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Knowledge Translation: The Rise of Implementation

NOVEMBER 2020

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The Hospital for Sick Children

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Contents

Page

Introduction 1
Methods 1
Report Organization 1
Definitions of Knowledge Translation, Implementation, Related Terms 2
Knowledge Translation 2
Diffusion/Dissemination 4
Commercialization and Technology Transfer 4
Knowledge Brokering 4
Knowledge Management 4
Knowledge Mobilization 5
Translational Research 5
Implementation and Implementation Science 5
Knowledge Translation Origin and History 6
Knowledge Translation During the 20th Century 6
Stakeholder Engagement in Knowledge Translation 10
Knowledge Users and Stakeholders 10
Engaging Knowledge Users and Stakeholders 11
External Drivers of Advancement in Knowledge Translation 14
The Role of Funders in Shaping Knowledge Translation 14
Academic Promotion 16
Evolution in Knowledge Translation Theories, Models, and Frameworks 17
Classifications and Taxonomies: Organizing the Deluge 19
The Rise of Implementation Science 20
Evolution in Research Design for Implementation Studies 21
Dissemination and Implementation Categorizations 23
Taxonomy of Implementation TMFs 25
Key Concepts for Knowledge Translation and Implementation 26
Planning for Knowledge Translation 26
Planning for Implementation 27
Knowledge Translation Strategies for Dissemination and Implementation 27
Types of Knowledge Translation Strategies for Dissemination and Implementation 29
Effectiveness of Knowledge Translation Strategies for Implementation 31
Common Issues for Implementation Effectiveness Studies 34
Reporting Standards for Implementation Research 35

Knowledge Translation in Disability and Rehabilitation Research 36
Contemporary Trends and Future Directions 39
References 41
About the Authors 59

Figures

Page

Figure 1. Evidence Hierarchy 3

Figure 2. Knowledge Translation Goals 3

Figure 3. Adapted Diagrammatic Representation of Nilsen's Taxonomy for Implementation TMFs 26

Tables

Page

Table 1. Summary of Design Principles for How to Engage Stakeholders in Research 13

Table 2. Distinctions Among Theories, Models, and Frameworks 18

Table 3. Overview of Tabak et al.'s (2012) Categorization of D&I Research 23

Table 4. Selected TMFs Identified Through Tabak et al.'s (2012) Categorization in D&I Research 24

Table 5. Selective Summary of Recent Systematic Reviews of KT Strategies 31

Table 6. Selected Examples of Summary Articles About KT in Disability and Rehabilitation Studies 38

Introduction

In 2007, the National Center for the Dissemination of Disability Research (NCDDR) commissioned the report, *Knowledge Translation: Introduction to Models, Strategies, and Measures* (Sudsawad, 2007) to provide an overview of the field of knowledge translation (KT). The report highlighted KT definitions and characteristics, as well as various models and frameworks prevalent at the time. The past decade has seen significant advancements in KT theory and practice that have led to a new generation of approaches and strategies for sharing evidence and for facilitating and evaluating behavior, policy, and organizational change, including a larger focus on implementation. The resulting magnitude, variety, and complexity of new KT evidence present challenges to many researchers and knowledge users (KUs) in making sense of and choosing approaches that are ideally suited for their needs. The Center on Knowledge Translation for Disability and Rehabilitation Research, as NCDDR is now known, commissioned the present narrative review as an update of the KT literature. We reflect on advancements in KT practice generally, KT's relationship with implementation science (IS), and its practice in the specific area of disability research.

Methods

A narrative review is best suited for summarizing knowledge about a topic and for distilling key findings in fields as diverse and broad in scope as KT (Green, Johnson, & Adams, 2006). We have focused on the literature published after 2007 relating to empirically supported definitions, conceptualization, and theories, models, and frameworks (TMFs) of KT and IS.

Report Organization

This report describes the field of KT and how IS has emerged to provide a focus on implementation. The first sections provide an historical overview of the KT field, highlighting changes in definition and the overall evolution of the concept and related methodologies. The next section describes the importance of stakeholder engagement, followed by a discussion of the advancement of theories, models and frameworks. The following section focuses on the rise of IS. Next, key aspects of the KT process are presented, including defining a KT goal, the fundamentals of KT planning, dissemination, and implementation strategies, and evaluating KT. KT advancements related to disability research are highlighted, followed by a look at future directions in KT.

Definitions of Knowledge Translation, Implementation, Related Terms

Knowledge Translation

Understanding the scope of KT requires greater clarity relative to terms and definitions. Definitions express the essential nature and enable a common understanding of a word or subject (Whitfield, 2012). For over two decades, the term "knowledge translation" has generated much discussion and confusion stemming from its more than 100 different definitions (McKibbon et al., 2013).

According to Azimi, Fattahi, and Asadi-Lari (2015, p. 96), the most commonly cited and adopted definition of *knowledge translation* is:

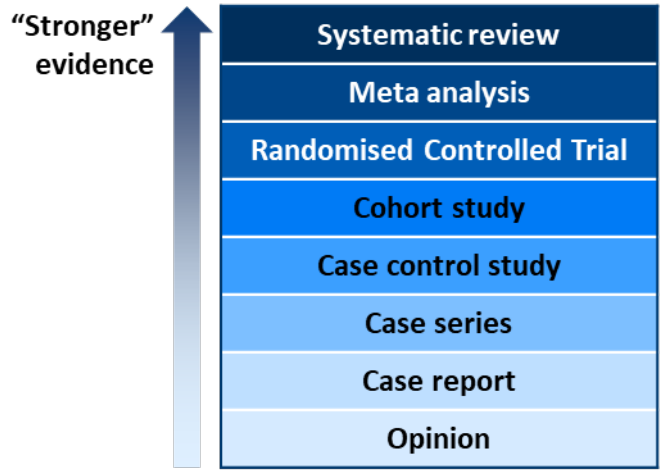
> *[The] exchange, synthesis and ethically-sound application of knowledge—within a complex system of interactions among researchers and users—to accelerate the capture of benefits of research for Canadians, through improved health, more effective services and products, and a strengthened health care system.* (Canadian Institutes of Health Research [CIHR], 2015)

This CIHR definition of KT focuses more narrowly on the instrumental use of research evidence and its application in health care settings. In this report, we conceptualize KT more broadly: that is, beginning with the processes and strategies that ensure research evidence is accessible to a range of KUs such that they can understand and benefit from evidence in some way, and ending with the implementation of evidence that is ready for application. Inherent in our definition are three key elements: (1) accessing evidence, (2) understanding that evidence, and (3) benefitting from the evidence. The benefits users may derive from research evidence are related to the type of research discovery (e.g., a new concept, an intervention, a new technology, improved knowledge), level or quality of evidence (see Figure 1), and stage of discovery on the research continuum. In medical research, those stages can range from the "bench" of basic science research (i.e., preclinical studies and animal research) through the "bedside" activities of clinical research with humans, until findings are put into clinical practice (Westfall, Mold, & Fagnan, 2007).

Benefits capture the results of research evidence (Amara, Ouimet, & Landry, 2004) and are categorized as instrumental, conceptual, or symbolic. Instrumental use applies research results in concrete, specific, and direct actions, now largely considered the realm of IS, a KT sub-specialty. Conceptual use involves general enlightenment or improved knowledge, where research may influence actions but more indirectly and less specifically than in instrumental

use. Symbolic use involves using research evidence to legitimate and sustain predetermined positions (Amara et al., 2004).

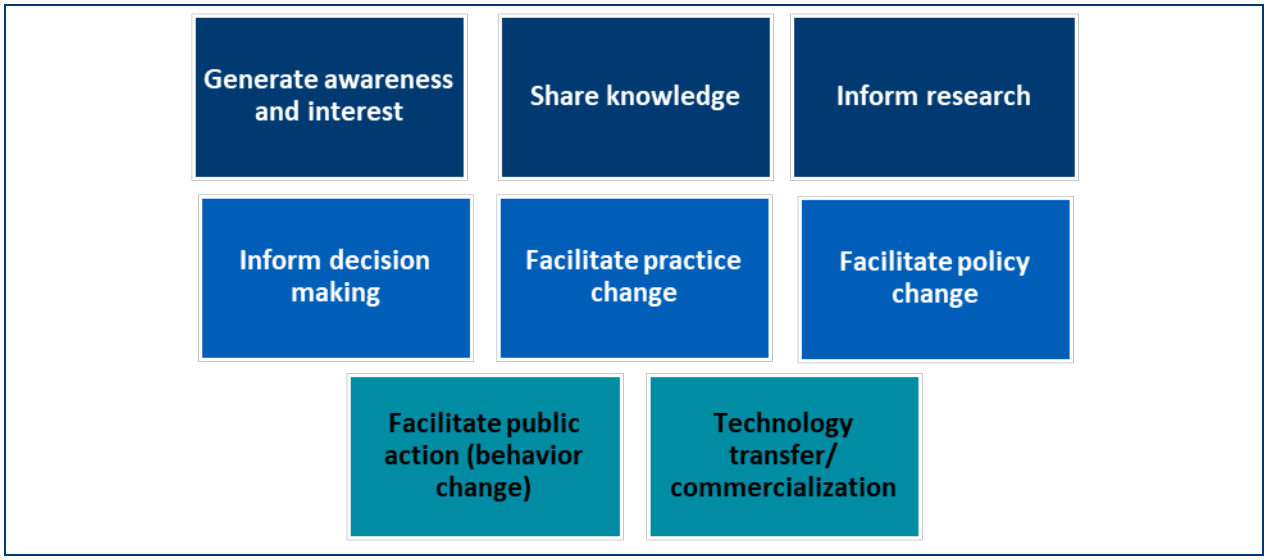
Figure 1. Evidence Hierarchy



Source. Reprinted with permission (Creative Commons Attribution-No Derivatives 4.0 International License) from RCVS Knowledge, 2020, p. 2. Color added for visual effect to show a transition from less strong to stronger evidence.

In light of the prominence that is often given to instrumental research use (particularly in health care, where the focus is on practice and behavior change), it is important to keep in mind the extent to which certain benefits reportedly occur. Researchers report estimates of instrumental research use that fall somewhere between 40% (Caplan, Morrison, Stambaugh, & University of Michigan, 1975) and 12%, with 22% reporting conceptual use, and 16% claiming symbolic use (Amara et al., 2004). Being realistic with respect to what we might achieve with KT efforts is important.

Figure 2. Knowledge Translation Goals



Source. Barwick, Butterill, Lockett, Buckley, & Goering (2005). Used with permission.

The central aim of KT is to accelerate the benefits emerging from research; these benefits may be related to knowledge, attitudes, behaviors, practices, or policies. The research continuum

discussed previously focuses on *when* KT occurs rather than its *purpose*. The level of research evidence (see Figure 1) informs the *purpose* behind the KT goal (see Figure 2). For instance, practice and policy change must be based on strong evidence, but any level of evidence can be disseminated to build knowledge and to inform. The *purpose* or KT goal may be to share what we know—as when evidence emerges from a single study; to build awareness and knowledge; to inform research, decision-making or policy; to facilitate change in practice, policy, or behavior based on a body of high-quality, rigorous evidence; or to transfer technology via a commercialization pathway.

KT may involve exchange (diffusion, dissemination), data management, synthesis, or application (implementation) of knowledge within a complex system of interactions among researchers and users. The past decade has resulted in a variety of KT classifications that warrant greater distinction. We review several of the terms we believe fall under the KT umbrella.

Diffusion/Dissemination

Diffusion and dissemination capture the collaborative problem-solving that unfolds both passive and active linkage and exchange between researchers and KUs. "Whereas diffusion is the natural spread of ideas, dissemination is the conscious effort to spread new knowledge, policies, and practices to target audiences or the public at large" (Green, Ottoson, García, Hiatt, & Roditis, 2014, p. 3).

Commercialization and Technology Transfer

Commercialization usually refers to processes, products, and inventions making their debut in the market or private sector. *Technology transfer* and commercialization may involve the assignment of technological intellectual property that is developed and generated in one place to another entity through legal means such as technology licensing or franchising. It is the process of converting scientific and technological advances into products, processes, applications, materials, or marketable goods or services.

Knowledge Brokering

Knowledge brokering forges new partnerships that facilitate interaction between researchers and KUs. Serving as both a role and a process, knowledge brokering promotes better understanding of one another's goals and professional cultures, influence on one another's work, and benefits from research-based evidence (Bornbaum, Kornas, Peirson, & Rosella, 2015).

Knowledge Management

Knowledge management (KM) was established as a discipline in 1991 within the information and KM literature. KM captures the systematic management of an organization's knowledge assets to create value and meet tactical and strategic requirements. It consists of initiatives, processes,

strategies, and systems that sustain and enhance the storage, assessment, refinement, and creation of knowledge. The Japanese organizational theorist, Ikujiro Nonaka (1991), made the early connection between tacit (experiential) knowledge and explicit (articulated, codified, and stored) knowledge and knowledge conversion—the interaction of these two forms of knowledge—to enhance an organization's efficiency, productivity, and profitability. KM places strong emphasis on organizational knowledge culture. It involves the strategic use of information and knowledge resources within an organization and includes the creation, management, sharing, and flow of knowledge within organizations and across systems. Since some managed knowledge emerges from research or quality assurance activities (e.g., surveillance monitoring of cancer incidence rates), we include it in the spectrum of KT.

Knowledge Mobilization

Knowledge mobilization is a common synonym for KT and refers to getting the "right information" to the "right people" in the "right format" at the "right time." Knowledge mobilization was introduced in Canada in 2001–2002 by the Social Sciences and Humanities Research Council of Canada (SSHRC) and was based on the French term *la mobilization,* which means making ready for service or action (SSHRC, 2019).

Translational Research

Translational research is the process of applying discoveries generated in basic, preclinical studies to the development of trials and studies in humans. Translational research describes efforts to move scientific knowledge "from bench to bedside," building on basic research advances such as studies of biological processes using cell cultures or animal models and using them to develop new therapies or medical procedures. The term "translational research" appeared as early as 1993, yet few references to it were documented in the medical literature during the 1990s, and most were in reference to cancer research (Rubio et al., 2010). At the time, the literature on cancer tended to use the term translational research to refer to work covering different types of research (e.g., immunology studies including basic and clinical research) or work spanning disciplines within a particular type of research (e.g., bench research involving molecular genetics and immunology).

Implementation and Implementation Science

Implementation refers to the use of methods and strategies to facilitate the adoption of evidence-based interventions and change practice patterns within specific settings. Relatedly, *implementation science* is the systematic study of the processes, factors, and mechanisms necessary for successful adoption of an evidence-based intervention or innovation that results in widespread use, the uptake of new practices, or broad-scale reach and penetration through

dissemination and implementation efforts, marketing, laws and regulations, and/or systems research and policies (Bauer, Damschroder, Hagedorn, Smith, & Kilbourne, 2015).

Knowledge Translation Origin and History

Despite the onset of *knowledge translation* as a formalized term decades ago, its components—*knowledge* and *translation*—are ancient concepts (Ackerley, 2017, p. 32). Through the years, a plethora of terms and activities have been used to label KT activities across disciplines and countries (Backer, 1991; Lane & Flagg, 2010; McKibbon et al., 2010). If one looks beyond terminology to the essence of the activity itself, the concept, practice, and study of KT are not new (Ackerley, 2017, p. 27).

Marking key moments in KT's evolution largely depends on its evolving definitions. KT conceptualized as communicating research-based knowledge to meet the needs of society dates back to the Greeks (Backer, 1991). As a field of inquiry, KT can be linked to the beginning of social science in the early 19th century, as illustrated in the work of sociologist Gabriel Tarde, who explored the spread of innovations throughout society as a way of explaining why some innovations were adopted while others were rejected (Backer, 1991).

In health, the related term *research utilization* has been used for almost five decades (Ackerley, 2017). KT research has dominated in the health context, arguably as a reflection of the urgent, life-or-death nature of health care and the costly consequences of failing to use evidence for improving practice and outcomes (Ackerley, 2017).

The conceptualization of KT presented throughout this monograph crosses several disciplines (e.g., knowledge utilization; diffusion of innovations; technology transfer; evidence-based medicine; quality improvement; knowledge management; communication), each shaping their own focus of interest and terminological preferences. Examples include Rogers' (2003) work in diffusion of innovations in rural sociology, nursing research utilization, and more recently, dissemination and implementation research in the United States; KT and KM in Canada; knowledge transfer and research capacity in the United Kingdom; and the "know-do" gap in Australia (Ackerley, 2017; Lane & Flagg, 2010; McKibbon et al., 2010; Straus, Tetroe, & Graham, 2009). This breadth in terminology and application highlight efforts to name and present KT in ways specific to particular disciplines. The following sections describe key factors shaping KT's notable evolution (Ackerley, 2017, p. 27).

Knowledge Translation During the 20th Century

The evolution of KT during the 20th century has been shaped by three successive waves of activity, each with a unique focus and level of political support (see Backer, 1991). Our

conceptualization of evolving KT waves primarily centers on events in the United States and Canada, where the term has been documented in detail. Where available, examples from other countries also are noted. Note that Backer's historical summary uses the term *knowledge utilization (*as opposed to *knowledge translation)*, defined as "research, scholarly, and programmatic intervention activities aimed at increasing the use of knowledge to solve human problems" (Backer, 1991, p. 226).

Wave 1: 1920–1960

The focus of KT between 1920 and 1960 was primarily on how individuals adopted innovations. The Research Committee on Social Trends, established in 1929, was the first official initiative designed to maximize the impact of science on society's needs (Backer, 1991). In the late 1930s and early 1940s, agricultural technology advanced rapidly, and Ryan and Gross (1943) examined the diffusion of hybrid corn to farmers in Iowa. In 1962, their highly cited, seminal work illustrating the characteristics of innovation adopters informed Rogers' influential diffusion theory (Backer, 1991).

Wave 2: 1960–1980

From 1960 to 1980, KT broadened to the dissemination and utilization of innovations resulting from research and demonstration activities. At the user level, KT's focus was on innovation adoption by both individuals and organizations (Backer, 1991). In the 1960s and 1970s, the United States established several institutes, programs, and offices promoting the application of federally funded research, including the National Institutes of Mental Health. National investments in knowledge utilization were largely motivated by the goal of stimulating economic growth through advancing technology and a need to increase the application of innovations emerging from various areas of research (e.g., defense and space; health, education, and human services) (Backer, 1991).

In the United States, the federal emphasis on knowledge utilization led to several important developments in the field (Backer, 1991):

- The number of dissemination activities increased (e.g., creation of clearinghouses by federal agencies to increase research and knowledge access; publications and other printed materials).
- Research studies began to test the effectiveness of dissemination and utilization strategies such as print materials, films, videotapes, organizational development, technical assistance, conferences and workshops, and participant observation.
- KT developed as a distinct field of professional and scholarly activity, with its own journals (e.g., *Journal of Technology Transfer* [1975], *Knowledge in Society* [1988]), professional

societies (e.g., Knowledge Utilization Society, 1985), and university programs (e.g., Center for Research on Utilization of Scientific Knowledge at the University of Michigan).

Although KT flourished in the United States during this time, with the Reagan administration came significant reductions in federal funding, and some KT initiatives were terminated as a consequence.

This wave marked another noteworthy moment for KT. In 1972, an article included in the MEDLINE database was indexed for the first time under the term "knowledge translation" (cf. Greenhalgh & Wieringa, 2011). The article, published in French, discussed measures to promote the application of laboratory discovery research to improve disease diagnosis or treatment. These activities corresponded to what the National Institutes of Health's (NIH's) Roadmap for Medical Research has labelled T1 or "bench to bedside KT"; with T2 describing the rest of the continuum (i.e., namely, the transfer of findings from clinical studies to practice settings) (Kon, 2010). This initial NIH conceptualization of two basic steps of translation was then further refined and expanded to include T3 (i.e., moving evidence-based guidelines and treatments into health practice) and T4 (i.e., evaluation of real-world health outcomes of guidelines/treatment applications in practice) (Kon, 2010).

Wave 3: 1990s

The 1990s saw a continued emphasis on KT and strategic partnerships between federal and local agencies to transfer knowledge into action to improve health, education, and human services, as well as further refinements in how KT was conceptualized. For example, Backer (1991) proposed a hierarchical, four-level model to classify federal KT programs across diverse sectors (health, education, human services, defense, aeronautics, space administration, and transportation).

- Level 1: Dissemination (D)—Programmatic activities are limited to dissemination through publications, information clearinghouses (e.g., National Institute on Aging).
- Level 2: D + Utilization (U)—Programmatic activities include both dissemination and activities promoting utilization through targeted funding, technical assistance, and other avenues. (e.g., National Cancer Institute; U.S. Department of Veterans Affairs).
- Level 3: D + U + Research on knowledge user (KU) processes (R)—Programmatic activities support dissemination and utilization as well as research on knowledge utilization (e.g., National Institute on Disability and Rehabilitation Research).
- Level 4: D + U + R + Integrated System for Knowledge Utilization (I)—Programmatic activities include dissemination, utilization, and research, all conducted under an integrated plan for

a knowledge utilization system, including a clear policy for the federal agencies (e.g., Office of Educational Research and Improvement).

In Canada, the genesis of KT can be traced to the creation of the Canadian Health Services Research Foundation (CHSRF) in 1996, with its mission to support evidence-informed decision-making in health care through funding research, building capacity, and transferring knowledge (CHSRF later became the Canadian Foundation for Healthcare Improvement). In 1999, CHSRF organized a seminal national workshop encouraging efforts to translate research evidence to meet the needs of decision-makers.

Wave 4: Contemporary Trends in Knowledge Translation (post-2000)

Setting international priorities to reduce the evidence to practice and policy gap (e.g., Grimshaw, Eccles, Lavis, Hill, & Squires, 2012) has characterized the period post-2000. In the United States, this has taken the form of unprecedented investments in KT research. For instance, NIH expressed its "profound commitment […] to do whatever is necessary to rapidly exploit the revolutionary advances of the past few years for the benefit of our people" (Zerhouni, 2003, p. 72). In 2006, NIH introduced the Clinical and Translational Science Award program with the goal of funding 60 centers over six years, at an annual cost of U.S. $500 million (Greenhalgh & Wieringa, 2011; NIH, 2007).

In 2000, the government of Canada established the Canadian Institutes for Health Research (CIHR) from the former Medical Research Council as Canada's national health research funding agency. Playing a central role in CIHR's mandate from its beginning, KT is reflected in the agency's mission and the Parliamentary act under which it was established. KT is integral to CIHR's strategic plan, with management roles and structures specifically dedicated to KT, including KT-specific funding mechanisms (McLean et al., 2012). In 2004, Canada's SSHRC similarly prioritized knowledge mobilization to ensure social and/or economic impact (Ackerley, 2017).

In 2006, the Cooksey Report in the United Kingdom introduced a comprehensive strategy to guide translational research in both basic and clinical sciences, leading to the formation of the Office for Strategic Coordination of Health Research (Cooksey, 2006). Translational medicine was recognized as a key area of focus for the newly established office and was allocated a significant portion of the £1.7 billion budget (Greenhalgh & Wieringa, 2011).

With an increased international emphasis on KT has come significant growth in KT research and practice and recognition of the imperative for disseminating research evidence and emerging best practices. Several new journals were founded during this time, with 27 journals listed on the NCBI index of medical journals containing the term "translational," 18 of which have been launched since 2008 (Greenhalgh & Wieringa, 2011). In the post-2000 era, implementation

science also has emerged as a burgeoning research field. Across Europe, approximately 20 national research and government agencies have implemented research translation systems, including a multimillion-euro network of European biomedical translation hubs based on existing research centers. This initiative followed the United States' initiative to institute a consortium of 60 clinical and translational science centers (CTSCs) based at universities and medical centers across the country (Butler, 2008).

In the United States, within the field of disability and rehabilitation research, the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR; formerly known as the National Institute on Disability and Rehabilitation Research, NIDRR) steered early and influential KT work. NIDILRR is a federal agency that funds applied research, training, and development with the end goal of improving the lives of people with disabilities. From early on, NIDILRR's mission strongly emphasized the discovery and application of new knowledge to improve well-being and functioning among people living with disabilities (National Research Council, 2012).

NIDILRR's long-range plan for 2018–2023 places KT as central to promoting the effective use of research discoveries, innovations, and products developed with NIDILRR funding (NIDILRR, 2020). In concrete terms, this means that NIDILRR has and will continue to integrate KT systematically into all funding programs and grant operations by incorporating KT requirements into the grant competition process, providing educational KT support to grantees, and identifying opportunities to promote the use of knowledge and products generated from NIDILRR-funded research.

Stakeholder Engagement in Knowledge Translation

Knowledge Users and Stakeholders

The translation of evidence-based knowledge occurs in the service of KUs, defined as individuals who are "likely to be able to use research results to make informed decisions about health policies, programs and/or practices" (CIHR, 2015, para. 22). We propose a slightly broader definition, such that KUs are individuals who are likely to *benefit* from research evidence in a manner that need not be instrumental (i.e., the term "use" implies practice, behavior, or policy change). For instance, KUs may benefit from new knowledge and understanding in symbolic or conceptual ways.

Stakeholders also can be KUs and, in particular, have something to gain or lose as a result of the outcomes of a project, program, or process (Hovland, 2005). Identifying relevant stakeholders early on in the research process can and should inform their potential involvement in KT activities by identifying their needs or desires with respect to the project goals (this will inform

evaluation), whether they are primary (key, directly involved) or secondary stakeholders, and by analyzing their degree of interest in and influence over the project outcomes. Clarity about stakeholders' needs and concerns helps to manage their expectations, ensures active and constructive engagement in the project and its evaluation, and informs how to deal with stakeholders who do not share the project's aspirations. Understanding the needs and expectations of both KUs and stakeholders informs the planning of research processes and KT.

A common way of classifying KT activities is by the role played by KUs and stakeholders in the process of producing, interpreting, and sharing knowledge and the timing of their involvement. This classification distinguishes between end-of-grant KT and integrated KT (CIHR, 2015).

- *End-of-grant KT* refers to the dissemination of findings generated from research once a project is completed through publications, conference presentations, policy briefs, and other forms of communication, with KUs having a minimal or non-existent role in the knowledge production process (CIHR, 2015).
- *Integrated KT* (iKT) has been defined as an ongoing relationship between researchers and KUs (decision-makers, clinicians, administrators, policymakers, patients), spanning all stages of research from formulating research questions to data analyses and interpretation and co-development and execution of KT activities. The goal of iKT is to promote mutually beneficial and meaningful decision making (Gagliardi, Berta, Kothari, Boyko, & Urquhard, 2016).

Engaging Knowledge Users and Stakeholders

KUs and stakeholders can be engaged in the research and translation process through iKT, which requires managing the needs and preferences of a heterogeneous group of individuals who may be located in diverse settings (Smits & Denis, 2014). Since KUs may differ in their knowledge needs, engagement styles, and perspectives, KU engagement can be useful for KT planning and execution. Identifying KUs requires considering their knowledge needs and how they may contribute to the development and deployment of the KT plan. KT outputs or deliverables need to consider the needs of particular KU audiences. Wickremasinghe and colleagues (2016) outlined the needs of four distinct groups of KUs:

- Academics and researchers need access to critically appraise research, identify research gaps, and replicate previous research.
- Advocates need to access overviews of research findings and evidence-based case studies to support advocacy work and the promotion of changes in policy and practice.
- Policymakers need to have an accurate and complete understanding of validated concepts, experiences, and technical knowledge relevant to the development of new policies and the revision of old policies.

- Professionals and practitioners need to have access to validated concepts, experiences, and technical knowledge to inform the implementation of policies and best practices.

To this list we would add consumers and patients (Banner et al., 2019).

In addition to considering the needs of KU audiences, effective KT must take into account KU preferences for dissemination format, modality and channel of communication, use of language (jargon terminology, plain language), prior assumptions, type of knowledge, level and quality of evidence, and relevance of outcomes (Gagliardi et al., 2016; Wickremasinghe et al., 2016). Consideration of these elements is important given that researchers and KUs can have different views on what constitutes evidence or what aspects of the evidence are most important or relevant. For instance, researchers tend to define evidence as knowledge produced through a systematic and scientific process, whereas practitioners, decision-makers, and policymakers define it more broadly as a combination of research findings and experiential knowledge (Lomas, Culyer, McCutcheon, McAuley, & Law, 2005). Similarly, lack of clarity in terminology can also widen the gap between knowledge creators and users (Dixon, Elliot, & Clarke, 2016). While these differences are generally acknowledged in the literature, there is a need for concrete guidance on how to minimize inherent differences in order to achieve truly integrated KT (Dixon et al., 2016).

Empirical evidence suggests that iKT in health care contexts enhances the use of scientific evidence. Specifically, iKT leads to more citations by decision-makers, improved clinical outcomes, enhanced communication among stakeholders, and enhanced skills and confidence in using research by the end-users (Gagliardi et al., 2016; Jolibert & Wesselink, 2012). A review of the peer-reviewed literature on stakeholder engagement in comparative effectiveness research and patient-centered outcomes research found that reports of stakeholder engagement were highly variable in content and quality (Concannon et al., 2014). While there was frequent engagement with patients, engagement with clinicians occurred less frequently, and engagement with KUs in other key decision-making groups across the health care system was infrequent. Stakeholder engagement was more common in earlier (prioritization) stages of research than in later (dissemination and implementation) stages. The roles and activities of stakeholders were highly variable across research and program reports.

Although research generally points to enhanced impact with KU and stakeholder engagement, it remains unclear which engagement strategies are most effective and that work best in different contexts (e.g., Camden et al., 2015; Gagliardi et al., 2016). Comprehensive descriptions of KT strategies are commonly absent in research reporting within the rehabilitation sciences, for instance, and stakeholder engagement outcomes are rarely evaluated (Camden et al., 2015). Future research could improve methods by identifying how different iKT strategies influence outcomes to clarify the relationship between the logic or

theory underlying iKT interventions and beneficial outcomes, and determine when and how decision-makers and other KUs should be involved in the research process (Gagliardi et al., 2016). Future iKT initiatives should be systematically planned, implemented, evaluated, and reported with sufficient detail to reveal how iKT was associated with outcomes.

To address this gap, Boaz and colleagues (2018) proposed several "design principles" for stakeholder engagement based on a review of the literature and their own experience with engaging stakeholders in a longitudinal study. Defining stakeholders as "individuals, organizations or communities that have a direct interest in the process and outcomes of a project, research or policy endeavor" (Boaz et al., 2018, p. 5), they proposed principles within three broad categories—organizational, values, and practices—to guide undertaking, monitoring and evaluating of stakeholder engagement (see Table 1 for the full list).

Table 1. Summary of Design Principles for How to Engage Stakeholders in Research

Organizational
1. Clarify the objectives of stakeholder engagement
2. Embed stakeholder engagement in a framework or model of research use
3. Identify the necessary resources for stakeholder engagement
4. Put in place plans for organizational learning and rewarding of effective stakeholder engagement
5. Recognize that some stakeholders have the potential to play key roles
Values
6. Foster a shared commitment to the values and objectives of stakeholder engagement in the project team
7. Share understanding that stakeholder engagement is often about more than individuals
8. Encourage individual stakeholders and their organizations to value engagement
9. Recognize potential tension between productivity and inclusion
10. Generate a shared commitment to sustained and continuous stakeholder engagement
Practices
11. Plan stakeholder engagement activity as part of the research program of work
12. Build flexibility within the research process to accommodate engagement and the outcomes of engagement
13. Consider how input from stakeholders can be gathered systematically to meet objectives
14. Consider how input from stakeholders can be collated, analyzed, and used
15. Recognize the identification and involvement of stakeholders is an iterative and ongoing process

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A recent systematic review of 48 studies on patient engagement to improve quality of care found that the main enablers of engagement were related to techniques to improve the design, recruitment, involvement and leadership action, and to create a receptive context (e.g., enable patients or carers to set the agenda; enable time to develop strong and trusting relationships; strive for a wide representation of patients at all stages; Bombard et al., 2018). A quarter of the studies formally evaluated patients' experiences of the engagement process. While most experiences were positive—increased self-esteem, feeling empowered, or independent—some patients sought greater involvement and felt that their involvement was important but tokenistic, especially when their requests were denied, or decisions had already been made.

External Drivers of Advancement in Knowledge Translation

The Role of Funders in Shaping Knowledge Translation

> *Greater involvement of [funding agencies] in all forms of KT is not just the right thing to do: it is essential for the maintenance of the health research enterprise in the face of many competing and compelling demands on the tax base.* (Kitson & Bisby, 2008, p. 6)

Motivated by a need to increase accountability and return on public money invested in research and to ultimately improve outcomes, funders around the world have played a crucial role in prioritizing KT and IS. The emphasis on KT adopted by numerous research funding agencies reflects increasing recognition that excellent research does not automatically lead to better outcomes unless it is coupled with high-quality KT directed to multiple audiences, and where appropriate, effective implementation. The impetus to fund and attend to KT on the part of research funders has strengthened the validity and credibility of KT as an emergent substantive field of study in its own right.

Holmes, Scarrow, and Schellenberg (2012, p. 2) argue that it is essential for the funders "to move away from the traditional 'fund and forget' model and review their funding priorities, grant review criteria, and research practices, and generally become more active in the space between research results and impact." Funders are meeting this challenge in various ways. In Canada, funder-supported KT activities have included research chairs; peer-reviewed funding of KT activities resulting from funded research; operating grants; KT education and professional development; KT networks (e.g., www.ktecop.ca); KT conferences; KT integrated in funding requirements to engage researchers, policy-makers, practitioners and the public within the research enterprise (Holmes et al., 2012); inclusion of KT activities in the common curriculum vitae template for national funders; and reporting of KT activities in final funding reports (i.e., CIHR).

In the United States, KT in the form of IS specifically has emerged as a national priority as reflected by the focus, activities, and funding allocations of several national institutes and agencies (Meissner et al., 2013; Morrato et al., 2015):

- The U.S. Department of Veterans Affairs, Veterans Health Administration (VHA) established the Quality Enhancement Research Initiative in 1998 (QUERI) designed to improve VHA health care outcomes by implementing evidence-based treatments with quality.
- The Agency for Healthcare Research and Quality (AHRQ) funds research networks to optimize the transfer of health care research into practice.
- The NIH funds research, conferences, and workshops with an implementation focus.
- The Patient-Centered Outcomes Research Institute (PCORI) has developed merit review criteria for proposals that focus on implementation; published a dissemination and implementation framework and is committed to investing 20% of its funding (approximately $400 million annually) into dissemination and research capacity building.

These efforts have driven the development of the KT and IS fields and been impactful for practice settings, but they come with challenges. An international study examining funding agencies' perceptions of their role in promoting the use of research findings identified difficulties with determining KT priorities, defining KT, evaluating investments in KT, identifying reviewers with sufficient KT expertise to evaluate KT activities and grants, and establishing a systematic approach to the KT initiatives they fund (Tetroe et al., 2008). Smits and Denis (2014) studied six nations' main health funding agencies and found similar complexity in integrating science into policy and practice and difficulties in measuring any resulting benefits. In response, several authors have suggested the need for funders to augment their role in supporting KT by providing clear definitions of KT; engaging in KT activities themselves; involving end-users in determining KT funding priorities; facilitating communication between researchers and end-users; requiring a KT plan for all funded research; providing training to reviewers who assess KT plans; and creating funding opportunities to address urgent population needs (Kitson & Bisby, 2008; Tetroe et al., 2008).

Some funding agencies have put these suggestions into play. As noted, NIDILRR has developed and integrated a clear KT framework and systematic evaluation into the fabric of all their funding programs. In Canada, CIHR has supported KT through research chairs, strategic funding opportunities, and project grants since 2000, although the organization could do more to fund IS strategically.

Academic Promotion

> *At institutions of higher learning, we become greater than the sum of our parts when we extend beyond knowledge transfer to knowledge mobilization, reward educational leadership and multidisciplinary collaborations, legitimize forms of scholarly activity such as advocacy and social justice, value scholarly work that extends beyond peer review, and recognize the creation of tools and resources that create change in communities, especially those at risk. In doing so, we fulfill our mandate of supporting and sustaining an innovative, resilient and diverse society.* (Riddell, 2016, para. 8)

More recently, universities are beginning to revise their criteria for academic promotion and tenure to include KT and community-engaged scholarship (Bunton & Mallon, 2007; Cabrera, Roy, & Chisolm, 2017; see also Community-Campus Partnerships for Health, https://www.ccphealth.org/). The shift has its roots in Ernest Boyer's challenge to redefine scholarship to recognize the scholarship of integration, application, and teaching in addition to the scholarship of discovery and publication (Boyer, 1990). Later, Boyer expanded his thesis to include the scholarship of engagement (Boyer, 1996, p. 21). Since then, the concept has been endorsed by several higher education organizations, including the American Association of State Colleges and Universities, the Association of Public and Land Grant Universities, and the Coalition of Urban Metropolitan Universities in the United States. In Canada, the University of Toronto Faculty of Medicine has adopted more inclusive criteria for academic promotion; and Research Impact Canada, a pan-Canadian network of universities, has been formed to maximize the impact of academic research for the public good in local and global communities.

Relatedly, the San Francisco Declaration on Research Assessment (DORA, 2012) made several recommendations toward improving ways in which the output of scientific research is evaluated by funding agencies, academic institutions, and other parties. Developed in 2012 during the annual meeting of the American Society for Cell Biology in San Francisco, the Declaration is now a worldwide initiative covering all scholarly disciplines and all key stakeholders, including funders, publishers, professional societies, institutions, and researchers. Individuals and organizations who are interested in developing and promoting best practice in the assessment of scholarly research are encouraged to sign DORA (https://sfdora.org/).

As new generations of scholars begin to favor innovative forms of scholarship, including digital and web-based publications that traditionally have not been valued in retention, tenure, and promotion policies, these are being integrated into promotion criteria in some institutions. For instance, in recognition that social media has become an essential tool for dissemination and outreach, the Mayo Clinic in the United States has outlined new strategies and tools for evaluating the impact of digital scholarship on the academe and general populations, and for recognizing scholars who are engaged in this work. A seminal paper outlines how altmetrics can

be used to assess dissemination and impact, and describes a strategy to recognize digital academia on career promotion and tenure (Cabrera et al., 2017).

As Cavallaro (2016) and Riddell (2016) note, paradigm shifts happen slowly. Cavallaro contends that changing policies and institutional culture can be challenging and may require multiple years of sustained effort. He states that few higher education institutions have succeeded in establishing well-articulated policies that would enable or support the recognition of community-engaged scholarship in the tenure and promotion process (Cavallaro, 2016). For more on this topic, we direct you to a special issue of *Metropolitan Universities* (2016, Vol. 27, No. 2) that examines institutional approaches to the recognition of community-engaged scholarship in faculty promotion and tenure policies and processes. Papers in this issue describe evidence-based approaches to defining and evaluating the quality of engaged scholarship, as well as analyses of the processes and outcomes associated with the adoption and implementation of engaged scholarship in review, promotion, and tenure policies. In addition, Smith, Else, and Crookes (2014) provide a sound review of engagement in academia.

Evolution in Knowledge Translation Theories, Models, and Frameworks

The need for sound conceptual guidance has been an essential component guiding our quest for effective and sustainable evidence-based change in a variety of systems (i.e., individual, community, or organizational). Without guidance for critical reflection on KT's key elements, it can be difficult to understand or explain why a particular endeavor may succeed or fail (Nilsen, 2015; Tabak, Khoong, Chambers, & Brownson, 2012).

There is no overarching KT approach that can meet all needs; rather, the KT approach must be tailored to a KT goal and context. While some theories, models, and frameworks (TMFs) pertain to dissemination, an overwhelming number are implementation-specific, addressing implementation process, determinant factors, strategies, and evaluation. The following section reflects on the evolution of TMFs within KT and implementation and draws attention to a select few examples.

Although TMFs tend to be viewed synonymously, they are unique in their assumptions and goals and, as a result, differ in their scope of inquiry. In some cases, there also may be overlap between TMFs, which can further generate confusion in understanding which TMFs are best suited for a KT undertaking. Some key distinctions among TMFs are presented in the following paragraphs, and Table 2 provides a brief overview.

A *theory* typically presents a set of principles, interrelated concepts, definitions, and/or propositions that aim to describe and explain events. Theories can be classified as descriptive, explanatory, or predictive, and can provide systematic guidance to help predict and examine which factors influence an outcome. Many theories are often described as "meta" theories that are broadly applicable, conceptual in nature, and not targeted to a particular context. Theories that have been applied to the field of KT include the Theory of Planned Behavior (Ajzen, 1985, 2005), the Theory of Diffusion (Rogers, 2003), and Social Cognitive Theory (Bandura, 1977, 1986, 2005).

A model seeks to describe—but not explain. Although models also can be quite conceptual, they aim to simplify understanding. The CIHR Model of KT and the Knowledge-to-Action (KTA) Model are examples. The CIHR Model of KT is "a global KT model, based on a research cycle, that could be used as a conceptual guide for the overall KT process" (Sudsawad, 2007, para. 21). The model identifies six opportunities for knowledge exchange in research, including defining research questions and methodologies; conducting research; publishing research findings in plain language and accessible formats; placing research findings into the context of other knowledge and socio-cultural norms; using research to inform decision-making decisions; and influencing subsequent research (CIHR, 2005). The KTA Model (Graham et al., 2006) is a first-generation process model that conceptualizes the relationship between knowledge creation and action. The KTA Model captures the need for evidence to be synthesized before its application and outlines the activities needed for implementation or application at a high, conceptual level. More recent TMFs, such as the Quality Implementation Framework (Myers, Durlak, & Wandesman, 2012), have gone further to describe the specifics of each process stage in greater detail.

Finally, a *framework* provides structured description of a given phenomenon via a series of concepts, categories, or variables, but does not necessarily explain the mechanism or 'why' a particular phenomenon unfolds the way it does. Common implementation frameworks include the Promoting Action on Research Implementation in Health (PARiHS) (Kitson et al., 2008) framework and updated iPARiHS (Harvey & Kitson, 2016), and the Consolidated Framework for Implementation Science (CFIR) (Damschroder et al., 2009).

Table 2. Distinctions Among Theories, Models, and Frameworks

	Brief Overview	Examples
Theory	• Highly conceptual; non-context specific • Aims to describe and explain a particular KT phenomenon through the presence of interrelated concepts, definitions, and/or propositions	• Theory of Planned Behavior • Theory of Diffusion • Social Cognitive Theory

	Brief Overview	Examples
Model	• Seeks to describe, but does not explain • Presents a more defined scope of inquiry	• CIHR Model of KT • Knowledge-to-Action Model
Framework	• Provides a systematic way to assess and evaluate the phenomenon under investigation • Focus is more on *what* is occurring than on *why* it is occurring	• PARiHS • CFIR • Quality Implementation Framework

Classifications and Taxonomies: Organizing the Deluge

KT has generated and incorporated theoretical and conceptual development in several fields. Theories within psychology, such as the Theory of Planned Behavior (Ajzen, 1985, 2005), the Theory of Reasoned Action (Fishbein & Ajzen (1975), and the Social Cognitive Theory (Bandura, 1977, 1986) have been widely applied to understand determinants associated with behavior change and user/adopter characteristics. Elsewhere, complexity science has emphasized that health care is a complex adaptive system: Linear implementation of evidence into practice is not feasible. "Complexity science forces us to consider the dynamic properties of systems and the varying characteristics that are deeply enmeshed in social practices, whilst indicating that multiple forces, variables, and influences must be factored into any change process, and that unpredictability and uncertainty are normal properties of multi-part, intricate systems" (Braithwaite, Churruca, Long, Ellis, & Herkes, 2018, p. 1).

Many TMFs elucidate greater understanding of diffusion, dissemination, adoption, and implementation. The term "KT," however, is often conflated with IS, particularly in Canada, which obscures the possibility that KT may pertain to sharing knowledge and informing decision-making, in addition to facilitating practice, behavior, and policy change. KT and IS are related but not synonymous. As noted earlier, we view KT as an overarching term and implementation as a sub-specialty that relates to the goals of facilitating practice, behavior, and policy change based on evidence.

While the myriad of TMFs has broadened our understanding of key factors influencing the translation of evidence, they have also resulted in a deluge of diverse and, sometimes, similar approaches that can be complex and challenging to navigate, select, and apply. In recent years, researchers have sought to distill the complexity of TMFs and guide implementers through the creation of various classification systems. TMFs have been classified according to key characteristics or overarching aim. A few categorizations are highlighted below, including those aiming to guide implementers in selecting TMFs that best suit their KT goals.

The Rise of Implementation Science

> *The practices no longer require research to demonstrate efficacy and effectiveness; as a practical matter, everything that needs to be known is already known. Furthermore, translation of these research findings into actions that can be used in practice is very simple. In addition, because the actions are not prohibitively expensive, cost is not an obstacle, and in fact, cost-effectiveness could be advanced as one more reason for their widespread adoption. Yet their application in the real world is not what it should be, and we need to find out why and to try new approaches to change this situation.* (Lenfant, 2003, p. 871)

In this oft-cited editorial, Lenfant makes a compelling case for improving our approach to the application and adoption of research evidence in order to increase return on investments in research (more than US $250 billion invested in the NIH since 1950). Lenfant (2003) provides multiple examples to highlight the prevalent issue of research findings being "lost in translation" somewhere on the "highway" from research to practice. He reports how beta-blockers (shown to be effective for patients recovering from myocardial infarction) and aspirin (shown to be effective for treating unstable angina and secondary prevention of myocardial infarction) were prescribed for only 62% and 33% of eligible patients, respectively. Similar statistics emerge from global health, where only 35% of young children were sleeping under insecticide-treated bed nets in 2010, and nearly 14,000 people living in Sub-Saharan Africa and South Asia died daily from preventable, treatable diseases (Panisset et al., 2012). These statistics converge to reinforce the same message: We know what works, but this knowledge is not successfully implemented in practice.

The imperative to attend to implementation process and effectiveness in addition to intervention effectiveness has emerged over the last two decades in the face of growing recognition that effective practices and treatments do not passively make their way into routine practice. Implementation is not a simple, linear process; rather, it is a highly complex, multi-stage, iterative, multifactorial process that requires distinct expertise and capacity (Brehaut & Eva, 2012). Implementation must be intentional, explicit, and systematic. Emerging research has illustrated that implementation effectiveness is as important as the effectiveness of the evidence that is being implemented, and a strong, positive relationship exists between implementation quality and treatment outcomes (Durlak & DuPre, 2008).

As a branch of KT, implementation science is concerned with facilitating practice, behavior and/or policy change and has emerged as a substantive area of scientific inquiry seeking to remedy the "know-do" or implementation gap. Defined as the "scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into

routine practice, and, hence, to improve the quality and effectiveness of health services" (Eccles & Mittman, 2006, p. 1), implementation science is a global undertaking. The first dedicated peer-reviewed journal for this field—*Implementation Science*—emerged in 2006, with numerous other peer-reviewed journals dedicating special issues and sections to the implementation of evidence-based practices since 2014 (e.g., *Evidence & Policy*). *Implementation Research and Practice* is a new online-only journal focused on implementation in behavioral health from the Society for Implementation Research Collaboration (SIRC), and *Implementation Science Communications* is an official companion journal to *Implementation Science*, with a focus on research relevant to the systematic study of approaches to foster uptake of evidence based practices and policies that affect health care delivery and health outcomes, in clinical, organizational, or policy contexts.

Although still somewhat nascent, IS research and practice have developed rapidly. Early implementation research focused heavily on identifying gaps in the use of evidence-based practices and barriers and facilitators to the uptake of innovations into practice. More recently, implementation research has concentrated on developing, revising, extending, and evaluating theories and frameworks, and testing effective strategies and processes for implementation (see below). In addition to these "evolutionary leaps" (Bauer et al., 2015), the IS field has defined and refined its research designs (Curran, Bauer, Mittman, Pyne, & Stetler, 2012), methods and measurement (Lewis et al., 2015), outcomes (Proctor et al., 2011), and reporting standards (Pinnock et al., 2017a, 2017b).

Evolution in Research Design for Implementation Studies

Before the rise of implementation research, KT research was commonly based on randomized controlled trial (RCT) designs to determine the effectiveness of particular KT strategies in changing the behavior of health care practitioners (see Grol & Grimshaw, 2003). During this time, the focus was on KT strategies (what we would now refer to as implementation strategies) and their impact on individual behavior. Fundamental to the RCT research design is the control of seemingly extraneous variables. As research evolved, determinant implementation frameworks identified a range of factors associated with successful implementation that fundamentally shifted our view of the so-called extraneous nature of these variables (e.g., process, inner and outer setting factors). Study designs for implementation have expanded to include a wider range of randomized, quasi-experimental, experimental, and mixed methods approaches (for a good review, see https://impsciuw.org/implementation-science/research/designing-is-research/).

The key processes involved in guiding implementation emerged in several models and frameworks. It also became evident that conducting efficacy, effectiveness and implementation research in a linear manner was inefficient. In light of this, Curran et al. (2012) adapted existing

research designs to the field of IS and proposed three types of hybrid effectiveness-implementation trial designs (types 1, 2, and 3). These are described as "hybrid" designs because they simultaneously examine both the effectiveness of the evidence-based treatment and the implementation approach utilized to put the treatment into practice.

The three types of designs differ in the emphasis placed on primarily testing the effectiveness of the evidence-based treatment (type 1), the implementation strategy (type 3), or both (type 2). The advantage of these designs is that they allow for systematically examining both implementation and treatment effectiveness with consideration of the level of evidence for the intervention. As such, hybrid effectiveness-implementation trial designs are more efficient and have the potential to identify important treatment-implementation interactions and enhance treatment delivery in real-world settings.

Another common characteristic of early implementation studies was their nearly exclusive focus on exploring patient- or system-level outcomes. This focus left out consideration of key factors that can facilitate or hinder implementation such as context, implementation process, and implementation outcomes. Specifically, the emerging focus on implementation outcomes is key to understanding clinical outcomes, relative to what works in practice and behavior change (Proctor et al., 2011).

Implementation outcomes are distinct from service outcomes (efficiency, safety, equity, patient-centeredness, timeliness) and client outcomes (satisfaction, function, and symptomatology). Implementation outcomes are defined as the effects of activities undertaken to implement a program and include acceptability, adoption, appropriateness, feasibility, fidelity, implementation cost, penetration, and sustainability. Measuring implementation outcomes in addition to client or service system outcomes is crucial for distinguishing effective or ineffective programs that are well or poorly implemented. Recent work in the United States is exploring measures associated with implementation outcomes (e.g., Lewis et al., 2015).

Finally, complete and accurate reporting of implementation research arguably contributes to the improved translation of research into practice, ensuring consistency in conducting and reporting implementation research, and building on earlier work in a meaningful and transparent way. To this end, the Standards for Reporting Implementation Studies (StaRI) propose requirements for an extensive description of context, implementation strategies, and interventions, as well as reporting on a broad range of effectiveness, process, and health economic outcomes (Pinnock et al., 2017a, 2017b). Recently published, the challenge moving forward will be to disseminate and implement these standards in the academic community, by involving journal editors and requesting use of these standards for submitted publications, as is often the case for other standards such as CONSORT (http://www.consort-statement.org/). Application of the StaRI standards may pose further challenges because it will require its own

implementation, that is, behavior change on the part of researchers and adaptations for journals to allow for longer papers and/or permit additional files.

Dissemination and Implementation Categorizations

In 2012, Tabak and colleagues' narrative review of dissemination and implementation (D&I) models characterized three key characteristics: (1) construct flexibility; (2) degree of dissemination or implementation involved; and (3) the level at which the TMF operates (i.e., socio-ecological framework [SEF] level) (Table 3).

Table 3. Overview of Tabak et al.'s (2012) Categorization of D&I Research

1. Construct flexibility	The degree of flexibility of a model's constructs. Broad models contain loosely defined constructs that allow greater flexibility to apply the model to a wide array of D&I activities and contexts. Operational Models provide detailed, step-by-step actions for completion of D&I activities.
2. A focus on dissemination or implementation activities themselves	Models were further categorized on a continuum from *dissemination* (the active approach of spreading evidence-based interventions to the target audience via determined channels) to *implementation* (the process of putting into use or integrating evidence-based interventions within a setting). Models informing this category fall along this spectrum from dissemination to implementation. D-only; D > I; D = I; I > D; I-only
3. SEF level	Classify models based on the level with which they operate. D&I strategies can focus on change at a specific level (i.e., clinician or organization) or cut across a variety of levels (individual, community, organizational, system, policy).

Source. Adapted with permission from Tabak et al. (2012).

Tabak's itemized list of approximately 60 TMFs draws attention to their conceptual flexibility for application across contexts, the focus on dissemination or implementation (or both), and the level at which the TMF operates. Based on this categorization, Table 4 highlights a few select TMFs that KT scholarship has widely applied.

Table 4. Selected TMFs Identified Through Tabak et al.'s (2012) Categorization in D&I Research

TMF	Authors	Overall Aim	D and/or I	Broad or Operational	Levels of Analysis
Diffusion of Innovation Theory	Rogers (2003)	Seeks to explain how, why, and at what rate knowledge and evidence spread.	D-only	Broad	Individual Community Organization
Streams of Policy Process	Kingdon (1984, 2010)	Provides an overview of the stages in the policy process.	D-only	Fairly broad	System Community Organization Policy
Research Knowledge Infrastructure	Ellen et al. (2011) Lavis et al. (2006)	Reflects on the implementation of research knowledge infrastructure (i.e., interventions, tools).	D > I	Operational	Community Organization Individual Policy
The Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) Framework	Glasgow et al. (1999)	Provides a series of stages to guide implementers from research planning to evaluation and reporting.	D = I	Operational	Community Organization Individual
Ottawa Model of Research Use	Logan & Graham (1998, 2010)	Guides implementation of innovation in six steps focusing on context and innovation, identifying barriers and facilitators, and evaluation.	D = I	Operational	Community Organization Individual
The Precede-Proceed Model	Ammerman, Lindquist, Lohr, & Hersey (2002)	Allows working backward from the ultimate goal of the research outcome to inform the intervention or strategy design and lays out evaluation methods for pilot and efficacy studies.	D = I	Operational	Community Organization Individual

TMF	Authors	Overall Aim	D and/or I	Broad or Operational	Levels of Analysis
A Six-Step Framework for International Physical Activity Dissemination	Bauman et al. (2006)	Focuses on describing the innovation, assessing the target audience, outlining a communication plan, identifying key stakeholders, analyzing barriers and facilitators, and evaluation.	I > D	Broad (but slightly structured)	System Community Organization Individual Policy
Promoting Action on Research Implementation in Health Services (PARiHS)	Kitson et al. (2008) Rycroft-Malone (2004)	Examines interactions between evidence, context, and facilitation in the implementation process.	I-only	Broad (but slightly structured)	Community Organization Individual
Consolidated Framework for Implementation Research (CFIR)	Damschroder et al. (2009)	Provides a consolidation framework from a systematic review that identifies key intervention and context attributes.	I-only	Operational	Community Organization
Active Implementation Framework	Fixsen, Naoom, Blase, Friedman, & Wallace (2005) National Implementation Research Network (2008)	Provides several frameworks on process, including notion of implementation teams and implementation drivers.	I-only	Operational	Community Organization Individual

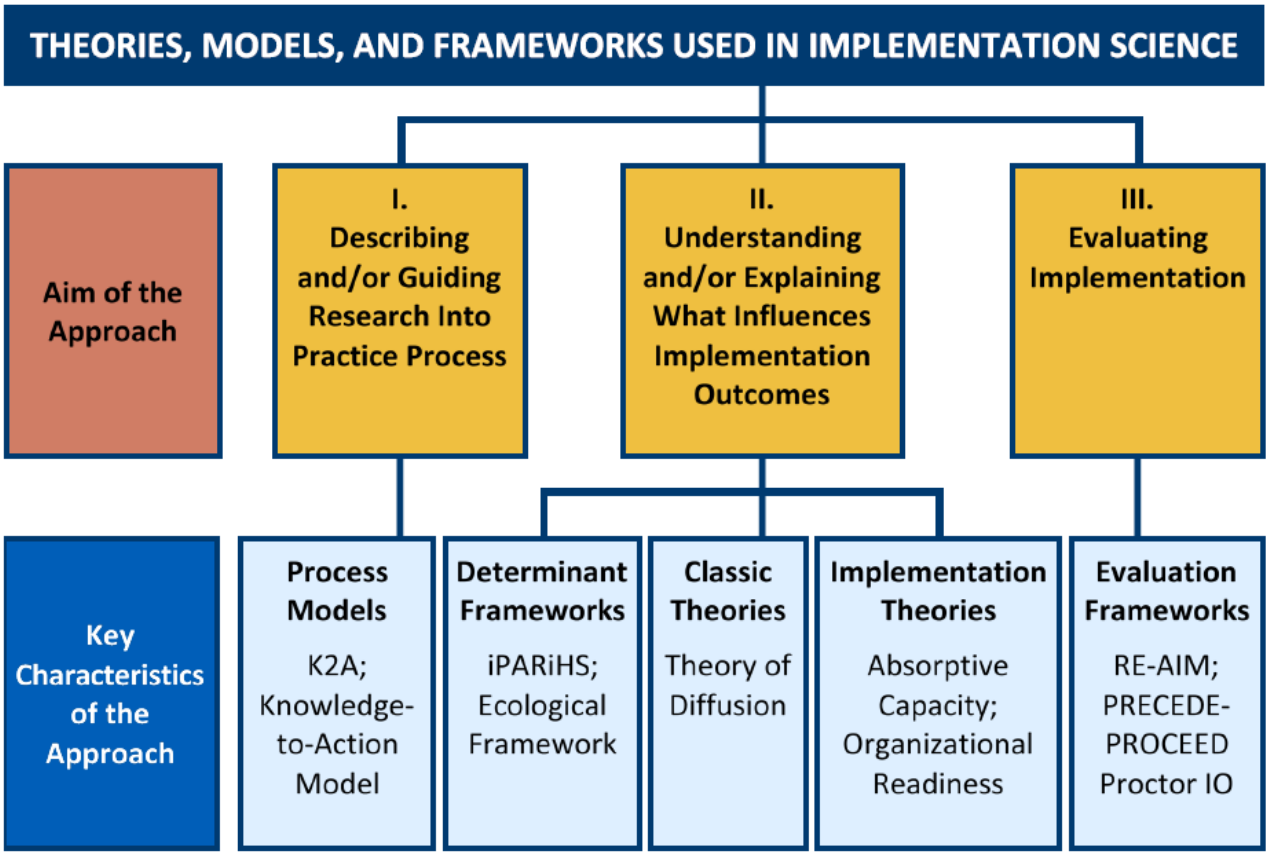
Source. Adapted with permission from Tabak et al. (2012).

Taxonomy of Implementation TMFs

In 2015, Nilsen categorized TMFs by process, determinant, and evaluative features associated with implementation alone. In this work, TMFs are organized according to their aim to (1) describe and/or guide the translation process (i.e., process models); (2) understand and/or explain factors that influence implementation outcomes (i.e., determinant frameworks, classic theories, implementation theories); and (3) evaluate various aspects of the implementation process (i.e., evaluation frameworks). Figure 4 offers a visualization of Nilsen's taxonomy. This conceptualization is particularly useful in clarifying that implementation initiatives require guidance from multiple TMFs, to guide the process, identify factors, and evaluate implementation outcomes. Often, researchers fixate on only one TMF when they should be

integrating several to address process, factors, and evaluation. Implementation TMFs are complementary, each addressing a core element of implementation: (1) describing and/or guiding the *process* of implementation, (2) understanding and/or explaining how the process *influences* outcomes and (3) *evaluating* implementation outcomes (see Rabin et al., 2020 interactive webtool).

Figure 3. Adapted Diagrammatic Representation of Nilsen's Taxonomy for Implementation TMFs



Source. Reprinted with permission (Creative Commons Attribution 4.0 International License) from Nilsen (2015).

Key Concepts for Knowledge Translation and Implementation

Planning for Knowledge Translation

KT can be haphazard and ineffective or unrealized if it is not planned in advance and integrated into the research plan. The Knowledge Translation Planning Template® (KTPT) is a well-known framework for guiding KT planning that outlines 13 steps in the dissemination planning process (Barwick, 2008, 2013, 2018; available at http://melaniebarwick.com/knowledge-translation-tools/). Similar key components of KT are discussed in at least two other practice-based documents (Jacobsen, Butterill, & Goering, 2003; Reardon, Lavis, & Gibson, 2006).

Planning with the KTPT begins with identifying project partners and main messages to be shared. Main messages can be stated in general terms if the KT planning is prospective and precedes research findings. The intended KU audiences are identified, and the purpose of the communication—the *KT goal*—is specified for each main message and KU. KT goals capture the KT purpose and include sharing knowledge, building awareness, informing decision-making, facilitating practice or behavior change or policy, commercialization, and informing research. Certain KT goals pertain to diffusion and dissemination aims, whereas others are the purview of IS. Comprehensive and functional KT activities require the identification of at least one KT goal that must align with a particular KU audience, main message, the strategies best suited to achieving the KT goal, and evaluation metrics that can indicate whether or not the goal was achieved. Evaluating whether KT goals were reached can be achieved with indicators of reach, usefulness, use, partnership/collaboration, program or service effectiveness, policy change, knowledge and attitude change, and/or behavior or systems change (Ohkubo, Sullivan, Harlan, Timmons, & Strachan, 2013).

Planning for Implementation

Planning for implementation is complex and requires a good understanding of what is now a rather extensive empirical literature. Researchers produce many evidence-based practices (EBPs) and interventions that can improve outcomes if successfully implemented. Optimal clinical outcomes depend upon their effective (successful) implementation, but implementation is a complex process that is subject to high rates of failure and can take many years to navigate, making it costly and resource intensive.

The Implementation Game© (Barwick, 2019) is a planning and learning tool that supports implementation of evidence-based practices, interventions or innovations using a group simulation activity. The tool guides an implementation team through five evidence-based core components of implementation that have been simplified to make them pragmatically understandable and useful. The tool is applicable to any context, intervention, or discipline.

Knowledge Translation Strategies for Dissemination and Implementation

As discussed in the previous sections, clinical practice consistently lags behind research evidence in health care and other sectors. For instance, widely cited statistics show that patient care is suboptimal: 30% to 40% of the patients do not receive care in accordance with the established research evidence. For 20% to 25% of the patients, the care received is unnecessary or even harmful (Freedman et al., 2011; Knapp, Simon, & Sharma, 2008). Statistics like these highlight an urgent need to bridge the gap between what is known empirically and what is done clinically in practice. As a result, identifying the most effective KT strategies to improve practice is a key priority in North America (Dault, Lomas, & Barer, 2004; Institute of Medicine, 2001), Australia (Tetroe et al., 2008), and the United Kingdom (Smits & Denis, 2014). In line with this

priority, a range of methods, activities, and strategies, commonly labelled as KT strategies, have been developed, tested, and implemented across various professional groups and settings.

KT strategies refer to how knowledge translation is executed; that is, the ways in which evidence is communicated to various target audiences and for various KT goals. Most definitions are quite general and describe KT strategies as vehicles to translate evidence without specifying to what end or the exact goal to be achieved (i.e., diffusion, dissemination, and/or implementation of evidence). This reflects definitional imprecision in the field as a whole (as discussed at the beginning of this review) characterized by a lack of standardized terminology for KT, its components, goals, and related activities (McKibbon et al., 2010). Many definitions focus uniquely on KT for practice change. For example:

> *KT strategies are used in public health to promote evidence-informed decision making.* (LaRocca, Yost, Dobbins, Ciliska, & Butt, 2012, p. 2)
>
> *KT strategies . . . include a variety of professional, financial, organizational, and regulatory interventions aimed at changing health care professional behaviour (i.e., change decision-making, change treatment, and management) to be aligned with evidence-based recommendations.* (Scott et al., 2012, p. 2)

In contrast, Armstrong and colleagues (2013) clearly outline whether the aim of a KT strategy is *diffusion*, *dissemination, implementation, or a combination:*

> *KT is informed by and builds upon conceptual understandings of the translation of research into practice, for which key theories include diffusion, dissemination, and implementation. Diffusion efforts are generally passive, while dissemination is a more active strategy to promote the spread of particular ideas. Implementation refers to systematic efforts to encourage adoption of evidence and knowledge by overcoming barriers.* (Armstrong et al., 2013, p. 2)

The literature has not been explicit about the focus of KT strategies research; in Canada, the tendency has been to use this term in reference to practice change or implementation strategies specifically. "A KT intervention is one which facilitates the uptake of research into practice and/or policy and can also be referred to as research utilization. When KT interventions are aimed at the clinician, organization, or health system level, these can also be considered implementation science interventions" (Tricco et al., 2016, p. 2). With the emergence of IS, there is now a greater consensus that KT includes both dissemination and implementation and that strategies to facilitate practice and behavior change are more commonly labelled as implementation strategies (e.g., Mazza et al., 2013; Powell et al., 2015; Proctor, Powell, & McMillen, 2013).

Types of Knowledge Translation Strategies for Dissemination and Implementation

A range of KT strategies have been evaluated for their effectiveness in achieving various KT goals (Grimshaw et al., 2012; Grol & Grimshaw, 2003):

- Printed educational materials—"distribution of published or printed recommendations for clinical care . . . including clinical practice guidelines, journals and monographs." (Farmer et al., 2011, p. 4)
- Educational meetings—participation of healthcare providers in conferences, lectures, workshops or traineeships (Forsetlund et al., 2009).
- Educational outreach or academic detailing—"use of a trained person . . . who meets with [providers] in their practice settings to give information with the intent of changing the [providers' practice]." (O'Brien et al., 2008, p. 3)
- Local opinion leaders—use of providers nominated by their colleagues as 'educationally influential' (Flodgren et al., 2010).
- Audit and feedback—"any summary of clinical performance of health care over a specified period of time." (Jamtvedt, Young, Kristoffersen, O'Brien, & Oxman, 2010, p. 2)
- Reminders—"patient or encounter specific information that is provided via a computer console (either visually or audibly) and intended to prompt a health professional to recall information." (Grimshaw et al., 2012, p. 8)
- Tailored interventions—"strategies to improve professional practice that are planned taking account of prospectively identified barriers to change." (Baker et al., 2010, p. 2)

More recently, Powell and colleagues reexamined the literature on KT strategies for practice change—herein referenced as *implementation strategies*—and provided several useful categorizations (Leeman, Birken, Powell, Rohweder & Shea, 2017; Powell et al., 2015, 2018). Powell and colleagues proposed a consolidated compilation of 73 discrete implementation strategies that a wide range of stakeholders validated through a consensus process. While this is not the first taxonomy or classification of implementation strategies, existing classifications appear to be narrow in scope and typically limited to a specific program, intervention, treatment, field of practice, or medical condition (Powell et al., 2015).

This consolidated compilation "advances the field by improving the conceptual clarity, relevance, and comprehensiveness of implementation strategies that can be used in isolation or combination in implementation research and practice" (Powell et al., 2015, p. 1). Specifically, the compilation provides a list of discrete strategies that can be used to develop a multifaceted implementation strategy, can be systematically assessed for feasibility and effectiveness, and

can be used as a tool to assess strategies reported in published research. Definitions provided for each strategy ensure consistency in specifying and reporting of strategies in papers.

KT strategy research has been overwhelmingly situated in health, but new KT strategies are emerging that are more amenable to non-health contexts and KT goals, like building awareness and knowledge. For instance, arts-based KT has emerged as a unique way of disseminating knowledge and engaging diverse stakeholders (Parsons & Boydell, 2012) because it can take several forms: visual (e.g., video, photography, painting), performative (e.g., dance), or literary (e.g., poetry, fiction). The use of arts-based KT has the advantage of communicating research findings and best practices by evoking emotional reactions and relying on different ways of representing a certain experience or knowledge. Despite the increasing popularity of arts-based KT, few studies have examined its effectiveness (Parsons & Boydell, 2012). A few studies have demonstrated promising results such as practitioners' increased awareness and understanding of patient issues (e.g., Colantonio et al., 2008), intention to change clinical practice (Gray, Fitch, Labreque, & Greenberg, 2003), as well as decreased sense of isolation and normalization of illness-related struggles in patients (Mitchell, Jonas-Simpson, & Ivonoffski, 2006). Given that arts-based KT involves diverse stakeholders with fundamentally different backgrounds (scientists, artists, patients, practitioners), the evaluation of arts-based KT is necessarily a complex task that needs to be informed by multiple perspectives to capture a range of outcomes (Parsons & Boydell, 2012).

Advanced social media also is changing how people communicate, share content, interact, and collaborate. Social media has arguably become a valuable platform with tremendous engagement and reach potential for facilitating knowledge sharing and communication (Ahmed, Ahmad, Ahmad, & Zakaria, 2018). Social media tools offer greater opportunities for rapid knowledge flow between people working across different geographical areas and contexts, compared to what can be achieved through traditional search engines or databases (Panahi, Watson, & Partridge 2016).

KT strategies are used either individually (called single, simple, or discrete strategies; e.g., printed educational materials, reminders) or in combination (called multifaceted or multicomponent strategies; e.g., training, consultation, audit, and feedback are combined to form a multifaceted strategy) (Proctor et al., 2013). Early KT research focused heavily on the effectiveness of discrete versus multifaceted strategies (Mazza et al., 2013). Most early studies did not provide any rationale for the component selection in multifaceted strategies or discuss their potential interactions (Grimshaw et al., 2012). Some multifaceted strategies were manualized or branded, such as the Availability, Responsiveness, and Continuity (ARC) organizational implementation strategies (Glisson et al., 2012), the Institute for Healthcare Improvement's learning collaborative (Institute for Healthcare Improvement, 2003), and the

Getting to Outcomes framework (Chinman, Imm, & Wandersman, 2004). Further complicating the nomenclature for KT strategies, the terms used to identify multifaceted strategies and their components have been quite variable. In some cases, multifaceted strategies have been labelled as "implementation strategies" comprised of multiple implementation interventions or as implementation programs that included multiple implementation strategies (Proctor et al., 2013).

Effectiveness of Knowledge Translation Strategies for Implementation

During the last decades, there was keen interest in identifying the most effective KT strategies in order to maximize practice change. Researchers persistently asked, "What works best?" and "what are the most effective KT strategies?" in the search for a prescriptive answer. A definite list of KT strategies that work effectively and offer a limited number of safe options would surely make researchers' and practitioners' jobs easier. Reviews of KT strategy effectiveness studies, however, demonstrate limited success in identifying KT strategies that are reliably effective in all contexts. Rather, research has identified KT strategies that are effective for specific areas of practice (e.g., public health, rehabilitation; LaRocca et al., 2012; Menon, Korner-Bitensky, Kastner, McKibbon, & Straus, 2009), clinical areas (e.g., spinal cord injury, child and youth mental health; Barwick et al., 2012; Noonan et al., 2014), or professional groups (e.g., physicians, nurses, allied health professionals; Bero et al., 1998; Grimshaw et al., 2004; Oxman, Thomson, Davis, & Haynes, 1995; Thompson, Estabrooks, Scott-Findlay, Moore, & Wallin, 2007). Table 5 illustrates this point by providing recent examples of KT reviews.

Table 5. Selective Summary of Recent Systematic Reviews of KT Strategies

Study	KT Strategies/Focus (professional group, clinical area, etc.)	KT Strategies Effectiveness
Albrecht, Archibald, Snelgrove-Clarke, & Scott (2016)	KT strategies used to support the implementation of research into pediatric practice (e.g., educational materials, meetings and outreach visits, multidisciplinary teams, audit and feedback, reminders).	Three KT strategies were shown to be effective in studies with moderate to strong methodological quality: two single KT strategies (reminders; clinical multi-disciplinary team) and one multiple, educational intervention (educational meeting train the trainer; educational meeting group session lead by trainer; educational outreach visits).
Bornbaum et al. (2015)	KT strategy—knowledge brokers; health-related settings.	Knowledge brokers perform a variety of tasks to transfer and exchange information, but inconclusive evidence regarding their effectiveness because only two studies had acceptable methodological rigor.

Study	KT Strategies/Focus (professional group, clinical area, etc.)	KT Strategies Effectiveness
Brouwers et al. (2011)	Nineteen KT strategies (patient education, decision aids, reminders, audit and feedback, local opinion leaders, guidelines to professions allied to medicine, health information technology); cancer control.	Most interventions were rated as promising but needing additional study; difficult to draw conclusions because of uneven methodological quality and limited descriptions of the KT strategies used.
Dobbins et al. (2009)	Three KT strategies (access to an online registry of research evidence; tailored messaging; and a knowledge broker) promoting the incorporation of research evidence by public health decision-makers into public health policies and programs promoting healthy body weight in children.	Under certain conditions tailored, targeted messages are more effective than knowledge brokering and access to an online registry of research evidence. In addition to KT strategy selection, greater emphasis must be placed on the identification of organizational factors in order to implement strategies that best meet the needs of individual organizations and fit the context.
Gagliardi et al. (2016)	Patient-mediated, single, and multifaceted KT strategies: print materials (brochures, booklets), electronic materials (video, computer program, website), and counselling; health care in cancer and arthritis.	Single interventions involving print material achieved beneficial outcomes, as did more complex interventions. Few eligible studies, and even fewer had acceptable methodological quality.
Grudniewicz et al. (2015)	KT strategy: printed educational materials; primary care physicians (knowledge and behaviors); patient outcomes.	Printed educational materials were not effective at improving patient outcomes, knowledge, or behavior of primary care providers. It is recommended for further trials to examine ways to optimize the effectiveness of this strategy and provide detailed information on the design of the materials. Most studies lacked details needed to replicate the intervention.
Noonan et al. (2014)	KT interventions (training for clinical staff, computerized reminders, involving organizational leaders) for assisting implementing practice change in the area of the spinal cord injury (SCI) care.	The methodological quality of the studies was mostly poor. There were too few studies and inconsistent results—it is difficult to identify effective KT interventions in SCI care. Interactive KT education for health care providers has a positive effect on patients' function, but its benefits for other health provider- and patient-related outcomes are inconsistent. Interactive education for patients leads to improvements in knowledge and function.

Study	KT Strategies/Focus (professional group, clinical area, etc.)	KT Strategies Effectiveness
Petkovic et al. (2016)	KT strategy: any type of evidence summary, policy brief, or other products derived from systematic reviews that presented evidence in a summarized form; health policymakers.	Two studies assessed the use of evidence summaries in decision-making and found that they made little to no difference. There also was little or no difference in effect for knowledge, understanding or beliefs (four studies), and perceived usefulness or usability (three studies). Evidence summaries were easier to understand than complete systematic reviews, but their ability to increase the use of systematic review evidence in policymaking is unclear.
Scott et al. (2012)	KT strategies; allied health professionals: dietetics, occupational therapy, pharmacy, physiotherapy, speech-language pathology.	Thirty-two studies: A variety of single and multiple KT interventions were identified, with educational meetings being the predominant KT strategy. Generally, the studies were of low methodological quality, and the majority of interventions demonstrated mixed effects on primary outcomes. Only four studies demonstrated statistically significant, positive effects on primary outcomes: multiple, education-only interventions such as educational material and educational meeting/ educational outreach visits; educational materials only.
Yost et al. (2015)	KT interventions for promoting evidence-informed decision-making (EIDM) among nurses in tertiary care. Almost all studies included an educational component.	No studies evaluated the impact on knowledge and skills; the focus was on the effectiveness of multifaceted KT strategies for promoting EIDM and improving client outcomes. A meta-analysis of two studies determined that a multifaceted intervention (educational meetings and use of a mentor) did not increase engagement in EIDM. Overall, it is difficult to draw firm conclusions about strategy effectiveness because of study limitations. Qualitative studies highlighted a range of factors (organizational, individual, and interpersonal characteristics of the innovation) with the potential to influence implementation success.

In addition to studies examining the effectiveness of KT strategies for a specific clinical area or professional group, the Cochrane Effective Practice and Organization of Care (EPOC) group has led several overviews of systematic reviews and conducted many high-quality systematic reviews of professional, organizational, financial, and regulatory interventions (Grimshaw et al., 2012). Overall, these reviews show improvements of various magnitudes in selective outcomes with the use of specific KT strategies (as summarized by Grimshaw et al., 2012). For instance, results for:

- Printed educational materials from 12 randomized trials and 11 nonrandomized studies showed relatively small improvement of care (median absolute improvement of 4.3%, range

of -8.9% to +9.6%) on process outcomes such as x-ray requests, prescribing, and smoking cessation activities.

- Educational meetings from 81 randomized trials in which more than 11,000 health professionals indicated (a) median absolute improvement in care of 6% (interquartile range of +1.8% to +15.3%) and (b) larger effects associated with higher attendance rates and more interactive meetings.
- Audit and feedback from 118 randomized trials found a median absolute improvement in care of 5% (interquartile range +3% to +11%).
- Local opinion leaders from 18 randomized trials, 296 hospitals, and 318 primary care physicians showed a median absolute improvement in care of 12% across studies (interquartile range +6% to +14.5%).
- Computerized reminders from 28 randomized trials showed a median absolute improvement in care of 4.2% (interquartile range +0.8% to +18.8%).

KT strategies, then, can facilitate change, but no strategies are universally effective in all contexts (LaRocca et al., 2012). Educational strategies seem to work for improving prescribing behavior and prevention in primary care. Computerized reminders are particularly effective for prevention (vaccination, cancer screening), and financial interventions improve prescribing behaviors (Grol & Grimshaw, 2003). It is very important to emphasize that KT strategy effectiveness requires consideration of the KT goal, the knowledge being shared, the KUs involved, and the mechanisms of change and evaluation.

Common Issues for Implementation Effectiveness Studies

Change requires attention to process, facilitative or hindering factors, and implementation outcomes; consideration of implementation strategy; and empirical evidence. Although KT strategies can lead to improvements in key outcomes, their effectiveness can vary widely, suggesting that contextual factors potentially influence their effectiveness (Armstrong & Kendall, 2010; Dobbins et al., 2009; Grimshaw et al., 2012). The success of the KT strategies thus depends on the extent to which barriers to KT can be overcome throughout the implementation process. To this end, maximizing the success of any KT effort means identifying and addressing modifiable and non-modifiable barriers (Grimshaw et al., 2012).

Implementation is complex and multidimensional, and effectiveness requires an understanding of the mechanisms of change, methods, measures, TMFs, contextual factors, and all their possible interactions (LaRocca et al., 2012). Establishing the effectiveness of implementation approaches requires the use of randomized designs complemented by mixed methods that can provide deeper insight into KT processes, people's experience with the implementation

endeavor, and how implementation strategies may vary with context. Relatedly, several authors have emphasized the importance of theory in the selection of KT strategies, as they serve to articulate an expected path or mechanism toward expected outcomes (Scott et al., 2012). Although important, theory driven KT strategies are rarely reported in the literature: fewer than 10% of the studies on guideline implementation had an explicit theoretical basis for the selection of KT strategies in 2003 (Davis et al., 2003). This has shifted over the years, such that of 63% of process evaluations used alongside trials of implementation interventions cited a theoretical approach. However, only a quarter of these studies were informed by, or applied, or tested a theory (McIntyre, Francis, Gould, & Lorencatto, 2020).

Several methodological and terminological concerns common to the majority of studies of implementation strategy effectiveness hinder our ability to draw firm conclusions about what works best in what context. For instance, as noted in the summary table, many studies evaluating implementation strategies are methodologically weak, making it difficult to both synthesize findings across studies and develop compelling KT practice recommendations (Albrecht et al., 2016). Results synthesis is further complicated by imprecision and variability in the terms used for KT strategies as well as the limited descriptions provided for the KT strategies that were evaluated (Powell et al., 2015; Proctor et al., 2013).

Reporting Standards for Implementation Research

Although implementation strategies are the engine for practice change, their potential has not been fully realized. Implementation strategies "are often inconsistently labelled and poorly described, are rarely justified theoretically, lack operational definitions or manuals to guide their use, and are part of 'packaged' approaches whose specific elements are poorly understood" (Proctor et al., 2013, p. 1). Implementation strategies need to be fully and precisely described with sufficient detail to enable measurement and reproducibility of their components (Craig et al., 2008). To address these limitations, Proctor et al. (2013) outline prerequisites for measuring implementation strategies. These include naming the strategy using language that is consistent with existing literature; operationally defining the implementation strategy and its discrete components; specifying the actors who enact the strategy, the actions enacted, and the targets of these actions; the temporality of when strategies are used and their dose; the implementation outcomes affected; and the empirical, theoretical, or pragmatic justification for selecting the implementation strategies.

Several reporting standards have attempted to remedy poor reporting in implementation. The Workgroup for Intervention Development and Evaluation Research (WIDER) Recommendations (Michie, Fixsen, Grimshaw, & Eccles, 2009) call for the provision of detailed descriptions of interventions and implementation strategies in published papers, including change processes and design principles, access to manuals and protocols for the clinical interventions or

implementation strategies, and detailed descriptions of active control conditions. The Standards for Quality Improvement Reporting Excellence (SQUIRE; Davidoff, Batalden, Stevens, Ogrinc, & Mooney, 2008) suggest similar accommodations.

More recently, the StaRI (Pinnock et al., 2017a) provided guidelines for transparent and accurate reporting of implementation studies, specifically. Informed by the findings of a systematic review and a consensus-building e-Delphi exercise, an international working group of IS experts discussed and agreed on the StaRI Checklist comprising 27 items. The tool prompts researchers to describe both the implementation strategy (techniques used to promote the implementation of an underused evidence-based intervention) and the effectiveness of the intervention that was being implemented. An accompanying Explanation and Elaboration document (Pinnock et al., 2017b) details each of the items and their rationale and provides examples of good reporting practice. Adoption of StaRI will improve the reporting of implementation studies, potentially facilitating translation of research into practice and improving the health of individuals and populations.

Adopting reporting guidelines would improve research methodology prospectively and address many of the problems that plague implementation research, including inconsistent labelling, poor descriptions, and unclear justification for the use of specific implementation strategies (Proctor et al., 2013). Use of standards would also simplify meta-analysis and replication and render implementation strategies more comparable across studies and contexts by encouraging consistent labelling and description.

Knowledge Translation in Disability and Rehabilitation Research

The mission of NIDILRR is to generate new knowledge and promote its effective use to maximize the full inclusion and integration into society, employment, independent living, family support, and economic and social self-sufficiency of individuals with disabilities of all ages (NIDILRR, 2020). In 2003, Rappolt and colleagues argued that while rehabilitation therapists are strongly encouraged to apply research in their practices, structured and systematic strategies, and mechanisms to guide them in this process were limited. To advance clinical outcomes, NIDILRR identified KT as a critical component of its mandate (Rogers & Martin, 2009). NIDILRR's Knowledge Translation Program aims to ensure that research is shared and applied by its KUs. NCDDR's 2007 report, *Knowledge Translation: Introduction to Models, Strategies and Measures* (Sudsawad, 2007), provided an overview of KT approaches toward achieving KT within the sector. Now, over a decade later, the current monograph serves as a reflection and historical overview of advancements within the KT field.

During the past decade, a number of tools and efforts have been developed to facilitate the translation of knowledge and the commercialization of knowledge products. A *Plain Language Summary Tool* (PLST) was developed by the University of Washington's Center for Technology and Disability Studies and the American Institutes for Research's (AIR) Center on Knowledge Translation for Disability and Rehabilitation Research (KTDRR) to enhance the comprehension of systematic reviews by distilling findings into everyday language (KTDRR, 2013). In addition, KTDRR developed the *Assessing Quality and Applicability of Systematic Reviews (AQASR)* checklist to guide clinicians, researchers, and administrators in the assessment of the strengths and weaknesses of systematic reviews (Task Force on Systematic Review and Guidelines, 2013).

Since the 2007 NCDRR report, KT remains an important and relevant area of research in disability and rehabilitation sciences. Moore and colleagues (2017) call for the cultivation of a shared vision for collecting and implementing evidence-based practices in rehabilitation science (see Table 6). Specifically, the researchers describe a need for the development of a learning health care system that integrates clinical operations, research, patient engagement, and robust technology infrastructure to improve the quality of health care and generate new knowledge. The Model Systems Knowledge Translation Center (MSKTC) is another example of a center funded by NIDILRR that provides technical assistance and training around KT for NIDILRR grantees focused in the areas of spinal cord injury, traumatic brain injury, and burn injury research. NIDILRR has also funded other centers to support KT efforts of NIDILRR-funded grantees working in specific content areas such as Technology Transfer, the Center on Knowledge Translation for Employment Research (KTER), and the Americans with Disabilities Act Knowledge Translation Center (ADAKTC) (NIDILRR, 2020).

Further research is necessary to understand end-user perspectives, and needs and contexts within the field of rehabilitation sciences (Rogers & Martin, 2009). Petzold and colleagues (2010) further emphasize that for a KT strategy to be effective, clinicians must tailor them to address the audience-specific facilitators and barriers they face when treating a specific clientele.

Several authors call attention to one of the unique challenges of the rehabilitation field, namely, the diversity of translation needs across the subfields of rehabilitation, including physical therapy, occupational therapy, and speech-language pathology. Each profession appears to require nuanced approaches to KT that are formatted to their clinical workflow, needs, and context (Jones, Roop, Pohar, Albrecht, & Scott, 2015; Menon et al., 2009; Scott et al., 2012). In moving forward, Colquhoun and colleagues (2010) highlight the paucity of theory-driven KT strategies in rehabilitation science and call for greater attention to conceptual development specific to the needs of the field.

Table 6. Selected Examples of Summary Articles About KT in Disability and Rehabilitation Studies

Author(s)	Title	Study Aim and Key Lessons Learned
Moore et al. (2017)	*Knowledge Translation in Rehabilitation Science: A Shared Vision*	Summarize KT-related proceedings from the 2016 IV STEP conference, and current KT in rehabilitation science. Propose an altered vision for a Learning Health Care System (LHCS) in clinical rehabilitation practice that includes the ongoing development, adaptation, and implementation of evidence-based practices. The authors emphasize that building a culture that supports learning and implementation of evidence-based practice is the most critical.
Phillipson, Goodenough, Reis, & Fleming (2016)	*Applying Knowledge Translation Concepts and Strategies in Dementia Care Education for Health Professionals: Recommendations From a Narrative Literature Review*	Argue that dementia education programs are being developed for health professionals, but with limited guidance regarding what works in design and content. Their paper examines the types of KT strategies used for education of health professionals in dementia care, while further exploring enablers and barriers to KT in this context. Findings revealed that multiple rather than single learning exposures seem to support KT, alongside relevant tools (such as checklists, toolkits), and expert support. Suggest the PARiHS framework as useful in providing guidance to planners.
Jones et al. (2015)	*Translating Knowledge in Rehabilitation: Systematic Review*	Authors undertook a systematic review to assess three key areas: (I) the state of science for KT strategies used in rehabilitation professions (physical therapy, occupational therapy, speech-language pathology); (II) the methodological approaches utilized in studies exploring KT strategies; and (III) report the extent to which KT interventions are described. Conclude with recommending that clinicians: (1) Match the education strategy to the KT goal and learner preferences; (2) use multimodal learning strategies for opportunities for feedback; (3) provide incentives to reach KT goals; (4) distil messages into simple and compelling formats; and (5) plan to change the workplace and not just the individual.
Scott et al. (2012)	*Systematic Review of Knowledge Translation Strategies in the Allied Health Professions*	Present results of the first documented systematic review of KT strategies in five allied health disciplines (dietetics, occupational therapy, pharmacy, physiotherapy, and speech-language pathology). The review was limited by outcome reporting bias, which limited determination of intervention effectiveness. Findings generally revealed an over-reliance on educational strategies without a clear effect on the intended outcomes.
Cameron et al. (2011)	*Knowledge Brokering in Children's Rehabilitation Organizations: Perspectives from Administrators*	Suggest knowledge brokering as an effective way to encourage clinician behavior change to implement new knowledge. Describe the experience of administrators' perceptions of the successes and challenges in using a knowledge broker (KB) to promote the use of evidence-based measures of motor function for children with cerebral palsy. Overall, findings suggested KBs as an effective medium for stimulating peer-to-peer and interdisciplinary learning. Yet, funding and resource constraints were highlighted as barriers.

Author(s)	Title	Study Aim and Key Lessons Learned
Petzold et al. (2010)	*Using the Knowledge-to-Action Process Model to Incite Clinical Change*	Apply the KTA Process Model to a series of national studies in stroke rehabilitation to demonstrate how the model is being used to increase the use of best practices in the management of prevalent post-stroke impairment. Findings reveal that personal and organizational barriers and facilitators influence successful adoption of evidence-based practice by clinicians. Further, clinicians must tailor KT strategies to address the audience-specific facilitators and barriers they face when treating a specific clientele. Finally, they suggest the KTA model as an effective guide in the complex KT process.
Rogers & Martin (2009)	*Knowledge Translation in Disability and Rehabilitation Research*	Reflect on the KT landscape within Disability and Rehabilitation Research and situate KT in the broader context of understanding issues with knowledge flow. Further, they introduce Knowledge Value Mapping (KVM) to elucidate key KT networks to be maximized for dissemination. Findings reveal the significance of interests in the evidence translation process, emphasizing the relevance of understanding the KT context.
Menon et al. (2009)	*Strategies for Rehabilitation Professionals to Move Evidence-Based Knowledge Into Practice: A Systematic Review*	Examined the effectiveness of single or multi-component KT interventions for improving knowledge, attitudes, and practice behaviors of rehabilitation clinicians. Authors identify active and multi-component KT strategies as most effective for behavior change.

Contemporary Trends and Future Directions

Looking ahead, experts have identified a handful of areas needing further research and development. Proctor and colleagues have called for a focus on the later-stage challenges of scaling up and sustaining evidence-supported interventions (Proctor et al., 2015). They identify a need for "conceptual consistency and operational clarity for measuring sustainability, developing evidence about the value of sustaining interventions over time, identifying correlates of sustainability along with strategies for sustaining evidence-supported interventions, advancing the theoretical base and research designs for sustainability research, and advancing the workforce capacity, research culture, and funding mechanisms for this important work" (p. 12). Some of this work has begun, including a framework to characterize modifications to interventions (Wiltsey Stirman, Baumann, & Miller, 2019) and development of the Sustainment Measurement Systems Scale for measuring determinants and outcomes of efforts to sustain prevention programs and initiatives (Palinkas et al., 2020).

Despite a wealth of conceptual implementation guidance, more studies are needed to validate TMF-guided approaches, explain mechanisms of change, and measure outcomes. According to Lewis, Weiner, Stanick, and Fischer (2015), the poor quality and impracticality of existing measures

for implementation factors and outcomes have hindered the study of implementation process and strategies that are needed for promoting widespread scale-up of evidence-based care. There is a need for strong and pragmatic measures that are relevant for KUs and feasible for use in practice, and work is needed to identify elements of feasibility or pragmatism from the implementer's perspective. Notable among this new direction for implementation inquiry is the Society for Implementation Research Collaboration's Instrument Review Project (Lewis et al., 2015).

Another emerging focal area is the unique features of implementing e-health innovations. As we continue to see growth in e-health technology, we will also need to contend with how best to implement these digital technologies within complex environments. We have a poor understanding of the impact that the process of implementation may have on outcomes of e-health interventions (Abbott, Foster, Marin, & Dykes, 2014). Abbott et al. (2014) call for a hybrid approach combining complexity science and IS to inform successful implementation of e-health innovations, and this work is only just beginning to emerge. Implementation TMFs can inform the design and evaluation of e-health innovations to better understand contextual and setting factors, develop more responsive and pragmatic interventions, and report results that are relevant to KUs (Glasgow, Phillips, & Sanchez, 2014; Ross, Stevenson, Lau, & Murray, 2016). Implementation facilitators identified in a recent systematic review on the effectiveness and implementation of technology-based interventions to support health care included aligning studies with organizational incentives, ensuring senior peer endorsement, and integrating the innovation into the clinical workload. Barriers included organizational challenges, and innovation design, content, and technical issues (Keyworth, Armitage, & Tully, 2019).

In a recent article, Powell et al. (2019) outline five priorities for enhancing the impact of implementation strategies. The researchers call for work to enhance methods for designing and tailoring implementation strategies; specify and test mechanisms of change; conduct more effectiveness research on discrete, multi-faceted, and tailored implementation strategies; increase economic evaluations of implementation strategies; and improve the tracking and reporting of implementation strategies. With respect to the latter priority, recent advances are notable, including the publication of StaRI (Pinnock et al., 2017a) and new guidance by the journal *Implementation Science* for appropriate reporting standards to be submitted alongside manuscripts.

Finally, emerging work is improving understanding of the mediating factors that are associated with implementation success. To date, however, the science of implementation has failed to elaborate on *how* different implementation strategies work. Improvement in implementation outcomes requires precise, testable theories that describe the causal pathways through which implementation strategies function (Lewis et al., 2018; Lewis et al., 2020). It is the hope of the authors and the Center on KTDRR, which commissioned this report, that this monograph helps to ground such future work in an appreciation of the ties between implementation science and its role within knowledge translation.

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