researchers simply did not know what a knowledge translation plan was or how to develop one, and many simply did not perceive the relative advantage of engaging in knowledge translation. This is not surprising given that, as Bauer and colleagues (2015) noted, "historically, the research-to-practice gap has not been the concern of academic clinical researchers". Along this line, some expressed concern that sparse research dollars would be directed away from research toward knowledge translation activities that were perceived to be questionable in their intent, utility, and effectiveness. Mostly, however, scientists were lacking knowledge translation knowledge and skills, and were rather perplexed about the form and development of a knowledge translation plan. It was in this changing context that a unique opportunity for professional development emerged.

Shifting the Research Paradigm: Changes at the Practice Level

Alongside the changes taking place among research funders was a shift in knowledge translation practice in the clinical realm during this time. A range of institutions, including non-profit, research, academic, public health, and voluntary health organizations worked to re-vision their strategic plans to incorporate knowledge translation, often instituting dedicated resources for knowledge translation practitioners to function as resident experts and knowledge brokers or intermediaries. Given that knowledge translation practice is an emerging profession within a dynamic landscape, it would be difficult to estimate how many individuals occupy knowledge translation roles across Canada. An informed guess would be a minimum of 173 individuals, based solely on the number of Canadian Knowledge Translation Community of Practice members (out of the full membership of 1422 individuals) who list knowledge translation within their job title (see www.ktecop.ca). A recent survey of knowledge translation practitioners across Canada (Barwick, Bovaird, & McMillen, submitted for publication) found that knowledge translation planning and development was a role responsibility for 68% of the respondents (N=130). Despite the importance placed on this task, 26% report having no educational training that is relevant to their knowledge translation role, and 89% have learned knowledge translation on the job. Seventy-five percent would like to receive knowledge translation training, including how to develop a knowledge translation plan (51%).

Research exploring the knowledge translation activities among health researchers suggests room for improvement. A study conducted with health researchers from three Alberta universities reported that applied researchers reported engaging in significantly more Mode II activities than basic researchers (i.e., activities that share research with decision makers and policy makers, to promote research knowledge creation and transfer based on the needs of knowledge users in the health care system) (Newton et al., 2007). Applied researchers also placed more importance on Mode II activities than their basic researcher counterparts. A similar study undertaken with UK-based publically funded applied and public health researchers reported that most recognized the importance of and appear committed to research dissemination, however most dissemination activity beyond the publishing of academic papers appears to be undertaken in an ad hoc fashion (Wilson et al., 2010). The conclusion appears to be that, while there is a good level of interest in knowledge translation, researchers need guidance and how best to plan, resource, and facilitate their knowledge translation activities.

Shifting the Research Paradigm: Changes in Academia

The knowledge translation landscape within academia is also undergoing a shift. Universities in Canada (see engagedscholarship.ca) and beyond (see ccph.memberclicks.net) are revising academic promotion criteria to include knowledge translation activities alongside the standard scholarship in teaching and research. By example, in the University of Toronto’s Department of Psychiatry and Faculty of Medicine more broadly, faculty can go forward for promotion on the basis of their research, teaching, and a newer category of scholarship called creative professional activity, which includes knowledge translation activities. Creative professional activity is increasingly recognized, alongside research, educational scholarship and sustained clinical and teaching excellence, as a category of scholarship that captures valued contributions to the academic enterprise that are deserving of consideration for promotion. The University of Toronto’s Faculty of Medicine recognizes creative professional activity under the following three broad categories: i) professional innovation and creative excellence (e.g., developing of an invention, development of new techniques, conceptual innovations, or educational programs); ii) contributions to the development of professional practices (e.g., in the form of leadership in the profession, or in professional societies, associations, or organizations that has influenced standards or enhanced the effectiveness of the discipline); and iii) exemplary professional practice (e.g., that which is fit to be emulated; is illustrative to students and peers; establishes the professional as an exemplar or role model for the profession; or shows the individual to be a professional whose behaviour, style, ethics, standards, and method of practice are such that students and peers should be exposed to them and encouraged to emulate them). Creative professional activities must be linked to research to provide an overall assessment of scholarly activity. (For additional information on the university's evaluation criteria, see University of Toronto, 2015).

The Development of the Knowledge Translation Planning Template

Although the emerging knowledge translation demands of the funding agencies have been key drivers for change in practice and academia, these shifts have been met by a lack of preparedness on the part of clinicians and researchers. However, importantly, the growing attention to knowledge translation across sectors has created an imperative for both researchers and practitioners to develop skills for knowledge translation planning as it relates to research, academia, or organizational activities. To this end, the Scientist Knowledge Translation Training course (Barwick et al., 2005) was developed through SickKids Research Institute and CHSRF funding (2004–2007) to assist researchers in developing their knowledge of knowledge translation, its application and relevance to their own research, and in the development of knowledge translation planning skills that could be applied to: i) research funding proposals and ii) to the subsequent conduct of successful projects to increase the impact of their work. During this time, the Knowledge Translation Planning Template was developed to assist with the knowledge translation planning task (Barwick, 2008, 2013).

The purpose of the Knowledge Translation Planning Template is to provide an evidence-informed framework for the development of a knowledge translation plan that incorporates what we recognize as the main components of knowledge translation. The Knowledge Translation Planning Template was informed by grey literature in knowledge translation planning (Goering et al., 2010; Reardon et al., 2006), the author's vision and experience, and two syntheses of evidence-based knowledge translation strategies for supporting practice change (Boaz et al., 2011; Grol & Grimshaw, 2003). Two groups in Toronto – the Institute for Work and Health (www.iwh.on.ca) and the Health Systems Research Consulting Unit at the Centre for Addiction and Mental Health (camh.ca) – were pioneers in capturing the basic components of knowledge translation planning. The Institute for Work and Health developed a workbook (Reardon et al., 2006) that proposes a framework to support knowledge translation planning. The Health Systems Research Consulting Unit at the Centre for Addiction and Mental Health, under the leadership of Dr. Paula Goering, also developed a knowledge translation framework, which they disseminated through coursework and within a knowledge translation document prepared to support grant reviewers at CIHR (Goering et al., 2010).

The Knowledge Translation Planning Template was designed to guide researchers, clinical educators, and knowledge translation practitioners through the knowledge translation planning process in a stepwise manner such that the core elements of knowledge translation planning are considered. Importantly, the Knowledge Translation Planning Template is an evidence-informed tool. For instance, the tool requests identification of key knowledge translation strategies – a core component of the template – and refers to the current state of the evidence base for knowledge translation strategies (Boaz et al., 2011; Grol & Grimshaw, 2003). In addition, the tool captures plans and methods for integrated knowledge translation based on an extensive amount of academic literature that describes how the involvement of knowledge users in the research process will increase the uptake of research results and improve the relevance of research findings (Cargo & Mercer, 2008; CIHR, 2013; Israel et al., 1998; Lomas, 2000; Macaulay et al., 2011). In contrast to open call researchers working in all types of health research, a CIHR evaluation of their knowledge translation funding found that researchers involved in integrated knowledge translation were more likely to report influencing their study stakeholders, health system/care practitioners, patients and consumers of healthcare, healthcare managers, healthcare professional organizations, federal/provincial representatives, community/municipal organizations, as well as consumer groups and charitable organizations (CIHR, 2013). Thus, the Knowledge Translation Planning Template is designed to support effective and evidence-informed knowledge translation of research to practice by knowledge translation practitioners and researchers alike. It is applicable across the health research pillars (i.e., basic, clinical, health services, and population health) and across sectors (i.e., health, mental health, education, social sciences, and environmental sciences).

Finally, reflecting on the Knowledge Translation Planning Template through the lens of the consolidated framework for implementation research (Damschroder et al., 2009), the tool meets several of the characteristics associated with implementation success: i) low cost and complexity; ii) careful attention to its design and quality; iii) strong evidence base; iv) trialability or the possibility to try its use and change course of action, if needed; and v) relative advantage, which is a user's perception of the advantage of implementing the tool versus an alternative solution.

Structure and Educational Objectives

The Knowledge Translation Planning Template is available as a downloadable static or fillable worksheet, and it is organized as 13 core planning steps/components:

1. Identifying the project partners

2. Degree of partner engagement

3. Partner roles in the knowledge translation planning

4. Knowledge translation expertise on team

5. Targeted knowledge users

6. Research findings presented as main messages

7. Knowledge translation goals, such as building awareness or interest, informing research or policy, or changing practice

8. Knowledge translation strategies to be used to meet the knowledge translation goals

9. Knowledge translation process, such as integrated or end of grant activities

10. Indicators of knowledge translation impact and evaluation metrics

11. Resources needed to actualize the plan

12. Related budget items to include in funding proposals

13. Details of how the knowledge translation strategies will be implemented

By using the Knowledge Translation Planning Template, the researcher or user learns the key components of knowledge translation and becomes better equipped to apply them in practice. Although these key components are elaborated upon in the related aforementioned workshop, the user can work through the tool independently given some background knowledge in knowledge translation. As such, the planning activity focuses on the application of new learning (i.e., Blooms revised taxonomy of learning domains; Pohl, 2000). By learning to actively plan, the user is able to demonstrate that they can use knowledge translation concepts in a new situation as they follow the steps to produce a knowledge translation plan that is relevant to their project or research endeavour. Use of the Knowledge Translation Planning Template also activates the user's ability to analyze the core components of knowledge translation, another higher-order learning objective, as the user outlines in stepwise fashion the core elements of the plan as it pertains to the project or research endeavour and describes the knowledge translation goals, strategies, and evaluation metrics for each targeted knowledge user. The user evaluates or makes judgments about the core components by selecting knowledge translation goals, strategies, processes (integrated or end of grant knowledge translation), and metrics. The final higher-order learning objective reflected in this exercise is the ability to create a plan, putting the component parts of the planning process together to form a type of logic model that will guide the knowledge translation activities for a project or research endeavour.

Deployment and Accessibility

The Knowledge Translation Planning Template is included as an educational component of two professional development opportunities: the Scientist Knowledge Translation Training Workshop (Barwick et al., 2005) and the Knowledge Translation Professional Certificate (Barwick et al., 2011). The Knowledge Translation Planning Template is available at no cost on the Internet at two locations:

- http://www.melaniebarwick.com/training.php
- http://www.sickkids.ca/Learning/AbouttheInstitute/Programs/Knowledge-Translation/Resources/LI-KT-Planning-Template-Form.html

In its most recent revision (2013), the tool outlines the entire planning process in successive columns and provides space for the user to write out the plan as it develops. No other materials are required. It is recommended that the plan be developed collaboratively by the research or project team, inclusive of knowledge users, as appropriate.

Limitations

Users with little knowledge in knowledge translation may experience some difficulties in using the tool without support. To address this, an e-learning module describing the core knowledge translation planning components and use of the tool is under development by the Knowledge Translation Program in the Learning Institute at the Hospital for Sick Children in Toronto (planned release, October 2016). A further limitation is that users with no Internet access or access to the knowledge translation courses mentioned above may not be aware of the tool or able to access it.

Complementary Tools

The Knowledge Translation Game (Barwick, 2009) is a card game that incorporates the core elements of knowledge translation planning, as defined by the Knowledge Translation Planning Template, and it is useful for active learning of the knowledge translation planning process. Knowledge Translation Game cards identify the process, knowledge translation strategies, and knowledge translation user audiences that are integral to a knowledge translation plan for a scenario depicted on knowledge translation scenario cards or for a project or research endeavour of the users' own choosing. The Knowledge Translation Game is available for purchase from Cvent (www.cvent.com/d/44qs3m).

Impact Metrics and Evaluation

Reach is a measure of impact insofar as it identifies connection with one's potential audience. Reach metrics indicate how far content is disseminated and to how big an audience. The Knowledge Translation Planning Template has been disseminated and taught to over 2,300 Scientist Knowledge Translation Workshop participants since its development in 2008, and to 242 Knowledge Translation Practitioner Certificate participants since 2010. It has been viewed by over 20,000 unique visitors who have visited the website (www.melaniebarwick.com) from 152 countries. From the perspective of engagement, it has been downloaded over 10,000 times between January 2014 and August 2016.

Since its development, several organizations and authors have developed similar tools and resources to assist in knowledge translation planning and activities, and many more have adopted the Knowledge Translation Planning Template in its original format (e.g., Canadian Centre for Substance Abuse; Parachute; Michael Smith Foundation for Health Research; EENet; York University Knowledge Mobilization Unit; Health Care Programs and Policy Directorate at Health Canada; Ontario Agency for Health Protection and Promotion). Others have, with permission provided earlier on in its developmental history, adapted the Knowledge Translation Planning Template for their own purpose (e.g., Institut national de santé public Québec; Health Care Programs and Policy Directorate at Health Canada). Adaptations are no longer encouraged or permitted to protect against violation of intellectual property. The tool is currently undergoing a translation to French. An extension version is under development by the Center on Knowledge Translation for Technology Transfer at the University of Buffalo to capture knowledge translation activities in the commercialization realm: (see tinyurl.com/hn7ge9l).

Conclusion

Several changes to the research, practice, and academic landscapes have encouraged and facilitated knowledge translation capacity building across Canada, and others are looking to Canada as they develop their own national capacity and scientist competencies (e.g., Australia, England, Ireland, Scotland). With the maximization of healthcare value becoming a global imperative, there is both an urgency to ensure health research is relevant and accessible to a range of knowledge users, and that science can have demonstrable impact including but reaching beyond contribution to research to inform behaviour, practice, service, and policy. As an evidence-informed knowledge translation planning tool, the Knowledge Translation Planning Template contributes to capacity building by improving knowledge translation knowledge and supporting knowledge translation planning amongst researchers and others responsible for bridging the research to practice gap. It is a widely disseminated innovation, crossing the borders of 78% of the world's countries, has been emulated widely, has been incorporated as a core knowledge translation planning tool in many organizations, and continues to be highly accessed eight years following its development.

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Development of the Knowledge Translation Planning Template

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Implementing Knowledge Translation Strategies in Funded Research in Canada and Australia: A Case Study

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> “*Having knowledge but lacking the power to express it clearly is no better than never having any ideas at all.*”
>
> Pericles (495–429 BC)
> General, statesman, and orator

There is an emerging literature describing the use of knowledge translation strategies to increase the relevance and usability of research, yet there are few real-world examples of how this works in practice. This case study reports on the steps taken to embed knowledge translation strategies in the Movember Foundation's Men’s Mental Health Grant Rounds in 2013–14, which were implemented in Australia and Canada, and on the support provided to the applicants in developing their knowledge translation plans. It identifies the challenges faced by the Men’s Mental Health Program Team and how these were resolved. The strategies explored include articulating knowledge translation requirements, ensuring a common understanding of knowledge translation, assessing knowledge translation plans, methods of engaging end users, and building capacity with applicants. An iterative approach to facilitating knowledge translation planning within project development was rolled out in Australia just prior to Canada so that lessons learned were immediately available to refine the second roll out. Implementation included the use of external knowledge translation expertise, the development of knowledge translation plans, and the need for internal infrastructure to support monitoring and reporting. Differences in the Australian and Canadian contexts may point to differential exposure to the concepts and practices of knowledge translation. This case study details an example of designing and implementing an integrated knowledge translation strategy that moves beyond traditional dissemination models. Lessons learned point to the importance of a long lead-up time, the use of knowledge translation expertise for capacity building, the need for flexible implementation, and the need for efficiencies in supporting applicants.

Introduction

There is an increasing emphasis on the need to integrate knowledge translation strategies into funded research processes to ensure research is relevant to identified needs and prompts action. For example, Sibbald, Tetro, and Graham (2014) and Hoeijmakers, Harting, and Jansen (2013) describe research partnership approaches to increasing the relevance of research and its use in policy and practice; Grimshaw and colleagues (2012) provide guidance on targeting research summaries and syntheses to particular audiences; Ruppertsberg, Ward, Ridout, and Foy (2014) point to the need to develop audit criteria to assess knowledge translation plans in health research proposals. Yet little is known about how research funders implement knowledge translation strategies in their grant processes or how they support applicants in developing knowledge translation plans in real-world contexts.

This article presents a worked example of how an international not-for-profit organization, the Movember

Foundation, integrated its commitment to knowledge translation into the grant process through which it funds new research projects. A case study of the grant rounds for the Movember Foundation's Men's Mental Health Program is used to illustrate the steps taken by the Program's team to embed knowledge translation strategies in organizational operations and provide support to applicants to develop knowledge translation plans in the Men's Mental Health Program Grant Rounds, in order to identify key actions, share the lessons learned, and build capacity in the wider research sector.

The Movember Foundation's Knowledge Translation Strategy

The Movember Foundation (movember.com) is an independent, global men's charity that funds and establishes major programs of work to drive improvements for its prioritized men's health issues: prostate cancer, testicular cancer, and mental health. Operating in 21 countries, the Movember Foundation's focus is to address gaps in knowledge and in effective programs pertaining to men's health, with a focus on prevention and treatment in these key areas.

In September 2014, the Movember Foundation commissioned the Sax Institute in Australia (saxinstitute.org.au), to work with them in designing an organization-wide Knowledge Translation Strategy that would use a comprehensive approach to integrating evidence-based knowledge translation activities across the spectrum of its programs. The strategy was developed in consultation with the Movember Foundation's staff from Canada, the United Kingdom, and Australia, who had oversight of major biomedical and health services funded research programs and of the implementation of population-level programs in men's health and men's mental health. Engaging staff from each country in which the programs were funded was considered essential to capture the diversity of programs, stages of development, and local contexts in which the programs were funded and implemented.

The plan encompassed four action areas: funded research, knowledge mobilization, networking and collaboration, and infrastructure. Together, these action areas were intended to embed knowledge translation in the Movember Foundation's own operations as well as in its major funded programs. This integration would help ensure that evidence from its funded research and knowledge gained through its population-level interventions would reach its target audiences in a way that was tailored to their needs and would prompt action. Key audiences included the Men's Health Partners who had carriage of major funded programs; organizations who could effect change based on the results of its funded research; men with lived experience of prostate and testicular cancer and mental health problems; and the community more broadly.

The Knowledge Translation Strategy included a three-year implementation plan with identified objectives and accountabilities as well as detailed strategies specific to each of its major program areas. In May 2015, the Movember Foundation finalized its Knowledge Translation Strategy and in November launched its public version (Moore et al., 2015): tinyurl.com/za66y2x

Consistent with the Movember Foundation's mission, the Knowledge Translation Strategy was intended to support and increase the impact of programs on the health and wellbeing of men and boys, through changing policy, practice, and research. Specifically, the Knowledge Translation Strategy sought to promote new knowledge from research and innovation that would advance treatment, care, and survival for men diagnosed and living with cancer, and would improve the physical and mental health and wellbeing of men and boys at a population level.

While the Knowledge Translation Strategy addressed organizational strategies broadly, it also provided detailed guidance on strategies for each of the Movember Foundation's key program areas, which were to be followed by implementation plans to be used in all countries. One of these key program areas was the Men's Mental Health Program.

The first task for the Men's Mental Health Program was to develop a detailed implementation plan targeted to the goals of the program. The implementation plan identified actions to be taken, the target audience, where the impact of each strategy should be observed, who would be accountable, what resources would be required, and what the first steps in implementation should be. The plan was completed early in 2016.

The implementation plan drew on the experience of the Men's Mental Health Program, which embedded knowledge translation strategies into its grant rounds in Australia in 2013 and in Canada in 2014 and is described in detail below. These were the organization's first attempts at integrated knowledge translation planning in its funded research, an approach described by Graham and Tetroe in 2009, and crystallized issues that would need to be addressed in the development of the organization's Knowledge Translation Strategy and in the later design of the Men's Mental Health Programs implementation.

Key Implementation Challenges

In developing the Movember Foundation's Men's Mental Health Program implementation plan, seven challenges were identified:

1. *Different contexts.* The implementation plan was to be enacted in very different contexts, in Canada, the United States, the United Kingdom, and Australia, with their different cultures, programs, and populations. Implementation strategies cannot be universal (Research Councils UK, 2014; Kings College London & Digital Science, 2015) but must be sensitive to context and circumstances (LaRocca et al., 2012). This requires a degree of flexibility in knowledge translation planning that enables the incorporation of local knowledge and facilitation, making each unique (Kitson et al., 2008).

2. *Consistency and responsiveness.* Implementing the plan would require balancing a consistent approach with flexibility in responding to the different contexts, stakeholders, and needs. Known as the fidelity/adaptation dilemma (Cherney & Head, 2010), this is an enduring challenge where responsivity to context, while vital, risks the loss of core content or standards (Bond et al., 2000).

3. *Applicant capacity for knowledge translation.* Applicants submitting knowledge translation plans are likely to have differential expertise in knowledge translation and may require different levels of support. The complex mix of factors that influence individual capacity to engage with knowledge translation have been acknowledged (Dobbins et al., 2001; Scott et al., 2008) and are reflected in some knowledge translation frameworks (e.g. Graham et al., 2006) and theories (Ottoson, 2009).

4. *Program capability to support knowledge translation.* The Men's Mental Health Programs Team needed a realistic assessment of its capability to support knowledge translation implementation. Capacity is often intangible and is likely to differ considerably across any organization (Kaplan, 2000). Further, knowledge translation itself is multifaceted, fuzzily defined (Straus et al., 2009) and was a relatively new practice cornerstone in the Movember Foundation. More recently, tools are being developed that assess differential capacity for knowledge translation within organizations (e.g. Makkar et al., 2016a; Makkar et al., 2016b) pointing to their important role in implementation.

5. *Rapid learning.* Embedding an action research approach that would enable lessons learned in implementation in the early funded programs to be promptly identified and shared to inform the development of new programs. The complex systems in which implementation takes place almost inevitably result in unpredictable interactions, which may strengthen or weaken knowledge translation efforts (Dixon-Woods et al., 2011). Effective knowledge translation planning is adaptive and thus maximizes the use of this information (Jones, 2011).

6. *A systems approach.* Monitoring and reporting systems were needed that would address accountability and contribute to the Movember Foundation's own understanding of best practice in knowledge translation. This approach was intended to maximize learning from experience and find ways to integrate this into everyday practice in a process of continual improvement. As the literature on learning organizations indicates, this requires effective data collection, knowledge management, and strategic leadership that nurtures an adaptive work culture (Senge, 2014).

7. *Infrastructure for knowledge translation.* Structures were needed that could enable grant recipients to share new knowledge produced by the funded projects, and to contribute to the developing understanding of and capacity for knowledge translation. Similar issues have been identified by others (Househ et al., 2011; Kothari et al., 2014; Wathen et al., 2011).

Addressing the Challenges

To describe how these challenges played out and were addressed in a concrete way, this case study reflects on the implementation of the Men's Mental Health Grant Rounds, rolled out in Australia in late 2013 and in Canada in early 2014. A summary of the strategies used in addressing the challenges is provided in Table 1.

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Table 1. Strategies used to address the seven challenges

Challenge	How the Challenge Was Addressed
1. Different contexts	A planning template was designed with broad questions and a requirement for responses to address contextual factors.
2. Consistency and responsiveness	The standardized approach was balanced with support to ensure plans were targeted to local contexts, including access to knowledge translation expertise in the application phase and suggestions about relevant resources.
3. Applicant capacity for knowledge translation	Access to knowledge translation expertise was provided for all applicants, using web conferences and a Q&A process. Mentoring by knowledge translation experts was provided to grant recipients to ensure a comprehensive and targeted approach to knowledge translation planning and implementation, and to build skills in key competencies such as in using conceptual frameworks, engaging potential partners, and managing co-production in the design, implementation, and evaluation of funded projects.
4. Program capability to support knowledge translation	Grant rounds in both Australia and Canada were managed by the same Men's Mental Health Program Team, with external knowledge translation experts invited to participate in weighting and assessing knowledge translation plans.
5. Rapid learning	Rapid identification of issues as the first grant round was implemented and the ways in which these were resolved was integral to the process. The staggered implementation meant lessons learned could be integrated without delay.
6. A systems approach	Existing monitoring and evaluation processes were adapted to include knowledge translation, with capacity building for the monitoring and evaluation team. Additional monitoring was provided in the symposium (see Challenge 7).
7. Infrastructure for knowledge translation	A symposium was held and included consultation about the development of a community of practice.

Both the Australian and Canadian grant rounds used the Men's Mental Health Request for Applications and were similar in application format and priority areas, with the application and review process managed by the same Men's Mental Health Program Team.

In introducing knowledge translation requirements into the grant rounds, the Men's Mental Health Team were able to draw on professional opinion about what might work, on their own experience of implementing knowledge translation activities, and on a somewhat limited evidence base about the effectiveness of knowledge translation strategies. Evidence of strategies' effectiveness is particularly limited in the mental health domain (Williamson et al., 2015).

Articulating knowledge translation requirements

The Men's Mental Health Team's expectations regarding the knowledge translation plans of the Request for Applications were made clear from the outset; projects required an integrated knowledge translation strategy in order to be funded. Applicants were required to outline how the knowledge produced from the project would be disseminated and used to influence and inform practice, in alignment with the project's goals. The end users of this knowledge were to be identified and engaged in the project's design early in its development; end users were broadly conceived and included men with a mental health problem, their families, community members, and practitioners. In addition, applicants were directed to the five areas identified by the

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Canadian Institutes of Health Research (CIHR; cihr-irsc.gc.ca) that contribute to successful knowledge translation strategies: goals, audiences, expertise, strategies, and feasibility in terms of financial, human, and in-kind resources. (See CIHR peer review resources: cihr-irsc.gc.ca/e/37790.html).

In setting forth requirements for knowledge translation plans, the Men's Mental Health Team anticipated that these would generate mixed results. For example, some applicants may be more familiar with the end-of-grant knowledge translation approach (Graham & Tetroe, 2009), which focuses on publication and presentations of research findings; others may agree in principle with a co-production approach (Heaton et al., 2016), but might lack the skills or networks to make this is a reality in advance of submitting an application. The Men's Mental Health Team therefore decided to provide access to knowledge translation experts for successful applicants whose knowledge translation plans needed further development. This approach would build capacity in the grant recipients, ensuring that funded projects included sound knowledge translation strategies.

Communicating knowledge translation requirements to applicants

The next task was to ensure that applicants were provided with consistent information to support the development of their knowledge translation plans in an easy and comprehensible format. The need for such assistance has been acknowledged by others; for example Proctor and colleagues (2012) provide ten "tips" for writing grant proposals. In the emerging field of knowledge translation however there are few such guides. The CIHR talks about the need to clearly communicate their knowledge translation vision to applicants (CIHR, 2012) and Barwick provides an example of a knowledge translation template to guide researchers (Barwick, 2008).

The Men's Mental Health Team devised a written Knowledge Translation Planning Template (see Appendix 1) and provided webinars shortly after the release of the Request for Applications in both countries. This was followed by consolidated Q&As, made available online and emailed to those who had indicated an intention to submit. Additionally, questions from individuals were shared for consideration by applicants prior to submission. This consolidated document was available in both official languages in Canada (i.e., English and French) and this was intended to address the fact that applicants may have very differing levels of exposure to or experience of knowledge translation.

The strategy was successful to a degree; however, the reviewers assessing the knowledge translation plans in the Australian grant round provided some pertinent feedback. The majority of proposals addressed the question of stakeholder engagement (often limiting this to the design stage), but failed to consider strategies in the implementation stage of the project. Most plans lacked the detail needed to demonstrate how the strategies would actually be operationalized or sustained. There was a lack of familiarity with the literature on the effectiveness of knowledge translation strategies and a lack of awareness about theories, models, and frameworks that might support implementation; the reviewers pointed to Colquhoun and colleagues (2014) as an example, and we are aware of others (e.g., Ottoson, 2009; Sudsawad, 2007). The Men's Mental Health Team's expectation that applicants would prioritize traditional dissemination through peer reviewed publication and presentation was also realized.

Assessing and weighting knowledge translation plans

The first grant round assessed the knowledge translation plans against three criteria:

1. The proposal contains a comprehensive knowledge translation strategy detailing how knowledge produced from the project will be shared and disseminated, in alignment with the project's goals and to prompt changes.

2. Recipients of the knowledge generated by the project have been identified and engaged in the project's design.

3. The knowledge translation strategy addresses how new knowledge gained through the project can be applied at a population level to change practice and behaviour.

In the second round, and to prompt a more considered approach by the applicants in Canada, the Team drew on the approach from Ruppertsberg and colleagues (2014) and worked with two well established knowledge translation experts, one of whom developed new criteria to assess the plans. These criteria were then used by both reviewers.

In addition, consideration was given to how to weight knowledge translation plans within the Request for Applications, using a "merit review" process similar to that described by the CIHR (2011), where the scientific merit and the potential impact are assessed using separate scores, and the assessment panel includes a re-

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searcher and a knowledge-user. In line with its definition of stakeholders, the Men's Mental Health Team took a somewhat different approach. The panel included researchers, practitioners, and men with lived experience of mental health problems. Applications were given a combined score, aimed to measuring the likelihood that the project's outcomes will support the creation, dissemination, and translation of new knowledge that would lead to behaviour change and improved mental health and wellbeing for men and boys.

Allowing for differential expertise in knowledge translation among applicants in these initial grant rounds, the panel looked for "good bones" for knowledge translation, the presence of the critical elements outlined above, and factored-in mentoring for successful applicants as a condition of funding. The flexibility in this approach was engineered to address the third challenge described above.

Monitoring and reporting on knowledge translation
In addition to establishing systems to promote and assess knowledge translation in the Request for Applications process, the Men's Mental Health Team also needed to set up monitoring and reporting systems to evaluate the implementation of the funded projects, to allow for the organization's understanding of knowledge translation to develop, and to have systems in place that would capture learning in an ongoing way.

The Men's Mental Health Team used the existing Movember Foundation system of "report cards" (au.movember.com/programs/strategy), which enables information about projects to be reviewed and in part uploaded to the Foundation's website to promote learning and transparency. Additional questions pertaining to knowledge translation were added to the annual internal project reporting process. This is consistent with Graham and colleagues (2006), who discuss the importance of monitoring knowledge translation to know how new knowledge is implemented and to assess which strategies are most effective.

Enacting a "learning organization" approach
Given the very tight timeline between the roll-out of the grant rounds in Australia and Canada, the Men's Mental Health Team identified a window of opportunity to learn from the Australian implementation and apply this learning to improve the process for the Canadian implementation. For example, based on feedback from the reviewers of Australian knowledge translation plans, and working with two Canadians with knowledge translation expertise, the requirements were adjusted in the second round to include an additional paragraph that provided applicants with greater guidance:

> *"It is important to note that 'knowledge translation' is not merely the dissemination of project information and findings. Knowledge translation is fundamentally about practice/behaviour change and ensuring that the project learnings are implemented by others. In particular, given that the Movember Foundation's strategic goal for this project is to contribute to change at a population level, the knowledge translation strategy should address how new knowledge gained through the project can be applied at a population level."*

The staggered implementation across the two countries allowed early learning about guiding applicants in preparing knowledge translation planning in the Australian grant rounds to be rapidly taken up in the grant round in Canada,

Mobilizing knowledge
With its grants rounds in place, the Men's Mental Health Team turned its attention to systems to enable researchers to share their experiences of implementing knowledge translation strategies, to build relationships with their fellow researchers, and to identify ways to improve their knowledge translation plans. The symposium served a dual purpose as it also enabled the Men's Mental Health Team to communicate and clarify its expectations of grant recipients as they worked through their projects.

At the symposium, grant recipients were asked about their interest in developing a community of practice, a group of people who engage in collective learning around a shared endeavour (Wenger-Trayner & Wenger-Trayner, 2015). This idea resonated with the recipients and was formally included in the Men's Mental Health Programs' implementation plan. The development of a framework to underpin the community of practice is now in the design phase, and an online survey of needs has been undertaken. A pilot will be conducted late in 2016 and full implementation will include open access for all those who might wish to learn, collaborate, or network in the field of men's mental health. Opportunities for face-to-face interaction are also envisaged.

Key Learnings

Allowing sufficient lead-up time
Integrating knowledge translation into the Request for Applications process and designing strategies to sup-

port applicants may have benefited from a longer lead-up time than the Men's Mental Health Team had at their disposal. Further, the implementation of the grants round in Canada followed swiftly on the Australian round, leaving little opportunity for the Men's Mental Health Team to investigate and evaluate other models of embedding knowledge translation into funded programs.

In addition, implementing new processes in two continents while developing new systems to support knowledge translation added to the complexity. A longer lead-up time would have allowed a more in-depth exploration of the lessons learned in others' experiences of integrating and implementing knowledge translation strategies into grant funding models and more time to review their effectiveness and transferability to the Men's Mental Health grants rounds context.

Addressing the fidelity/adaptation dilemma
The need for consistency in core components and diversity in their application is an established principal in competitively funded research processes. The Men's Mental Health Team built this flexibility into the grant applications, as the core knowledge translation components were listed and explained, and the applications were each specific to its own context, population, and identified needs. This is a relatively new aspect of knowledge translation, however, and aligns with the literature on co-production where the end product is negotiated among stakeholders and integrates diverse views (Heaton et al., 2016). Given the international context in which the grant rounds were operationalized, it would be worth exploring this in greater detail with a view to assessing its effectiveness.

Finding efficient ways to support applicants
Given the critical lead up time, the Men's Mental Health Team chose to support applicants through webinars and a Q&A process. The decision to supplement this universal approach with mentoring for grant recipients was intended to address the weaknesses identified by reviewers, in advance of projects' implementation. However, it is not clear whether the improvement in the quality of the knowledge translation plans in the Canadian round was due to the changes made to the processes, stimulating a more considered approach among applicants, or arguably, to a more widespread culture of knowledge translation in Canada compared to Australia, or to the Men's Mental Health Team's access to a larger and more established pool of knowledge translation experts in Canada. Determining whether to target resources for capacity building to the application phase, or to successful recipients, or both, will be something for the Men's Mental Health Team to review in future grant rounds. It is possible that, as a culture for knowledge translation planning becomes more widespread, a less resource-intensive process will be needed. Standardized approaches such as webinars and information materials will also be developed.

Conclusions

This case study details the Movember Foundation's experience of designing and implementing an integrated knowledge translation strategy in its grant review process and moves beyond traditional dissemination models. Lessons learned point to the importance of a long lead-up time, the use of knowledge translation expertise, the need for flexible implementation, and potential efficiencies in supporting applicants. These lessons may be of value for other agencies.

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Appendix 1. Mental Health Commission of Canada (MHCC): SPARK Training Workshop – Knowledge Translation (KT) Planning Template (Page 1 of 3)

MOVEMBER FOUNDATION MEN’S MENTAL HEALTH PROGRAM: ENGAGING APPLICANTS IN CREATING AND INTEGRATION KT STRATEGIES (VERSION 1)

Step 1: State the Purpose of Your KT Plan

It’s important to begin the KT process by describing what you would like to accomplish. What is your reason for doing KT? Answering these questions will better prepare you to build a KT plan.

- What problems are you trying to address?
- What are your objectives?
- What practice or policy are you trying to improve?
- What are the desired outcomes?
- What would be different if this knowledge were translated successfully?

Step 2: Select an Innovation

An Innovation is a product, action, service or relationship that has the potential to enhance health outcomes. (It is not the approach to delivering KT.) Is the Innovation specific enough? Is the Innovation feasible?

- What is the Innovation you want your target audience to know about/use?
- What is the knowledge base for this Innovation?

Appendix 1. Mental Health Commission of Canada (MHCC): SPARK Training Workshop – Knowledge Translation (KT) Planning Template (Page 2 of 3)

Step 3: Specify Actors and Actions

If the Innovation is to be taken up by your organization or community, certain stakeholders (actors) will need to adopt new behaviours (actions). This step helps you recognize the actors who need to change and the actions they need to adopt, after which you will be in a much stronger position to plan your KT activities: you will know to whom you are presenting the Innovation and what you want each person to do.

- Actors:

- Actions:

Step 4: Identify Agents of Change

An agent of change is someone who motivates actors to adopt new actions. Agents of change include individuals or organizations who can effectively deliver knowledge and foster action. The effectiveness of an agent in creating change often depends upon the actors who need to change.

- Actors:

- Agents of change:

Step 5: Design your KT Plan

You're here! Many people, when they first approach KT, want to start at this phase. KT will be most effective when it is carefully planned and has an active rather than passive quality, which is why the first four steps of the I2I (Innovation to Implementation) are in place. Understanding which methods work most effectively for specific actors will allow you to select the KT method that is most appropriate.

KT ACTION PLAN

What do you need to do, in which order and by when? Who needs to be involved? What resources will you need? What are the potential barriers to success? How can you overcome these barriers?
- Task
- Who needs to be involved?
- Resources needed (funding, people, skills)
- Potential barriers
- Which KT methods are available to you?
- Which methods are appropriate for the particular actors who are meant to adopt this Innovation?

Ensure that your KT Method is Interactive, Targeted and Tailored, Engaging, Endorsed, Championed, Action Oriented, and Persuasive.
- Potential solutions
- Completion date

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Appendix 1. Mental Health Commission of Canada (MHCC): SPARK Training Workshop – Knowledge Translation (KT) Planning Template (Page 3 of 3)

Step 6: Implement the KT Plan

You might choose to implement your KT plan all at once or in a gradual manner. Where there is low readiness to adopt the Innovation, it may prove best to use a phased approach to implementation, in which the Innovation is gradually introduced to different parts of the organization, system or community. Also, as you implement your plan, it is useful to get feedback through the use of actor consultations (e.g., interviews, survey, and focus groups) to get feedback about the KT process.

A few important questions to consider before implementing your KT plan:

- Is the KT plan perceived as appropriate and acceptable by the relevant actors?
- Are there particular elements of the plan which are not seen as acceptable or appropriate?
- Is the Innovation perceived by actors as effective and important?
- Is the Innovation perceived by actors as feasible in their organization, system or community?

Step 7: Evaluate Your Success

A number of evaluation frameworks have been proposed – but we have chosen to apply the RE-AIM framework developed by Glasgow and colleagues, primarily due to its emphasis upon sustainable system-level changes.

- Reach: Did the target population receive the intervention?
- Effectiveness: Did the intervention have its intended effect?
- Adoption: Was the intervention adopted by its intended users?
- Implementation: Was the intervention implemented with high fidelity to its essential features?
- Maintenance: Was the intervention maintained in practice over long-term follow-up?

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Developing Tacit Knowledge of Complex Systems: The Value of Early Empirical Inquiry in Healthcare Design

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> “*To know that you do not know is the best.*
> *To think you know when you do not is a disease.*
> *Recognizing this disease as a disease is to be free of it.*”
>
> Lao-Tzu (6th–5th century BC)
> Ancient Chinese philosopher

Infection prevention and control has been the subject of much study in medical and epidemiological research and a variety of best practice guidelines have been developed to support healthcare workers and related stakeholders. Yet, despite the availability of information, managing healthcare-associated infections remains a challenge because the relevant explicit knowledge is not being adequately developed and mobilized as tacit knowledge for use "on the front lines". Some researchers have called for a human factors perspective to help address challenges in designing for infection prevention and control, but relatively few studies have been conducted to date. Researchers also suggest that empirical inquiry is needed to better inform the design process, and particularly the design of complex systems where attention to detailed processes and interactions can support the success of an intervention. A human factors approach can help designers develop a deeper understanding of work processes, technology considerations, as well as physiological, psychological, cultural, and organizational factors. The need is particularly pressing in low-resource healthcare environments where funds, time, and human resources may be scarce and strategic design decisions based on evidence are needed to support meaningful and effective changes. With this in mind, a human factors study was conducted in an existing neonatal intensive care unit to identify the influence of product and environment design on infection prevention and control and to inform recommendations for improvement. In this case study, we illustrate how the application of an empirical, methodical approach can help design professionals and stakeholders develop tacit knowledge of complex systems – knowledge that can be used to better inform design priorities, the design process, decision making, and the allocation of resources to help maximize improvements.

Introduction

Every year, more than 200,000 patients in Canada acquire an infection while receiving healthcare and more than 8,000 die as a result (Public Health Agency of Canada, 2013). Infections can arise from the entry and multiplication of a microorganism in a person’s tissue (Public Health Ontario, 2012a, 2012b). As healthcare workers perform tasks, they circulate among patients, objects, and surfaces, thereby creating opportunities for transmitting microorganisms and possibly contributing to the spread of hospital-acquired infections. Newborns hospitalized in neonatal intensive care units are particularly vulnerable because of inherent risk factors such as low birth weight, underlying illness, undeveloped immune systems, and greater skin permeability. Other risk factors include poor staff-to-patient ratios, crowded environments, and exposure to invasive devices (Public Health Ontario, 2012a, 2012b).

These challenges point to the need for more care in the study of design for infection prevention and control. Best practice guidelines and protocols do exist to prevent and control infections; the key challenge is developing and mobilizing the tacit knowledge required to realize the intended improvements.

Currently, there are two basic protocols in infection prevention: i) routine practice, which is a fundamental requirement used on "all patients at all times in all healthcare settings" (Public Health Agency of Canada, 2012) and ii) additional precautions, which include a more rigorous process required when risk assessments performed on a patient suggest extra barriers are needed to mitigate the risk of infection transmission. Four "moments" of hand hygiene (Figure 1) are recommended in routine practice to break the chain of infection transmission. But in neonatal care, five moments are recommended, with an additional hand hygiene step required prior to entering the neonate environment (Public Health Ontario, 2012a). Despite the prevalence of guidelines for infection prevention and control and new technologies focused on improving survival rates and outcomes, infectious complications in neonates is challenging for healthcare institutions (Pessoa-Silva et al., 2007). For example, a survey of 997 pediatric patients across 19 Canadian hospitals revealed that 80 children had a combined total of 91 healthcare acquired infections (or 9.1 % of patients surveyed) (Gravel et al., 2007). The study also showed that the highest prevalence of healthcare associated infections was in the neonate age category. This group was 1.5 times as likely to have a healthcare associated infection than all other groups combined.

Some common reasons given for poor compliance with infection prevention measures include: poorly located and insufficient quantities of sinks and hand sanitizers (e.g., Graham, 1990; Muto et al., 2000; Pittet, 2000); poorly located supplies (e.g., Hendrich, 2003); lack of knowledge of protocols or disagreement with protocols (e.g., Pittet, 2001); perceptions that the risk of transmitting infections is low; perceptions that protocols interfere with staff–patient relations; perceptions that patient needs take priority over hand hygiene (e.g., Pittet, 2001); and issues such as understaffing, forgetfulness, insufficient time, and high workload (e.g., Archibald et al., 1997; Pittet, 2001; Ulrich et al., 2004). This brief list illustrates the broad range of considerations in infection prevention and control, and researchers are suggesting that multimodal, multidisciplinary, and systemic approaches are needed to adequately address the scope of issues (Alvarado, 2012; Pessoa-Silva et al., 2007; Pittet, 2001).

Here, we present the results of a study into the challenges of infection prevention and control experienced by a neonatal intensive care unit (NICU) as a case study

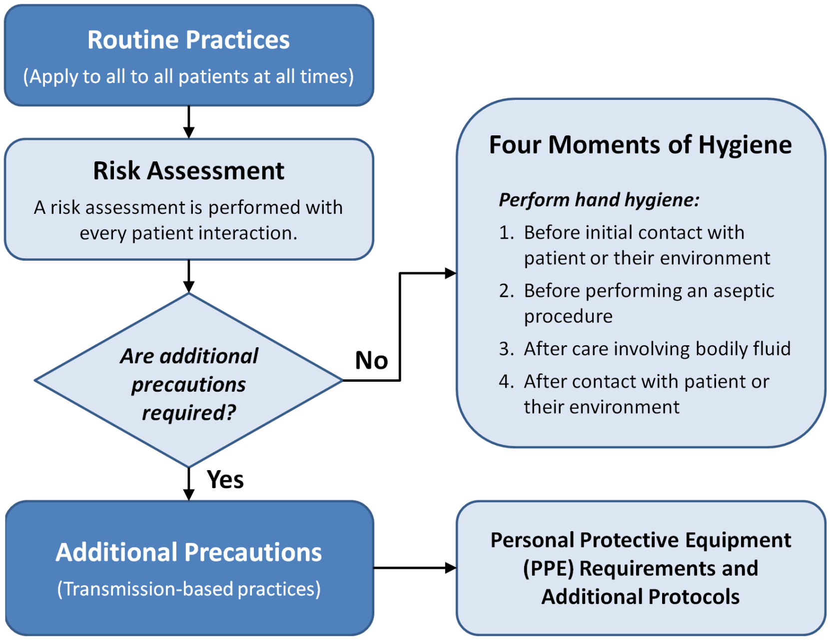

Figure 1. The "four moments" of hand hygiene in routine practice

of the broader issue of knowledge mobilization in complex systems. We discuss the rationale for the study design and briefly outline the methods and the principal outcomes that were developed from applying the approach. The two main outcomes from the study are: i) a framework illustrating what healthcare workers are experiencing in infection prevention and control and how this relates to design and ii) the NICU IPAC [Infection Prevention and Control] Design Exploration Guide, which categorized issues and opportunities for future study and design development.

Another, less obvious outcome that we discuss is the benefits associated with the inquiry process itself in facilitating a deeper knowledge of the issues – knowledge that led to the development of the NICU IPAC Design Exploration Guide. The process required a thorough and systematic approach to data collection and analysis, which we propose helped improve our understanding of the issues healthcare workers are experiencing in infection prevention and control. We provide evidence that suggests human-centred design can deepen our knowledge of complex work and support a more informed path for designing in the field.

The Existing Context and the Need for Pre-Design Investigation

The context of this study, a Level III neonatal intensive care unit (NICU), was renovated prior to the introduction of standards for NICU design, which recommend single patient rooms, appropriate space per infant, and dedicated hand-wash sinks for each patient (White, 2006, 2007). Apart from these basic considerations, stakeholders explained that "adhering to "the five moments" of hand hygiene was difficult due to the nature of their work in relation to the design of products and their environment. As a result, the unit adopted the "four moments" model and zoned the unit into the hospital environment and the patient environment (Figure 2). In this model, healthcare workers were required to perform hand hygiene before contact with each zone, bring only sterile supplies into the patient environment, and disinfect items moving between zones in order to break the potential path of pathogen transmission. Despite reports of high hand hygiene compliance (approximately 90%) during the time of the study, the unit wanted to improve measures to support infection prevention.

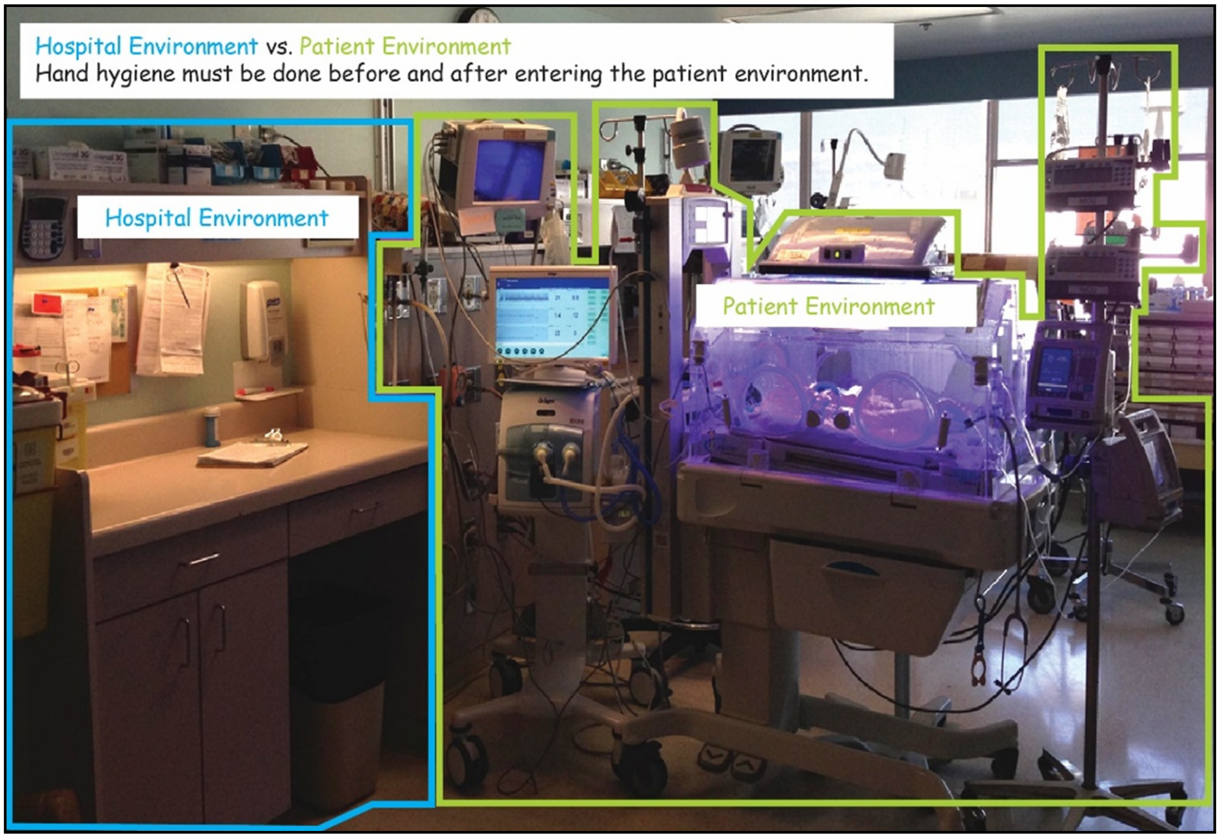

Figure 2. Zoning of the patient environment and the hospital environment in the neonatal intensive care unit

Stakeholders suggested their main challenges in infection prevention and control involved overstocking of bedside supplies, shared equipment, and workflow relationships to products and the environment. The researcher, who had past experience in healthcare design, asked if supply carts had been considered to replace the bedside counter, given that some were capable of being decontaminated, could move with the patient if needed, and might provide opportunities for mounting and organizing supplies and accessories. This suggestion was met with hesitation by stakeholders, who felt this would not resolve their challenges. However, they were interested in studying the issue in greater depth and using the knowledge developed in the study to inform future design initiatives. Considering the health and safety and financial risks involved in developing an effective strategy for improvement, the value of conducting empirical inquiry early on – indeed prior to – developing specific design interventions was clear.

Support for Empirical Inquiry in the Design of Complex Systems

There is growing interest in using empirical inquiry prior to design to help inform development (Brehmer et al., 2014). Friedman (2003) has voiced concerns with designers taking on increasingly complex projects, stating that failures and issues related to design are commonly due to a "lack of method and absence of systematic and comprehensive understanding". In discussing architecture, Remjin (2006) highlights several problems with top-down design approaches, including that they rely too heavily on: the objectives and goals set by management; the past experience of the architect, which may not necessarily fit the project needs; and generalized programmatic requirements, which may not recognize the difficulties and intricacies of complex work. Remjin (2006) notes that, in “a complex work situation it is plausible that practice differs from the expected situation by architect and perception of management” and that this can lead to designs that do not support work processes.

A human factors/ergonomics approach in design focuses on minimizing the effects of constraints, complementing the strengths and abilities of end users, and not forcing people to adapt to undesirable conditions (Chartered Institute of Ergonomics and Human Factors, 2016). These principles are supported by analyzing existing conditions as well as possibilities for new states or situations (Remijn, 2006). The experiences and perspectives of front-line workers, as well as goals set by management, are incorporated to develop a "systems approach" to generating proposals. A systems perspective may also help identify factors that can improve a situation outside the traditional domain of design (e.g., the impact of education and training) or outside a particular field of design (e.g., the impact of product versus architectural design).

The Study Design

Data collection methods from human-centred design frameworks (see ISO 2015,; Maguire, 2001) can help foster a greater understanding of front-line workers, their tasks and objectives, and the greater work context (Rogers et al., 2012). Data collection methods for human-centred design, such as naturalistic observation, encourage participant feedback during observations, which can help people — particularly in complex work — explain what they do (Rogers et al., 2012).

With regards to analyzing data, thematic analysis respects the natural context of the phenomenon by integrating the views and experiences of participants to support an in-depth understanding of their situation (Vaismoradi et al., 2013). The process involves familiarizing oneself with the data, generating codes, searching for themes among codes, and defining themes to produce a framework (Braun & Clarke, 2006) that can move analysis beyond describing individual experiences (Guest et al., 2012) to theorizing why certain behaviours are prevalent. Coding actions keeps the codes tied to activities, reducing the tendency "to make conceptual leaps” from the data (Charmaz, 2014) and helps support the validity of the interpretation (Saldaña, 2009). The resulting framework serves as an organizing principle for illustrating and disclosing the interpretation of the data to the researcher and translating knowledge to a wider audience (Attride-Stirling, 2001).

These methods were selected to identify breaches in infection prevention, behavioural patterns and perceptions related to observed breaches, and the potential influence of design on infection prevention practice. The methods were chosen to help generate a framework that illustrates the issues staff are experiencing, to verify this understanding with stakeholders, and to guide recommendations for future study or design development.

Approach

The study took place in a Level III NICU primarily at the patient bedside, where the majority of patient contact occurs. Field notes, photos, and sketches were used to document the site, comments from stakeholder meetings, observations, and participation of 81 healthcare workers (e.g., nurses, respiratory therapists, housekeepers, supply workers, physicians, technicians). Fifty hours of observations in 4-hour intervals were conducted over the course of twelve shifts on weekdays and weekends, distributed equally over a 24-hour work cycle, covering the beginning, middle, and end of shifts. Observing a large pool of healthcare workers for 50 hours during a 24-hour work cycle produced a rich dataset.

Thematic analysis took place throughout the collection of information. The researcher assigned action codes to the data and wrote memos that captured reflections throughout the study about what was being observed but also on the study process itself. The process helped "chunk" (or categorize) the data into themes, which led to a final framework outlining the main issues healthcare workers are experiencing in infection prevention and control and a recommendations guide to assist the unit with future developments.

Findings

The study revealed that healthcare workers lack a shared mental model of infection prevention and that design is failing to support a shared, functional model. In some cases, the model was functional, with some healthcare workers taking extra precautions in infection-prevention practice beyond what would be required. Other healthcare workers exhibited hazy or faulty models, which resulted in lapses or breaches in infection-prevention practice. The study also showed that the design failed to provide appropriate or clear cues, space requirements, and other necessary attributes to support the understanding and practice of infection prevention and control. This core theme was illustrated in a larger framework of understanding and helped in the development of a recommendations guide to support future initiatives for improvement. For more detailed information on the overall study findings and framework, please refer to Trudel and colleagues (2016a, 2016b). Apart from these findings, with a particular focus on knowledge mobilization and study design, we asked:

- What evidence is there to suggest that the methods themselves fostered a deeper understanding of the experience of healthcare workers in infection-prevention practice?
- Can this approach help inform and strengthen strategies for design development?

Evidence for the value of the approach
The use of multiple data-collection methods and media led to a rich dataset of the environment, products, equipment, supplies, work processes, participant behaviour, and participant comments. Spending 50 hours on the unit over a 24-hour work cycle allowed the researcher to observe processes related to infection prevention and control that occur only at specific points in the work cycle (e.g., blood work, rounds). The data and insights from observing such processes may be missed in design approaches that rely predominantly on collecting information from user-group meetings held outside the unit or during regular work hours. Participant comments and observations demonstrate that the methods helped clarify misinterpretations or correct assumptions held by the researcher (Box 1). Observing front-line staff on site helped them discuss the complexities of their work and infection prevention and control in relation to the existing design, allowing them to physically illustrate the issues and suggest possibilities for improvement.

Field notes and codes were reviewed during and after the observation to produce a thematic framework illustrating the relationship between design and infection prevention and control. This process helped the researcher "chunk" codes into categories (Table 1), identify dominant categories, identify relationships between categories, and develop a high-level, systemic picture of the experience with infection prevention and control within the unit. Recurring words from the dataset were also assessed. Whereas the frequency of some words could perhaps be foreseen (e.g., isolette, supplies, bedside counter), others were not readily anticipated by the researcher (e.g., drawers, chart, walking), suggesting more detailed investigation may be needed in these areas.

The researcher's memos (Table 2) demonstrate that using empirical and systematic methods prior to design may help deepen our understanding of the experience of healthcare workers in infection prevention and control and may inform recommendations for further research and design development. The memos illustrate:

- missing details or micro-interactions relevant to infection prevention and control, which required verification in subsequent observations

Box 1. Examples of observation scenarios and participant quotations

The scenarios below illustrate the rich detail that came from the participation of healthcare workers in the study and how methods from human-centred design such as naturalistic observation and stakeholder meetings can help clarify unknowns or misinterpretations about the context within which infection prevention and control is practiced.

Scenario 1: Routine Checks

Researcher (speaking to Nurse A): “Can you explain what you’re doing when you silence the alarms?”

Nurse A: “The oxygen saturation levels usually drop when an infant comes close to the end of a feeding since the stomach expands and compresses the diaphragm and lungs. When this happens the physiological monitor alarm rings off warning that oxygen saturation levels are low. The nurses then adjust the siPAP or biPAP to adjust the oxygen supply to increase oxygen saturation. With the IV pumps, the alarm might go after telling me the infusion is complete or the rate we’ve set it at is complete.”

Researcher: (watching Nurse B set up feeding supplies in the corner of the work surface closest to the bedside): “Why do you set them up there?”

Nurse B: “To avoid going in the drawers.”

Researcher (speaking to Nurse B): “Why have you left the stethoscope on the cot instead of putting it back on the blender?”

Nurse B: “I’ll be using it again and it reminds me to disinfect it before putting it back.”

Scenario 2: Feeding

Researcher: I move to room 2 to observe. Nurse D is feeding the infant in one of the parent chairs. Nurse E is burping the infant within the isolette, her arms and body are in an awkward posture. I missed where Nurse E’s infant was fed. Nurse D and Nurse E are each taking care of two infants. After burping the infant, Nurse E is trying to set up a feeding syringe to give the remainder of the feed by gravity in the incubator.

Researcher (speaking to Nurse E): “Can you explain what you’re setting up?”

Nurse E: “When infants are not at risk for regurgitating and are capable of handling a gravity feed we will set up this way. But if the feed amount is really large we will put it in the syringe pump and set the flow rate to suit the infant’s status.”

Researcher: Nurse E struggles a bit with setting up the gravity feed trying to use the ventilator tubing holder but this is not working well: it keeps dropping out.

Nurse E: “The tube is too rigid and the holder’s not the right size.”

Scenario 3: The Family Chair

Researcher (speaking to Nurse F): “I’m confused about the family chair because from my understanding it’s part of the hospital environment yet it’s just dawned on me that infants are pulled out and fed in these chairs. Are the chairs disinfected between use, what about the arms in particular or the top of the chair?”

Nurse F: (looking a little crestfallen by my question): “But they need to be held.” (understandably a bit defensive).

Researcher: “I understand and know how important it is to hold the infant, but I’m trying to understand the chair in relation to infection prevention.”

The conversation is informal. No one else is in the room and I am sitting beside her in one the family chairs as she sits in another. Nurse F looks up in the air, pausing (to reflect?) as she continues to feed the infant.

Nurse F: “I never thought about it, but yes feeding in the chair, that could be a problem. I touch the arm, I stroke the infant’s head: that’s a breach. I’ve always thought about it as the seat being the issue but I never thought about the arms. We had a mum once who was a carrier of MRSA [infection]. Even though she doesn’t have it, she can spread it to the infants. The mum would be sitting in the chair, she’d get up and I’d wipe it down every time she used it. But I never really thought about the chair otherwise. I would question the chair... my hands are going to go to that arm and then go to another chair. I try to kick things out of the way, but it makes so much noise... I try to do a lot with my feet.”

Table 1. Examples of early themes from process coding

Example Themes	Process Codes	
Handling the baby with physical barriers (an emotional contradiction?)	• holding the baby in chair • feeding the baby • wearing protection • putting on gown • making a pouch • reaching the counter from chair	• carrying baby outside of bay • moving gloved hand between isolette & supply drawers • going into isolette • sitting in the chair
Chart intricately tied to caring for the baby	• touching the chart • looking at the chart • writing in chart • leaning over chart	• charting at the counter • charting in the chair • not having room
Trying to carve out a “safe space”	• finding space to work • using hands to define • creating perimeters to remind • creating perimeters to define area • creating a barrier • separating supplies	• separating us from surfaces • managing equipment and controls • wanting things closer • moving back and forth • touching equipment

- considerations in infection prevention and control that needed clarification by participants to deepen the understanding of processes and constraints

- aspects of the context that were striking, not previously known, or not understood

- sensitivities around infection prevention and control and discussing it with participants

- benefits of the method and strategies to improve the method

- thoughts on future research and design development

Discussion

Early empirical and systematic inquiry and accountability in design
As noted earlier, the researcher had initially suggested perhaps replacing the existing work counter with a supply cart to help with issues around infection practice, a suggestion which was met with some hesitation by stakeholders. At the time, this exchange did not seem significant, but it gained importance during the study. Applying a qualitative, multi-method approach focused primarily on the experiences and perceptions of front-line workers led to a better understanding of this hesitation and the complex challenges healthcare workers had been contending with in infection prevention and control.

It is not clear whether a traditional "top-down" design approach as described by Remijn (2006) would have yielded the same depth in data collected or the level of analysis and recommendations that resulted from the approach. The changes that occurred in the researcher’s own level of understanding of the healthcare workers' experiences of infection prevention and control, evidenced by field notes, memos, and the process of thematic analysis, suggest that early empirical and systematic inquiry can help support design development and perhaps improve accountability in design.

Challenges and opportunities in the method
The main advantage of conducting empirical inquiry prior to design is to help deepen our understanding of end users and their workspace in order to inform design requirements for subsequent development. Developing a framework that structures the main issues end users are experiencing in their workplace can help designers assess whether their understanding of the issues is comprehensive and resonates with that of stakeholders. The results of this study, the framework and the NICU IPAC [Infection Prevention and Control] Design Exploration and have been shared with the leadership team and the organization is working towards a major renovation of the unit to address these challenges. Requirements may change as the design progresses and new information is discovered. A framework that outlines the main issues healthcare workers are experiencing and a design guideline, can

Table 2. Examples of researcher memos

Topic	Example Memos
Identifying lapses in observation - missed interactions relevant to IPAC	• I'm finding it difficult to see the interactions at times so feel like I am missing breaches that are occurring. I also find it difficult to watch multiple people at the same time and feel like I see partial tasks. Have to think about this and how to improve the observation process. • Nurses put supplies in the corner of the counter. They Virox it when they go on shift and sometimes throughout the shift, perhaps before a procedure. The aspect I find confusing is that the chart is often on the counter and is considered part of the hospital environment. I have not seen it wiped down and it touches the counter where the supplies are often set up. Sometimes the supplies are set up on sterile packages that have been opened but the outside of the packages have touched the inside of the drawers which don't seem to get cleaned regularly, don't get cleaned between baby transfers or discharges, so effectively the outside of the package is dirty?
Identifying lack of clarity in what constitutes a breach or best practice in IPAC	• Is the isolette cover 'dirty'? It gets touched after hand hygiene then nurses go into the isolette. Are they contaminating the bed? • Talk to nurses about chair being 'dirty' and feeding infants .
Awareness and questions emerging from observations	• There's no Purell on the left side of the baby in their infant bay. So staff working on that side have to come around to the right to Purell or use the Purell in the adjacent infant bay (if a bay is located there). There is no Purell on the chair which is also POC [point-of-care]. • 'Corners' are little carved out spaces for the nurses. They want a clean corner and sterile corner to manage the transition of supplies. • Being caught off guard or unprepared justifies going into the drawers. Wanting to complete tasks justifies going into drawers. • There may be confusion on when it makes sense to use gloves and hand sanitizing practice before and after glove use. Too many rules and exceptions? Can steps be distilled?
Thoughts on sensitivities around IPAC	• I think the hardest thing for me is telling people I have observed a breach. Participants seem to shut down when I tell them and feel nervous around me. I hope it does not impact further interaction I have with them or a sense of trust.
Thoughts on method	• I feel the coding is working as an observation tool to better focus observations because as I code, I question very precise interactions which prompts me to look even closer at seemingly simple actions. The process coding forces you to distill things to the string of actions, interactions. When you see them together in a suite, it generates questions, like I missed that, what happened there? Why did she do that? Why is it done that way? Is there a problem with these codes being side by side? The codes allow you to see things side by side without the visual break of time and space and thus allow you to see "distance" interactions better. The coding is helping me visualize a path a pathogen could potentially take from surface to surface.
Thoughts on future explorations to investigate, test, evaluate design requirements	• Discussed with one nurse central backup supply within room itself and reduce supplies at the counter to eliminate waste and encourage discarding supplies after baby is discharged. Challenge will be space and rearranging space.

help assess the introduction of new information and refinement of requirements.

Additional measures could have increased the depth of the analysis. More detailed and comprehensive data related to specific work domains and data from unavailable stakeholders may have helped fill gaps in "the work system approach" to understanding infection prevention (Alvarado, 2013). Other challenges included the fast pace of work and vigilant observation of micro-interactions that may be associated with breaches in infection prevention and control. But transcribing and process coding field notes after an observation session helped reveal micro-interactions or steps in work processes that had been missed. Memos were also helpful in catching such lapses and informing subsequent observation strategies.

The use of naturalistic observation may be criticized for encouraging "appropriate" behaviour. But, because the approach was non-punitive, the identity of front-line workers was protected, and the study emphasized the importance of front-line participation, this may have in fact helped support natural behaviour. The study time frame limited the extent and type of methods that could be implemented, but future work would ideally include:

- participatory development and assessment of mockups to draw out more information and insight on infection prevention issues and possibilities for improvement

- post-occupancy evaluation of design proposals in simulations or lower acuity areas supported by statistical analysis

Is the method sustainable?
Implementing this type of approach may be met with resistance, because it goes beyond a traditional design scope. At the same time, the term "evidenced-based design", which involves basing designs “on credible research to achieve the best possible outcomes” (The Centre for Health Design, 2016) is becoming increasingly required in healthcare design. Organizations should be able to demonstrate that they have resources and strategies in place to truly support a design process that is based in evidence. The use of systematic, empirical, and multi-method approaches can help support evidence-based practice and accountability over processes that depend solely on the past experience of designers, goals set by management, or generalized programs (Remjin, 2003), or approaches that rely predominantly on unsystematic or singular techniques to understand the issues.

Some may argue this level of inquiry compromises "the bottom line". However, discovering critical issues early can inform design requirements, improve the focus and consensus-building ability of the client-design team, and provide a better measure for evaluation. Further, without implementing such a strategy, how can an organization truly know if it will negatively impact the bottom line without the evidence to support this assumption? Organizations may also consider partnering with academic institutions to pilot and measure such initiatives to mitigate against the risks of developing and integrating "research systems" into an organization’s culture and strategic plan.

Conclusion

This study demonstrates how early empirical and systematic inquiry using methods from human-centred design and thematic analysis led to a framework of understanding and a recommendations guide to help stakeholders improve their understanding and practice of infection prevention. Specifically, the study provides evidence illustrating how our own understanding of designing for healthcare was clarified, broadened, and changed through the application of scientific methods in design. In applying such approaches, we can help professional designers gain the necessary knowledge to make better decisions in the design of complex systems, and at a broader level, sensitize a new generation of designers to the importance of rigour in knowledge acquisition, transfer, application, and assessment.

Developing Tacit Knowledge of Complex Systems

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Keywords: healthcare design, human factors, ergonomics, design research, knowledge mobilization, infection prevention and control, neonatal intensive care unit

Mobilizing Knowledge: The Evidence Gap for Assistive Devices

Edward D. Lemaire

> “*The temptation to form premature theories upon insufficient data is the bane of our profession.*”
>
> Sherlock Holmes
> Fictional private detective
> In *The Valley of Fear*
> by Arthur Conan Doyle (1859–1930)

Knowledge mobilization can be hindered in healthcare technology settings where the pace of change outpaces the ability to perform high-quality research methodologies that provide timely knowledge to enable informed prescription and technology application to the end user. Although well-controlled research with appropriate sample sizes is needed, this approach must be balanced with other evidence sources to address the knowledge immediacy requirements. Using carbon-fibre ankle–foot orthoses (i.e., lower-limb braces that improve stability, alignment, and foot-to-ground placement) as a case study, various sources of assistive device evidence were explored for their contribution to the continuum of knowledge in this area. A basic level of knowledge exists, but the quality is insufficient to inform the physical rehabilitation community on selecting from the almost 70 different devices on the market and the expected clinical outcomes for a target population. A combination of enhanced single-participant reports should be considered as an important part of the knowledge continuum and essential for knowledge immediacy. This approach must also be expanded to national and multinational database initiatives that provide a better base from which to extract knowledge on assistive device performance and mobilize this knowledge to provide optimal care for people with physical disabilities.

Introduction

Knowledge mobilization relies on evidence of sufficient quality to enable appropriate decision making. Although many established sectors produce well-controlled research with sufficient sample sizes to guide decision making confidently, the knowledge mobilization process is challenged in sectors where the pace of change outpaces the ability to complete high-quality research methodologies. For example, technology-sector research involving products and humans can take much longer to complete that the annual or faster product-revision cycles. Therefore, the outcomes from a large multi-site, randomized control study may not apply to a new product that replaces the tested technology. Although well-controlled research with appropriate sample sizes is needed, this approach must be balanced with other evidence sources to address the knowledge-immediacy requirements. The assistive device sector is an interesting group for exploring this human–technology knowledge mobilization issue.

Assistive devices that improve mobility for people with disabilities cover a range of technologies, from wheelchairs to prosthetics and orthotics to robotic exoskeletons. Although the target populations and core technologies vary between these mobility assistive devices, a common element is the rapid pace of innovation in relatively small markets (Baljko & Hamidi, 2014). Modern assistive devices are on annual or biannual revision cycles, often with faster revision cycles for devices controlled by high-end microprocessors. While this pace of innovation should be encouraged to provide the best technology for people with mobility disabilities, constant change presents challenges for evidence-based practice and knowledge mobilization.

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In the field of physical rehabilitation, several challenges have been identified for knowledge development and mobilization (Johnston et al., 2009). These challenges include:

- the complexity of interactions between people with a disability and their environment (WHO, 2016)
- the need to evaluate people as they participate in their daily lives
- small sample sizes
- the difficulty or impossibility of implementing blinding or placebos
- ethical issues for control groups who do not receive treatment
- integrating assistive technology evaluation with other research methods and design factors
- the lack of funding for large effectiveness studies
- the difficulty of addressing issues between large social systems and physical, economic, and environmental factors

These challenges are directly related to knowledge mobilization for assistive devices. In fact, poor consideration of assistive technology use in rehabilitation research can be a confounding factor when interpreting research results (Rust & Smith, 2005).

To positively affect practice, the appropriate evidence with the appropriate quality must exist. For mobility assistive devices, appropriate evidence may be in forms other than peer reviewed academic publications. Appropriate assistive device research for knowledge mobilization can be classified as technical, biomechanical, and clinical. An aspect that is often overlooked on the technical category are standards-based evaluations that may be conducted by the manufacturer, independent laboratories, or government laboratories. Although countries may implement additional test procedures, the base for assistive device technical evaluations are the International Standards Organization (ISO, 2016; Rust & Smith, 2005) and Rehabilitation Engineering Society and Assistive Technology Society for North America (RESNA, 2016). Standard tests typically cover structural capacity (load tests, etc.), device function (wheelchair stability, etc.), and other factors such as flammability.

The study by Gebrosky and colleagues (2013) demonstrated the usefulness of these standard tests by performing the ANSI/RESNA standard tests on a series of lightweight wheelchairs. Most of the wheelchairs tested did not meet durability standards and a recommendation was made for stronger regulations and testing by independent and certified facilities. Ensuring that standard tests are appropriately administered is essential, but access to these test results is also lacking given that companies, test facilities, and regulators are not required to share test outcomes. Even if the intent to share this information existed, a reference and indexing source that can easily be used by clinicians is not available. For knowledge mobilization, systems such as clinical trial registries (such as ClinicalTrials.gov) are needed to provide an access gateway to the standard evaluation outcomes for assistive devices. This would enable direct access by the healthcare community and provide a base for knowledge synthesis by researchers and other stakeholders.

Assistive devices are typically categorized under Class 1 or Class 2 for regulatory approval. In Canada, Class 1 devices have the lowest medical risk and do not require a Medical Device License. Therefore, much of the background evidence is not provided through the regulatory process. Even with regulatory information, independent research evidence to guide clinical decision making is usually lacking when new or modified devices appear in the market.

From a biomechanical perspective, a modest amount of literature exists for the effect on movement and body structures from assistive device use. A search using the Scopus database with keywords “wheelchair biomechanics” returned 953 results, and 151 results since 2012. A search using “(prosthetics or orthotics) and biomechanics : excluding implants (surgical), Animal, Arthroplasty, Bone Cements, Biomedical Engineering – Surgical Implants” returned 2,689 publications, with 406 results since 2012. In comparison, a search using “physical rehabilitation and biomechanics” returned 55,042 publications. Most of the biomechanics literature involves motion laboratory studies, with the majority of locomotor research on level ground. However, the emergence of wearable sensor systems and room-scale virtual reality systems (Sinitski et al., 2015) are providing research tools to generate device-function evidence that better reflects movement environments encountered in daily living.

Clinical research on assistive technology includes questionnaire-based tools for evaluating user perceptions of using an assistive device for daily living and function-based tasks. On a base level, classification tools can be used to facilitate collection of data related to assistive devices and disability and to define categories related to disability and assistive technology (e.g., function, body structures, activities, participation, environmental factors) (Jutai et al., 2005; Lenker & Paquet, 2003). Other tools measure psycho-social aspects of assistive technology use (Jutai & Day, 2002; Scherer et al., 2011), user satisfaction (Demers et al., 2002; Samuelsson & Wressle, 2008), factors for assistive technology selection (Bernd et al., 2009), and device specific tools (Condie et al., 2006; Miller & Swanson, 2009; Wright, 2009).

Ideally, a continuum of evidence can be amassed that covers the need for immediate information on new technologies, broader research that quantifies how a device compares with similar assistive devices in the market or literature, and high-quality evidence for assistive device concepts that exist throughout a device class. To explore this continuum concept, a case study involving carbon-fibre ankle–foot orthoses is presented here.

Evaluating the Current State of Carbon-Fibre Ankle–Foot Orthoses

A carbon-fibre ankle–foot orthosis (CF-AFO) is a lower limb brace that controls movement of the foot relative to the shank for people with lower limb weakness, paralysis, or excessive tone/spasm. Carbon-fibre materials produce a device that is thin and light, stiff, or capable of storing and returning energy when walking. A market survey conducted by the investigator returned 68 distinct CF-AFO products from 13 manufacturers (i.e., devices with distinct designs or functions, not including different sizes). Most CF-AFOs consist of a carbon-fibre foot and shank section that inserts into the shoe and a strap at the proximal end to anchor the orthosis to the shank (Figure 1). The energy storage design consists of separate foot and shank sections that both connect to a centre energy storing part (rods or rectangular section) that stores energy after foot strike and then releases stored energy at toe off. An expiring patent on this technology should lead to many more devices entering the market place in the next few years.

The first level of evidence for device function and unique contributions is patents. The investigator identified 25 relevant patents with a Google Patent search using the keywords “carbon fibre ankle foot orthosis AFO”. This information provides claims and design concepts for many of the commercial devices. Peer review is from patent office experts. Although this level of evidence is insufficient to guide clinical practice, it does provide information to help understand the objectives, concepts, and novel contributions that differ between devices.

From a regulatory perspective, CF-AFOs are Class 1 medical devices and therefore the manufacturer is not required to provide evidence on device safety or function. Although regional regulatory requirements may provide a level of evidence, this information cannot be expected for this class of assistive device. In general, when assembling knowledge for mobilization, regulatory testing results are typically not considered, but could be a useful source of information that would be available as a technology enters the market.

From the literature, searches of Scopus and Google Scholar databases with the keywords “ankle foot orthosis afo carbon fibre” produced 29 relevant articles published between 2006 and 2016. Of these, 9 were related to AFO mechanical testing, 15 using biomechanical and physiological analysis, and 4 using clinical tests.

For mechanical testing, a series of experimental protocols were used to apply loads and measure the resulting AFO movement. These methods evaluated AFO stiffness, engineering modelling and structural analysis, and repeated loading to determine how the device could fail. However, the lack of a standard measurement method prohibits valid comparisons between studies and meta-analysis. The orthosis–limb interac-

Figure 1. One piece prefabricated ankle–foot orthosis (A: Ossur AFO Dynamic) and custom ankle–foot orthosis with carbon-fibre strut (B: Fabtech Posterior Dynamic Element).

tion is also a consistent deficiency. Orthoses are designed to intimately interact with the foot and lower limb; therefore, the limb is part of the structural system and therefore must be considered when testing device performance. Most studies did not consider the limb and, of the three studies that tested the AFO with a limb surrogate, a rigid plaster limb shape with a single axis joint was employed. For carbon-fibre AFO with multiple axes of possible movement, a solid single-axis foot–leg model is insufficient for replicating AFO movement under daily activity loads. Future research should develop a more appropriate foot–leg surrogate to enable mechanical testing so that the results can be more directly translated to the real world. For knowledge mobilization, this example applies broadly to knowledge obtained through simulation and modelling. Insufficient or inappropriate identification of the person within the system being evaluated could lead to poor evidence that would not be easily identified by the knowledge user following knowledge translation.

Biomechanical testing can be grouped by design: custom AFO with a posterior strut that stores and releases energy during gait, or lighter one-piece carbon-fibre AFO that is typically prefabricated. 3D quantitative motion analysis demonstrated that devices with a posterior strut typically stored and returned more energy, thereby helping the person walk more naturally and with less effort, and fine control of strut stiffness may not be required for prescription but can affect comfort and range of movement. Although the biomechanical evidence is adequate, most papers originated from one study at one laboratory and many of the other studies did not provide appropriate comparative data. Biomechanical research on the one-piece carbon-fibre designs included different populations in each study, such as able-bodied, Charcot-Marie-Tooth, polio, multiple sclerosis, peroneal nerve injury, and stroke. Given that each population had different walking characteristics and requirements, comparisons across populations become difficult. Analyses also vary, from full 3D motion analysis to simple stride analysis to physiological energy expenditure. Although the available biomechanical information provides a basis for understanding how various CF-AFOs perform during walking, the level of evidence remains insufficient to support clinical decisions when choosing between the many designs available in the marketplace.

Biomechanical laboratory-based analyses have difficulty meeting the immediacy requirement for knowledge mobilization, where barriers for providing timely outcomes include costs and time for completing the study (fitting devices for each person), laboratory access, and recruitment fatigue from a regional participant pool that are approached for multiple evaluation studies. Economically, funding these studies may be difficult for small manufacturers where profits from individual products are much less than other health sectors, such as pharmaceuticals. Motion-laboratory analyses may be better positioned for assessing broader classes of devices and first occurrence of disruptive technologies.

Methodologically, many biomechanical studies compared AFO gait to walking without a device. Given that the literature has previously established that any appropriately prescribed AFO improves gait over walking without the orthosis (Tyson et al., 2013), this comparison does not inform the clinical community as to the device's relevance in the marketplace. This is in contradiction to the typical placebo methodology where the placebo is a harmless intervention prescribed for the psychological benefit of the participant. For knowledge mobilization, comparisons between the assistive technology and the current standard of practice for the target population are required to ensure that a clinical decision maker can use the translated knowledge to recommend the most appropriate device for the patient.

Clinical testing also varied between the four studies. Across all studies, different combinations of 14 tests were employed to evaluate balance, muscle strength, functional status, walking and movement capacity, mobility capacity, quality of life, and disability. As with the biomechanical studies, different populations participated in each study, and each population had different movement characteristics. These clinical tests provided functional performance measures that helped to complete the knowledge base for CF-AFO; however, the quantity of information is insufficient for making evidence-based decisions for CF-AFO prescription and fitting. The advantage of these clinical tests are relatively quick implementation (minutes), portability, quick reporting, and standardized protocols. However, these tests only provide a high-level assessment of the parameter (i.e., we could learn that a person walks faster with a new assistive device, but not why they walk faster).

As with much of the assistive technology literature, participants were not well described in reference to how their disability could affect CF-AFO performance. Detailed research participant descriptions are required to enable the reader to assess the study and make decisions about the relevance of outcomes to a specific clinical population (e.g., deciding whether a study is relevant to a clinician's practice). Similar guidelines to the “ISPO Recommendation for Defining Participants in Prosthetics Research” (ISPO, 2016) would benefit knowledge mobilization for CF-AFO. Also, CF-AFOs are often not well described, which is essential for study replication and applying the results in practice. This is especially relevant for custom manufactured orthoses. With many academic publishers being able to include additional documents online, detailed orthotic device descriptions should be included with publications in this area. For prefabricated devices, the model and date are essential because a CF-AFO brand name may differ annually as device characteristics evolve at the manufacturer level. For knowledge mobilization involving technology, insufficient description of the tested technology occurs often. For example, the technology’s model number may be provided but the software/firmware version that is essential to the technology’s performance is typically not provided. A consistent effort from multiple stakeholders would be required to affect change and solve these reporting deficiencies.

Conclusion

As demonstrated by the CF-AFO case study, it is apparent that typical medical research methods are insufficient to generate timely evidence to guide assistive device prescription and consumer/clinician decision making and enable effective knowledge mobilization (Johnston et al., 2009). Immediacy is a core requirement that is contrary to the time required to complete controlled research with a sufficient sample size. Overall, a series of recommendations can be considered.

First, as outlined by Ottenbacher and Hinderer (2001), single-participant studies should be considered for evidence-based practice when quick reports on new devices or practices are needed. The lack of generalizability from single-participant studies can be partially addressed by adding additional replications of the measured treatment effect, systematic replication of the program or treatment over a wider range of situations, and meta-analysis. However, consistent data collection and reporting in the field are needed to provide the appropriate information.

Second, beyond single-participant studies, the assistive device field requires a multisite, multinational clinical database approach to support data assembly, knowledge extraction, and knowledge mobilization (Fuhrer, 2001). Secure international data networks are now available for collecting de-identified information on the user, assistive device characteristics, and outcome measures (e.g., SwedeAmp quality registry [Emilsson et al., 2015]). By engaging multinational clinical, non-government, and government organizations, the infrastructure to participate efficiently in a global registry can be created, thereby providing timely data on device outcomes that can be synthesized computationally to reveal patterns, trends, and associations related to assistive-technology utilization (i.e., Big Data approaches). The obstacles to achieve such an objective include data-security requirements across jurisdictions, engagement at the clinician level to collect high-quality standardized outcome measures, engagement at the local administration level to enable de-identified data sharing, and partnerships to enable timely and relevant analysis and reporting from the system to the appropriate recipients (i.e., knowledge mobilization). Differences in clinical practices between sites is also a potential problem because the local therapy methods may influence outcomes beyond factors attributed to the assistive device.

Third, in addition to clinician-generated information, assistive-device consumers may also participate by sharing their wearable mobility device information (smart watch, smart phone, etc.) or stored data from their intelligent assistive devices (microprocessor controlled prosthesis, powered wheelchair, etc.). Industry must be engaged by multiple stakeholders (including end users, healthcare providers, professional associations, and privacy regulators) to make the transition from only using device sensor data for device control and product development to making this device-user-centric data an integral part of the evidence base.

The research process cannot keep pace with innovation, so evidence to guide prescription is lacking; however, the continuous knowledge generation era is upon us and the assistive technology field is well positioned to take advantage and bring immediacy to knowledge mobilization. For assistive devices, partnerships and action are required to “mobilize” knowledge mobilization.

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Edward D. Lemaire

About the Author

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Mobilizing Knowledge: The Evidence Gap for Assistive Devices

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Transferable Practices for Knowledge Mobilization: Lessons from a Community-Engaged Health Research Study

Renate Ysseldyk, Angela Paric, and Tracy Luciani

> “ *Slow and steady wins the race.* ”
>
> Aesop (620–564 BC)
> In *The Hare and the Tortoise*

Community-engaged health research can have both immediate and lasting impacts, yet is often plagued with various unknowns and unanticipated delays – this can be especially true in hospital settings with older adults. In this informal case study based on the authors’ collective experiences of an unraveling of the research process, the challenges and issues faced in assessing the health benefits of the “Music & Memory” iPod program in a complex continuing care hospital wing are discussed. Specifically, the lessons learned through the processes of acquiring ethical approval to work with a particularly vulnerable population, of effectively measuring the benefits of the program, and of the day-to-day logistical issues are recounted, with suggestions for overcoming these challenges through transferable practices for working with vulnerable or older adults and mobilizing the knowledge gained.

Introduction

Researchers often have grandiose plans. Plans to collect huge amounts of data. Plans to disseminate their findings through the most prestigious and widely read outlets. Plans to change the world. While these ideas are usually well intentioned, they are too often overly ambitious. For example, one avenue through which many researchers see that their work can have immediate but also lasting impacts is by engaging with community partners to facilitate knowledge mobilization and effect change. Community-engaged research provides opportunities to impact community leaders, policy makers, and fellow researchers alike, many from day one. Within a health framework, community-engaged research is “increasingly viewed as the keystone to translational medicine” (Michener et al., 2012). Nevertheless, it is often plagued with various unknowns and unanticipated delays, and this can be especially true in hospital settings with older or vulnerable adults. Here we recount the issues and challenges experienced while assessing the health benefits of a social intervention among complex continuing care patients, offer suggestions for transferable practices for working with vulnerable or older adults, and describe the lessons we learned along the way – not least that the mobilization of knowledge stemming from community-engaged research is often a slow and steady process.

Background

In the summer of 2014, our team came together for the first time: a brand new faculty member at Carleton University, her new PhD student, and a knowledge broker at Bruyère Continuing Care, which is affiliated with several hospitals and long-term care facilities across the city of Ottawa, Canada. We had plans. Big plans. Our first initiative was to assess the health benefits of an arts-related social intervention (wall mural painting) among older adults living with dementia in a secure long-term care unit (in which residents with age-related conditions, such as dementia, typically live for years). We began to put together the pieces of the project but quickly encountered many barriers. Ethical considerations in working with a very vulnerable population, funding cuts, and logistical issues all quickly collided and our project was grounded before it could even begin.

While still interested in the health benefits that social interventions – especially those related to the arts – might have among people with complex healthcare needs, we turned our attention to the Music & Memory (Box 1) iPod program that, coincidentally, was about to be rolled out within one of Bruyère's hospitals, specifically in the complex continuing care wing (in which patients with medically complex conditions receive specialized care, often for several weeks, months, or years). And unlike the long-term care home in which we had made our first research project attempt, this hospital's Therapeutic Support Services department, which includes volunteer resources, was piloting a new service delivery model; staff and volunteers were trained and keen to try something new, and this project fit. The timing was perfect.

A substantial amount of evidence has shown that music listening is beneficial to health and well-being. This has been demonstrated in various populations, including those living with dementia (e.g., Evans, 2002; Sung et al., 2010). Additionally, we are now discovering that the personalization of such activities, making them more reflective of one's personal and social identities (Gerdner, 2000; Haslam et al., 2014) can further enhance the benefits of the activity. However, despite some recreational programming offered within hospital settings, patients within complex continuing care units (whose stays are generally much longer than in acute care) are often bedridden and unable to participate in group programming. Thus, there is a need for new activities that can be carried out within patients' rooms. The Music & Memory program offered one such solution. Yet, while the benefits of the program have been captured qualitatively and anecdotally in many respects (see Sacks, 2007), quantitative evidence in this regard was lacking.

The hospital had already registered with the Music & Memory program and had obtained funding to purchase iPods. Our strategy to determine whether the program would have tangible benefits for patients was to create personalized playlists for each patient and then to quantitatively assess various health and well-being outcomes (e.g., changes in memory and cognition, positive and negative affect, etc.) over a period of two months – before, during, and after the intervention. The program would be piloted in the complex care unit. Due to their medical conditions (e.g., individuals on ventilators, with progressive diseases, and multiple medical issues or limited mobility), patients on this floor typically have longer hospital stays than those on other units. For this reason, they might especially benefit from having their own personalized playlists, while we could carry out a two-month research study in this wing without the data collection being interrupted by patient discharges. Over time, other hospital employees also joined the project. Their help and expertise were necessary to ensure that the program would run smoothly. Yet, despite piggybacking our health assessments on an existing hospital program that linked closely with our research goals and interests, we still faced many challenges.

Box 1. Music & Memory (musicandmemory.org)

The Music & Memory program aims to "help people in nursing homes and other care organizations who suffer from a wide range of cognitive and physical challenges to find renewed meaning and connection in their lives through the gift of personalized music" (Music & Memory, 2016). It begins with a certification process, wherein care professionals are provided with evidence supporting the use of music in healthcare and informed of best practices for obtaining listening devices, building and sharing a music repertoire, as well as engaging with staff and family members. Once certified, care professionals provide iPods with personalized music playlists to patients or residents with the aim of improving memory, socialization, and overall well-being. Music & Memory has gained particular attention for its use among older adults living with dementia. For these individuals, familiar tunes often trigger fond memories and awaken a spirit that otherwise seems consumed by the disease. These effects are captured in the documentary "Alive Inside: A Story of Music and Memory" (www.aliveinside.us).

Ethics Review Board Challenges

Many of the challenges we encountered occurred before the data collection phase of the project had even begun. The first of these was obtaining ethics approval simultaneously from two different organizations – the university and the hospital's research institute. In working with a particularly vulnerable population – in this case, patients in a complex care hospital unit – both the researchers' and (especially) the patients' interests must be safeguarded. Obtaining ethics approval from both institutions was required, and would minimize the likelihood that either the researchers or patients would be confronted with unanticipated negative outcomes as a result of the study. For example, how often could a researcher or volunteer visit a patient for data collection or to deliver the iPod without getting in the way of (or even compromising) their medical care (Davies et al., 1998)? How might our research design need to tailored to consider patients' health-related limitations? These issues were especially important to consider in the hospital ethics application, which required detailed accounts of what problems might be encountered and how they would be managed. Although such challenges are certainly not new to the world of community-engaged research within hospital settings (Minkler, 2004; Strike et al., 2016), anticipating those challenges before the study can begin is essential. Two simultaneous ethics application reviews (both with institution-specific forms and requirements), multiple revisions (back and forth as both institutions requested different amendments), and nine months later, we finally secured approval from both research ethics boards.

Among the most challenging ethical considerations we faced was the informed consent process. Although most of our patients were not living with dementia, they had other complex health challenges that made either verbal or written informed consent impossible. In some cases, a patient's power of attorney needed to be contacted for consent. After many iterations of our informed consent form with the ethics committees, what we learned was that the consent process needs to be as concise as possible: traditional comprehensive consent forms were simply not appropriate for this population. In our study, we summarized the consent form in brief terms, making sure to include only the most critical information (e.g., a sentence or two for each of the vital sections, such as study purpose, task requirements, and right to withdraw). What we learned from our experience with this unique study population was, much like the plain language recommended for translating policy or research findings to a broad audience, we needed to use brief and simple consent scripts and obtain verbal as opposed to written consent, because it ensured a swifter and more appropriate consent process for patients with mobility restrictions.

Measurement Challenges

Alongside challenges in obtaining ethics approval were various challenges in selecting measurement tools that would be appropriate for our sample. Much like our modified informed consent process, some of the questionnaires we had planned to use – including those we had used in previous research within retirement homes – were not appropriate for this population. How could we create survey questions that were easily interpreted by this group of patients? Some of our participants could not speak, and so modified versions of our questionnaires needed to be developed such that pointing to the preferred response could be recorded by the researcher. Other participants had limited mobility and could not hold a pen or pencil, resulting in the need for researchers to record responses on their behalf. In an effort to overcome these challenges, we obtained (or created) visual scales for many of our outcome measures, such as Cantril's (1969) Ladder of Life Scale. Gathering data was also more time consuming than anticipated. Patients needed breaks during survey completion. Some questionnaires also triggered memories that patients wanted to discuss. These challenges mainly affected the researchers' timelines for the study, as patients generally did not seem to mind the length of the questionnaire and, in fact, seemed to genuinely enjoy speaking with the researchers (perhaps because some of the patients spent much of their time relatively isolated from the type of social interactions that most of us take for granted on a daily basis, and also because they potentially gained an increased sense of purpose by contributing to a research study in this way (see Gysels et al., 2012). However, this experience taught us that, in future studies, researchers should carefully consider the appropriateness of the measurement tools for their study participants, set aside more time for survey completion, and be trained and prepared to discuss potentially sensitive information with patients.

Day-to-Day Logistical Challenges

In addition to ethical and measurement challenges faced, there were several day-to-day logistical challenges encountered. Many of these involved the technological aspect of our project. How could we establish and maintain a relationship with the IT department so that we were able to create and update playlists in a timely manner? USB ports on all hospital computers were blocked for security reasons – the IT department needed to know which researchers and volunteers were involved in the Music & Memory program so that USB port access could be swiftly granted. Further to this, several other challenges regarding storing and updating the iPods themselves had to be considered. Where could iPods and other materials be stored so that they were easily accessible to volunteers and yet be safe from theft? What was the best way to keep iPods and their accessories sanitized for infection control? How often could we ask patients whether or not they were satisfied with their playlist without being a bother to either the patient or the IT department? For security reasons, iPods had to be stored in locked cabinets that were only accessible to the researchers and volunteers. Keeping the iPods in small plastic bags in the cabinet within a common area on the same floor where a patient resided seemed to work best, while leaving the earphones in each patient's room proved to be most convenient and sanitary.

Despite our best efforts to have someone "with feet on the floor" each day and evening, we underestimated how often patients would want to listen to their iPods. Ideally, all hospital volunteers would be aware of ongoing research projects and know how to help patients participate (by providing access to the iPods, in this case) even when the researchers are not present. In this regard, it is often difficult for a researcher or volunteer to determine when patients would be available (e.g., not during mealtime or a physiotherapy appointment) to listen to their iPods or to spend time with one of the researchers to complete the surveys. Therefore, coordinating with hospital staff is also beneficial, but finding a way to do this without asking too much of an already overloaded workforce presented yet another challenge. Collaboration between researchers, volunteers, and staff not only enables such programs to run smoothly, but also involves those who are most familiar with each individual patient, thereby further safeguarding patient well-being.

The most important lesson that we learned along the way was that having a "community insider" who can share knowledge with everyone involved and obtain their support, from those with daily patient contact to upper level management alike, can make a huge difference. Many layers of staff and managers needed to "buy in" to the project: charge nurses on the floor, the recreation therapist who was the first point of contact with patients, the recreation coordinator who liaised with the information and technology (IT) department, the therapeutic support services director, and the upper management of the research institute. Our "community insider" – the knowledge broker on our team – through many meetings, phone calls, and emails, harnessed the support and guidance needed to make our research project possible.

Knowledge Mobilization Challenges

In the end, although we had planned to collect quantitative data from dozens of participants, only eight complex continuing care patients participated in the Music & Memory iPod program and our associated health study. Such a small sample size limits the scope for statistical analyses; nonetheless, over the course of the two-month project, self-reported life satisfaction increased while negative emotional symptoms decreased, coinciding with an increased number of music-listening days over time. Moreover, the qualitative responses collected from the participants confirmed that the program had made a positive difference in patients' lives. In a sample of patients living with a variety of complex and chronic health conditions, even the smallest improvements toward quality of life are meaningful – as one of our participants described her music listening: "It gets me away from everything".

Two years on, our work is having ripple effects within that complex care hospital wing and beyond. We have presented the results of our study at a local conference for practitioners and academics alike (led by the Bruyère Research Institute) devoted to improving the lives of individuals in long-term care (Paric et al., 2015), and at an international academic meeting focused on building better communities and social identities (Ysseldyk, 2016). We have also spoken about the lessons we learned through putting the project together for a university community-engagement event (Ysseldyk & Luciani, 2015), and we have plans for further presentations and publications in this regard.

Our project has been highlighted on the websites of the Bruyère Research Institute and the Music & Memory program – complete with a YouTube video (bruyere.org/en/newsroom?newsid=156) recounting one patient's experience in our study (Bruyère Newsroom, 2016). By using multiple avenues to share or "mobilize" our research, we are increasing the reach of our study to audiences outside academia (SSHRC, 2016), most of whom will neither read the published findings nor attend an academic conference at which we present. For example, the video – which has thus far been viewed nearly 200 times – quickly synthesizes the purpose and impact of our project in plain language and in an accessible format (CIHR, 2015) – an effective and efficient means of spreading the word about the program and our results.

The Music & Memory program has also since been presented to Bruyère's hospital Board of Directors and will soon be carried out within their other hospitals and long-term care homes. Conversations regarding the dos and don'ts of successfully rolling out the program are also taking place among the therapeutic recreation services coordinator and the volunteer resources coordinators at these various institutions. Indeed, the newsroom video and this article itself (reviewed by Bruyère's therapeutic support services management before publication) have provided alternative formats for disseminating the knowledge gained by this project in order to impact departmental processes, such as how participants and volunteers will be recruited for involvement in the ongoing Music & Memory program at Bruyère's other sites.

Conclusion

What we gained from the project as researchers was greater insight into what to do – and what not to do – when engaging in community-based research with older or vulnerable adults and then in mobilizing the knowledge outputs. Indeed, we learned numerous key lessons and transferable practices from our experience:

1. Timing in community-based health research is important in order for projects to get off the ground and then run smoothly from inception to completion.

2. Piggybacking a research project on an existing hospital initiative or intervention is helpful for a variety of reasons, including increasing internal support and integrating the research team more smoothly into the institution and its processes.

3. Acquiring ethics approval for working with vulnerable populations from multiple review boards can take several months (or more). Researchers should plan ahead to avoid disappointment, and it is advisable to acquire approval from the (usually) more stringent hospital review board first.

4. A brief, simplified, and verbal informed consent process can make the process more accessible and understandable for study participants from the very start.

5. The use of visual scales and succinct measurement tools for research with older or vulnerable adults is highly recommended.

6. When the project involves a technological aspect, it is important to find a way to keep the technology sanitary and secure, but also accessible to patients and researchers.

7. Involve volunteers as much as possible to avoid overburdening hospital staff while enabling projects to run smoothly.

8. Having a "community insider" on the research team can help gain support from those with daily patient contact to upper-level management alike.

9. Knowledge mobilization in community-engaged research should take advantage of both "community" and "research" resources, thereby increasing the reach to audiences both within and outside of academia—the audiences who will gain the most benefit from knowing about the results.

10. The fruits of researchers' knowledge mobilization efforts in community-engaged research may not be immediately seen, but rather developed over many months or even years following a project's completion.

Further to these lessons learned, this project has had lasting impacts both within the hospital community and within our own research programs. Although we started with grandiose plans for data collection and knowledge mobilization, we learned from our experience that in the practice of community-based health research with vulnerable or older adults, some questions are simply best answered one participant at a time, and the knowledge mobilized as a marathon rather than a sprint. Slow and steady.

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Research on Fire: Lessons Learned in Knowledge Mobilization

Susan Braedley

> *When one burns one's bridges, what a very nice fire it makes.*
>
> Dylan Thomas (1914–1953)
> Poet and writer

In this article, I outline knowledge mobilization lessons learned while working on politically "hot button" issues in public policy research related to fire services. These lessons were shaped by the research funding context. Researchers are increasingly required to develop research relationships with government, industry, and community partners to ensure research is relevant to those who can best use it, to embed knowledge mobilization in research processes, to ensure that knowledge has an impact in the world beyond the academy, and to provide research funding. Perhaps not surprisingly, when my findings created challenges for research partners, controversies erupted, potentially imperiling my research program, career, and potential research impact. Drawing from my knowledge-mobilization experiences as well as those of other researchers, I offer some insights gained from mobilizing knowledge on a "hot topic" in public policy.

Introduction

Lurking within the new politics of university research are two interlocking hazards for public policy researchers: first, the requirement for research partnerships and second, latent conflicts of interest within these partnerships. These hazards may be invisible or suppressed until knowledge mobilization, when they can erupt into flame. As an academic whose research on municipal fire services almost ended in a knowledge mobilization firestorm, I found very little in the research literature on dealing with these challenges. In what follows, I offer some lessons learned along my research path. I begin by describing and illustrating these hazards through the experiences of researchers in a Dutch research consortium. Next, I describe my own experiences in addressing these hazards and share some lessons learned that may be useful to others conducting research with public policy dimensions. I conclude with some thoughts and suggestions about how universities and funding bodies can better support researchers who aim to contribute to public policy debates.

Two Hazards, Two Questions

Across many countries, including Canada, university research funding infrastructures have been significantly re-tooled and reorganized. The first hazard of this new university research funding infrastructure is the increasing reliance on external partnerships, including funding from external stakeholders and corporate partners. In Canada and elsewhere, government-funded granting agencies now commonly require these arrangements, with the explicit goal of making research more directly relevant to stakeholders. But these partnerships and funding arrangements suggest a critical question. Whose interests should guide funded university research on public policy? In fields such as medicine, agriculture, energy and climate change, partnerships and corporate funding have influenced research projects to serve the profit motivations of partners, sometimes at the expense of researcher integrity, wider public interests, and more pressing public issues (Brownlee, 2015; Mirowski, 2011). This concern is also emerging in public policy-oriented research. While public benefit remains a priority for Canadian granting agencies (SSHRC, 2016), what counts as public benefit may be limited in some cases to issues such as value for tax dollars or accountability (Estabrooks et al., 2008) that often benefit elite stakeholders at the expense of others, as the example that follows illustrates.

In the Netherlands, a well-respected research consortium won a government contract to conduct a review of childcare quality. A scientific advisory board of stakeholders, including providers and government, was involved with the research team. In 2005, the research findings showed that over a third of the country's daycare centres had poor quality, which was a significant net drop in quality since a similar review in 2001. Further the research revealed that Dutch day care quality lagged when compared to countries such as Canada and Germany. From a researcher perspective, the knowledge mobilization process went well. The report made front-page news, generating significant public debate. In response, the government went back to the research consortium to commission a more extensive daycare quality survey. However, one of the stakeholders, a for-profit daycare provider, organized a boycott of the new survey, successfully blocking research access to many centres while retaining membership on the consortiums' scientific advisory board. Despite a ministerial reprimand, the agency continued its boycott, finally influencing the government minister to request changes to the research proposal to accommodate its concerns. These politics split the consortium, with one large group of researchers exiting the project on ethical grounds, leaving their research program and million-dollar funding behind (van IJzendoorn & Vermeer, 2015).

The second hazard, related to the first, is that conflicts between and among partner and public interests can lay dormant or unexpressed until research findings go public. Knowledge mobilization, as the latest iteration in the field of knowledge dissemination, transfer, translation, and exchange, has developed as an integral aspect of the increasing emphasis on research partnerships. Conceptualized to produce a closer relationship between evidence and practice, integrated knowledge mobilization is a systems approach in which knowledge users and researchers work together throughout the research process, from formulating research questions to sorting out how best to put evidence in practice (Baines, 2007; Levin, 2013). Public dissemination and accessibility are usually considered important components of research oriented toward public policy, but as the Dutch childcare case demonstrates, they can also be explosive. Some context makes the reasons for this controversy clearer. In 2005, seeking to increase the supply of daycare, the Netherlands government enacted legislation that switched the publicly funded supply-side childcare system to market provision. Almost overnight, publicly funded daycare centres were gone, replaced by a 60/40% mix of for-profit providers and private non-profit centres (Akgunduz & Plantenga, 2015). The survey findings suggested that this switch to market provision had resulted in quality reductions and access inequities for lower-income households (Noailly & Visser, 2009). These findings suggest that government policy – aimed narrowly at increasing the daycare supply with a minimum of public investment – offered a profit opportunity to business owners at the expense of daycare quality and accessibility for low-income parents. Researchers did an excellent job informing the public but at least some providers reacted strongly to protect their corporate interests, while the government, implicated due to the policy change, sided with providers. In turn, the researchers' academic freedom was reduced to a choice between compromising or walking away.

This second hazard provokes the question of values. In any given project, what values are guiding research processes? In considering the daycare case, were the values that guided the project commitments to improving equity, access, quality of service, good working conditions, social inclusion, and to maximize efficiency, choice, supply, and accountability? Which values ranked as more important than others? This consideration calls into question the assumption that researchers are, or ever can be, neutral observers, for research questions themselves contain assumptions about values and interests, even if research teams never acknowledge or discuss them. Indeed, as Harding (1995) points out, attempts at neutrality can block objectivity, preventing the necessary work of surfacing values.

Knowledge mobilization can and, in my view, should promote "catalytic validity" (Baines, 2007; Lather, 1986): a process in which knowledge shifts, re-orients, or energizes those engaged in a particular reality so that they may pursue transformations. In order to achieve this goal, some alignment of values must be achieved among the partners, including the academic researchers. But even when there is such alignment at the outset, political shifts affecting research partners can change it significantly. There are no guarantees. Attention to shifting priorities within a research project is particularly necessary in public policy and services research.

Learning the Hard Way

My experience in public services research provides another example of knowledge mobilization as a potential flashpoint in research partnerships. As a social sciences researcher whose work is informed by feminist anti-racist political economy (Luxton 2006), my research program focuses on social policies that affect care, including who provides, receives, and pays for care. I begin with the overt emancipatory objective to contribute knowledge that improves the conditions of care for vulnerable people and the conditions of work for those who provide their care. I brought this program to Canadian professional fire services, who have been roundly criticized for employment inequities and, at the same time, have been thrust into providing significant emergency support for many sick and suffering people. Some fire services signed on, agreeing to work with me to identify: i) promising practices in employment equity, both in terms of including women and under-represented minority groups as firefighters and ii) an assessment of their involvement in emergency response (i.e., 9-1-1, 999, 112, or 000 in most countries) to medical and social care emergencies as a significant shift in fire services' hyper-masculinized work. These issues were and remain controversial within fire services. In total, five of the original eleven fire services withdrew from the study, each indicating concerns about the potential backlash from research findings that could jeopardize already contentious relationships with city councils. Three others signed onto the study part way through, each with its own aims and goals for participation. As a solitary investigator, I watched research doors open and close in dizzying succession through the three-year project, often wondering if I would be able to complete the project at all.

I struggled along. In the summer of 2015, after reporting my findings-to-date at several industry conferences, in a publicly available report, and in a peer-reviewed academic journal, my research on fire services involvement in emergency medical response was covered in a short item in the Toronto Star, a major Canadian newspaper. The article (Mendleson, 2015) correctly stated that my research suggested that fire and paramedicine responses required closer integration to improve service delivery. Further, I had commented that debates about whether or not fire services should be involved in emergency medical responses were not likely going to alter the status quo, given that 9-1-1 calls were steadily increasing, paramedic services were stretched beyond capacity, fire services had capacity to assist at low cost, and there did not seem to be any political will to change the situation.

For some paramedics, firefighters, and emergency services organizations, these statements were perceived as an attack. Paramedics who were struggling for jobs, services expansions, and recognition as health professionals were angry, as were firefighters who opposed increased involvement in "medicals" as mission drift. Efforts to discredit me – as opposed to my findings – began. Although the news item was posted on lazy summer Saturday, my email filled immediately with messages of with hate, attack, and vitriol (from both paramedics and fire fighters) as well as disturbing messages of support that misinterpreted my position to mean that I thought firefighters should – or should not – be involved in emergency medical care. There were also vaguely threatening anonymous phone messages and denigrating tirades on industry-related websites. Some members of a large public services union were very angry with me. I have worked with this union since 2010 on several projects, and I worried that the resentment by one group might imperil my research relationships throughout the union. In September, two fire services withdrew from my study and another stopped communication without explanation. In October, a group of paramedics walked out of a talk I gave at a large union meeting. My research funding was due to expire in December and opportunities to conclude my study were evaporating. Further, my future research program that included research with both fire fighters and paramedics was looking like an impossible dream. I was also up for tenure and promotion. I worried that my career advancement and future research funding opportunities were evaporating. I spent many days away from teaching and writing, trying to build and retain research relationships.

But beyond these more personal worries, the original goals and values of this research were getting lost. What about improvements to employment equity for women and other groups left out of public firefighting work? What about improving services for the poor, marginalized, and suffering people who relied upon 9-1-1 as often their only accessible support service? It was a low moment in my research career.

Knowledge Mobilization Is Politics

These examples of researcher experience demonstrate that knowledge mobilization processes in public policy research are deeply political. Given the terrain, it is somewhat surprising that the knowledge mobilization literature has so little to say about political controversy (Estabrooks et al., 2008; Goering et al., 2010; Jacobson et al., 2003; Levin, 2013; Ward et al., 2010). Between research funding requirements and the challenges involved in gaining access to research sites, the need for research "partners" is putting pressure on research programs – as no doubt they are designed to do – to align with the political goals and values of "stakeholders" in exchange for research opportunities. To opt out of these politics may be possible for some researchers, but for others, it is a career-ending move. However, there are alternatives. Below, I outline some of my lessons learned through my fall into the knowledge mobilization political soup.

I did get a few crucial things right. First, a clear articulation of research project values and goals in research access agreements has proved to be an enduring touchstone, helping me and my research partners stay clear on the project's ultimate goals. These agreements were made in writing prior to beginning research at each fire service and kept me honest when desperation for access made compromise look like a sensible option. Second, rather than allow research drift justified by "stakeholder input", I returned to these agreements when concerns emerged. Third, I used this agreement review not as a sledge hammer but as an opportunity to open space, to listen, and to gain clarity and mutual understanding. Although some fire services left the project, this open communication has maintained my relationships with the people involved, who continue to provide opportunities for me to share findings and maintain dialogue. I was able to complete the project with the goals and objectives intact, albeit not as originally planned.

I also got a few things spectacularly wrong. First, I did not develop relationships with or include stakeholder groups whose goals and values aligned most closely with the research program. I needed to partner with fire services in order to gain access, and I hoped to create evidence that would stimulate change within them. But, due to worries about managing too many relationships and expectations, I did not include equity-seeking groups or groups committed to health equity – the people supposedly central to the research objectives. This was a mistake. If these groups had been included, my research might have taken a different trajectory. It would not have avoided controversy, but with other voices and interests to consider, the project would likely have proceeded differently, offering other possibilities and advice when partners withdrew or came on board.

A second mistake was to take on sole responsibility for knowledge mobilization. After reviewing some of the findings, my fire services research partners advised me that if knowledge mobilization proceeded as planned at the proposal stage, with services, unions, or fire chief associations sharing in dissemination, the project would be discredited as "biased" due to the increasingly volatile politics within the emergency services field. Research has shown that sharing knowledge mobilization with third parties can produce more research uptake (Levin, 2013). Perhaps if I had involved equity-seeking groups from the outset, I might have had alternatives. In the end, my options were limited and my knowledge mobilization goals for this project have yet to be fully realized.

I continue to reap the benefits and pay the price for my decisions, right and wrong. I continue to do knowledge mobilization on this project, unfunded, one relationship at a time, which has included productive discussions with some of the very paramedics who initially attacked and walked out on me, as well as with federal and municipal governments interested in policy change and services improvements.

Conclusion

If public policy-oriented researchers are to take up contentious issues and challenge conventional approaches, we must be prepared for controversy, both within and beyond our research partnerships. But this preparation could be better supported by research funders, university research departments, and university tenure and promotion structures. First, if our research is to serve a broad range of public interests, universities and funders must continue to develop knowledge mobilization funding that acknowledges the time it takes both during and after the research process to produce impact. Further, there must be more recognition that funding structures that require contributions from research partners privilege research partners with resources to contribute, potentially sidelining the interests of groups without resources. Thirdly, university research departments can enhance training on building and maintaining research relationships, including training on research agreements, knowledge mobilization, dealing with controversy, and how to deal with issues that may necessitate ethical withdrawal, including dealing with funders.

Finally, while university tenure and promotion structures are beginning to recognize knowledge mobilization in some ways, there is a long way to go. There is little status but some recognition for non-academic speaking and writing. However, researchers are not credited for the time, skill, and creativity required to develop and maintain research relationships that produce strong knowledge mobilization and particularly those that that can support "catalytic validity". Building and maintaining these research relationships is a topic worthy of its own discussion, just beginning in the research literature (Hofmeyer et al., 2012; Reyes, 2013). Without explicit support from universities and funders, researchers' abilities to pursue meaningful and high-impact research oriented on public policy will be hampered, no matter how many lessons we have been learned.

About the Author

Susan Braedley is an Associate Professor in the School of Social Work at Carleton University in Ottawa, Canada. She is co-editor of *Neoliberalism and Everyday Life* (McGill-Queens University Press, 2010) and *Troubling Care* (Canadian Press, 2013), and she is the author of many articles on social policy topics. She is a co-investigator on three large-scale comparative studies of long-term care policies and practices (funded by SSHRC and CIHR), as well as principal investigator on the SSHRC funded project "Equity Shifts: Employment Equity in Protective Services". Her research and teaching focus on social policies and their implications for labour, gender, race, and class, and on research methodologies.

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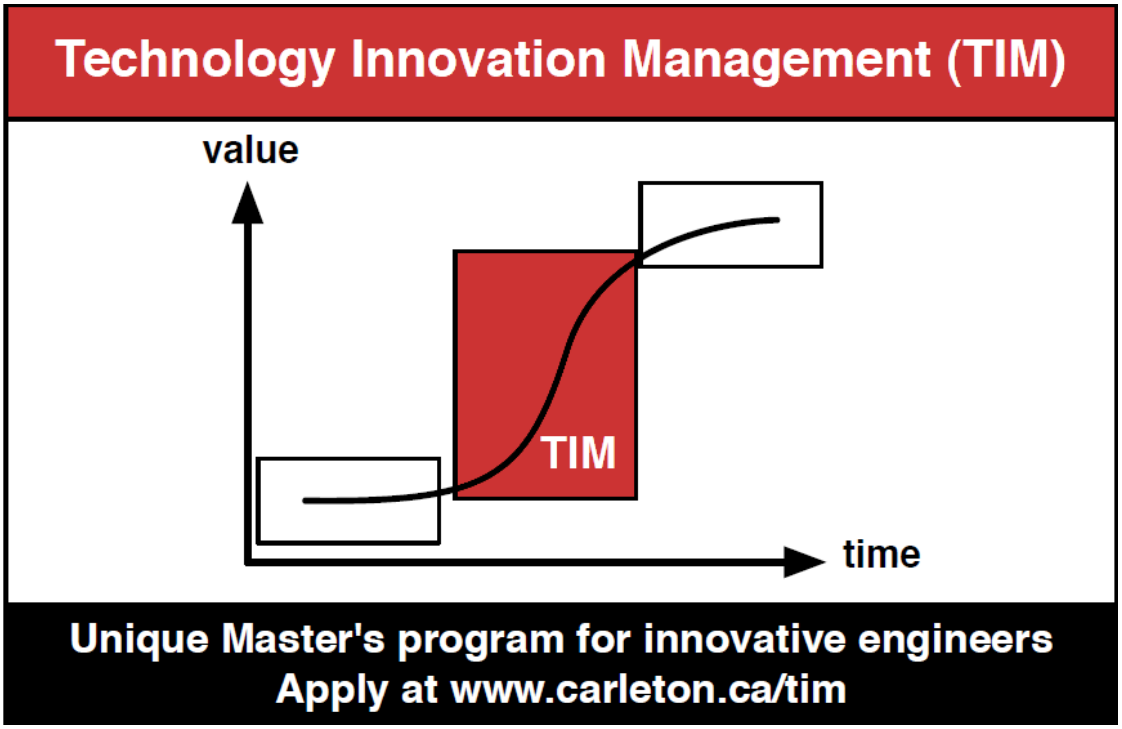
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