



Knowledge Translation and Learning  
Technologies:  
Perspectives, Considerations, and Essential  
Approaches



UNIVERSITY OF BRITISH  
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# Knowledge Translation and Learning Technologies:

Perspectives, Considerations, and Essential Approaches

IMPLICATIONS FOR HEALTH RESEARCHERS



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This publication is available electronically at [www.mschr.org/sub-whats-resource.htm](http://www.mschr.org/sub-whats-resource.htm)

Dear Reader,

With this document, we hope to provide information on knowledge translation (KT) and learning technologies, and to discuss perspectives, considerations, and approaches that may assist health researchers in defining and implementing KT strategies in their research.

Our primary focus is to support the researcher who seeks to construct or incorporate a knowledge translation strategy into your grant application (in particular, see section 4).

We intend the information provided here to also be of value if you are:

- an educator interested in making sure that what you teach gets practiced;
- a member of an organization that philosophically and/or financially supports health research and its infrastructure;
- an administrator interested in changing behaviours in your institution;
- a policy advisor wanting to identify ways that policy can influence practice, and vice versa;
- an information technology specialist interested in how technologies can play a role in human and systems behaviour; or
- a health practitioner wanting to know how your practice makes a pivotal difference to health care delivery through education and innovation.

No matter what your perspective, we ask that you take the time to evaluate our efforts. To this end, the document includes an on line survey to be found at <http://survey.msfhr.org/ktsurvey.htm>. We very much appreciate your feedback and assistance to help us better meet the needs of the BC health research community. Happy reading!

*For further information on knowledge translation (KT) and the use of technologies to enhance KT, or for any questions about this publication, please write to:*

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## 1. Introduction and Background

“Knowledge Translation is defined as the exchange, synthesis and ethically-sound application of knowledge - within a complex system of interactions among researchers and users - to accelerate the capture of the benefits of research for Canadians through improved health, more effective services and products, and a strengthened health care system.”<sup>(1)</sup>

Knowledge Translation (KT) is the process of making knowledge created within one professional community accessible, understandable and useful within other professional communities, leading ultimately to diffuse adaptation of that knowledge into everyday health practices by individual health professionals, policy-makers and administrators in the health system. From the perspective of those committed to promoting and enhancing KT activity, KT is fundamental to facilitating the human progress achieved by groups of people working together as a community of interest.

In recent years many health research granting agencies have increasingly identified KT as part of their mandates. Accordingly, they have sought evidence of effective KT activity by recipients of their funding. For example, the Canadian Institutes of Health Research (CIHR) has a mandate to create new knowledge and translate it into improved health for Canadians, more effective services and products, and a strengthened Canadian health care system<sup>(2)</sup>.

In pursuing this mandate, CIHR has set a policy that all research grant proposals submitted for competition require a strong KT component to demonstrate thinking and implementation approaches to accelerate the dissemination and inculcation of the knowledge generated from the research into health care practices.

This document is intended for health researchers to understand the issues related to knowledge translation. It is designed to assist them in constructing appropriate KT strategies in their research grant proposals to satisfy the application criteria, successfully compete in these grant application processes, and ultimately formulate a coherent and relevant dissemination blueprint to incorporate the new knowledge into mainstream health practices. And perhaps most urgently, the ideas and suggestions presented herewith are offered with the intention of providing practical tools for investigators to more effectively engage in KT activity.

## 2. A Framework For Knowledge Translation

The increased emphasis on KT activity referenced above has led to a concurrent expansion of interest in defining the nature and processes of effective KT. Among the exploration of issues related to KT, CIHR proposed an overall framework of knowledge cycle and the six opportunities in this cycle that can be particularly important <sup>(3)</sup>:

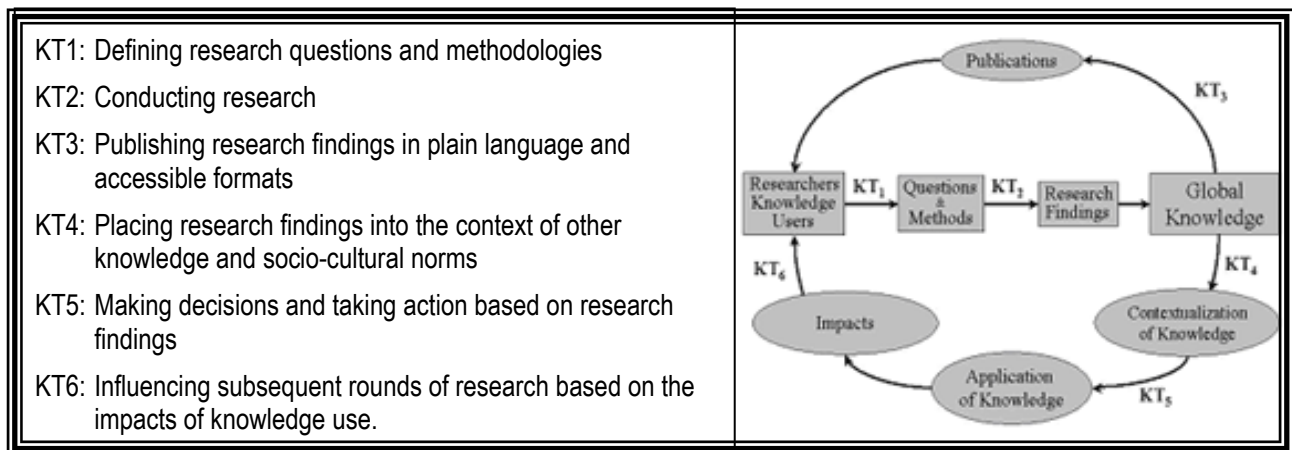


Figure 1: Knowledge Translation Opportunities within the Research Cycle<sup>(4)</sup>

In the past, researchers have pursued KT primarily in the domains of KT1 to KT3 only, without much contemplation or development of engagement strategies in the domain of KT4 to KT6. However, in order to implement lasting change in the healthcare system and individuals practicing in this environment, all six KT steps are influential and vital to the ultimate success of translation of the knowledge into mainstream health practices. Ultimately, knowledge from research can be thought of as being incorporated and used, or translated, in five major domains<sup>(3)</sup>:

1. Research in health related disciplines
2. Policy making, planning and administration
3. Health care provision
4. Maintenance and improvement of personal health
5. Commercialization

These are important frameworks for health researchers to consider as they build their KT strategies relevant to the subject of their research expertise, be it in biomedical research, clinical research, health services and health systems research, or population health research.

### 3. Factors Influencing KT Success: Advantages and Barriers

In our increasingly fast-paced and electronically linked world, those pursuing KT frequently consider application of information and communication technologies (ICTs) to help meet their challenges. These increasingly ubiquitous tools have therefore attracted special interest from anyone interested in better understanding effective KT interventions at all aspects of the research cycle.

On March 2003, a **Technology Enabled Knowledge Translation (TEKT)** workshop took place, designed to explore the specific issues surrounding research in, and evaluation of, knowledge and policy translation strategies. Of special interest to participants was the potential opportunity to incorporate ICTs as enabling tools. Researchers, clinicians, and policy decision makers, including government deputy ministers and hospital CEOs, as well as health authority CEOs from British Columbia, participated in this gathering. Delegates from other provinces, and international participants from the US, Europe and Asia, also added insights from their jurisdictions. The gathering pursued discussions around three closely linked topics:

- The individual factors (individual researchers, clinicians, policy makers, administrators, health consumers, knowledge brokers, etc.) that contribute to or challenge effective knowledge translation;
- The system characteristics (hospitals, health authorities, levels of governments, etc.) that influence knowledge translation; and
- The mechanisms that can contribute to accelerating knowledge translation between research, practice, and policy.

The primary foci of this meeting were in the following areas<sup>(4)</sup>:

- The importance of accelerating the incorporation of knowledge generated by research into clinical practice and policy.
- Building a network of like-minded individuals from various constituencies, including policy makers, technology experts, and health management professionals, to build a community of health researchers sharing an interest in TEKT for a mutual exchange of ideas and future collaboration.
- Highlighting of examples in technology enabled strategies in non-health related domains and the lessons in them that could be applicable in KT in health.
- Issues and directions in TEKT research in Canada, and the need to stimulate KT research to address these issues.

The two day workshop led to many insightful dialogues on the challenges and opportunities in KT. Presentations, the summary report and action plan resulting from the workshop are available electronically<sup>(5)</sup>. In these discussions, challenges and opportunities in KT emerged into four major themes:

- The role of language in knowledge sharing
- Accessibility of knowledge
- Learning and Development in TEKT
- Effective inter-group communication

## **A. The Role of Language in Sharing Knowledge**

Throughout the workshop, participants voiced concerns about the lack of a common language among the different stakeholder groups that prevents them from fully engaging in sharing knowledge. Effective communication among the stakeholders is seen as a key factor enabling health professionals to provide health care of the highest quality. An improved understanding of information as well as emerging technologies and the role they can play in knowledge translation can further facilitate effective use of evidence and other relevant information.

### Challenges

One of the inhibitors of effective collaboration seems to be the absence of a shared vocabulary common to all stakeholders, and the associated multiplicity of perspectives on 'what the system needs'. Not only do politicians seem to be driven by imperatives that differ from those used by implementers, but researchers and consumers often require some form of mediation (translation) in order to effectively communicate with each other. All stakeholders consistently 'talk past' each other in lobbying for their own positions, as all work to different budgets and deadlines. Stakeholder groups exist in relative isolation, creating distinct 'cultures', each with its own language and agenda. Low levels of social cohesion among the groups unfortunately produce low levels of mutual credibility and trust.

Many participants felt that little attention is currently paid to ensuring precision in communication specifically in the field of TEKT. No inclusive definition of information and communication technologies and what form they can take is widely accepted by all practitioners; each "subculture" relies on a narrow explanation relevant to its specific field. As a result, communities of practitioners have become mutually exclusive and isolated. Such isolation is compounded by and further propagates the lack of a common language. The divisions among the different users of ICTs prevent practitioners, researchers, and other stakeholder groups from fully realizing the possibilities and benefits of collaboration among the subcultures; namely, the ability to achieve the full impact of ICTs as effective instruments to facilitate health research.

The sheer volume of health information available on and off the Internet seems to represent a major barrier to effective knowledge translation. A number of participants have noted that fast access and easy retrieval of solid, reliable evidence is desirable but often problematic.

Furthermore, existing educational programs and professional development initiatives do not seem to equip health practitioners with appropriate skills for finding and interpreting data. Given the lack of a common language between groups, as well as too frequently reported lack of support, researchers, practitioners and others are easily discouraged from engaging in, and benefiting from, mutual collaboration.

### Opportunities

A number of health professionals who attended the March 2003 TEKT workshop suggested that complex evidence needs to be simplified and subsequently presented in such a way that it translates as practical information, easy to implement by clinicians. No clearly defined boundary concerning the responsibility for TEKT and its implementation currently exists. It was therefore proposed that a change specialist may

be required in some cases to take on the role of implementing steps for changing clinician behaviour. Furthermore, in order for health professionals to make effective use of the existing wealth of valuable information using new technologies, it is critical to have filtering mechanisms in place that will enable searching for information and sorting out the relevant pieces.

To help facilitate exchange, synthesis and application of information, it seems critical to develop a role for “knowledge brokers”<sup>(6)</sup> – skilled and respected figures with the social capital and communication skills to be trusted by all stakeholders. Knowledge brokers would possess the expertise to review and synthesize the high volume of relevant peer reviewed information and ensure its accessibility to other stakeholders in the system. They would act as filters and would facilitate effective use of the knowledge available on a given policy issue. However, the specification of a knowledge broker’s agency remains open. Depending on the particular context, either an independent knowledge broker or one who is affiliated with a specific stakeholder group might be most appropriate.

It appears essential to consider the needs and concerns of health care providers and consumers by involving them in a continuous process of improving the system. This solution would involve the creation of a dynamic framework that builds upon the strengths of the existing health care system. From a client perspective, web based products can facilitate the utilization of customized learning plans. With proper knowledge translation mechanisms involving appropriate language support, patients could frequently benefit from using online technologies to help care for themselves. It is therefore necessary to recognize that tools are there to help guide and manage the information exchange process that can benefit different groups of end users. Among their many uses, online technologies can provide the infrastructure needed for instantaneous analyses of patient surveys and otherwise collected patient satisfaction data.

The workshop participants have proposed that the issue of clarity and openness during the technology development process be seen as a logical first step to work towards. Through ongoing dialogue, stakeholder groups could not only develop a common language, but also ensure that relevant policy questions are asked and answered with appropriate levels of public accountability. It seems self-evident that information and communication technologies can play an important role in advancing this process. Perhaps the most obvious contribution of these technologies is their ability to shrink distances and break down the ‘silo-ing’ of stakeholder groups.

## ***B. Effective Inter-Group Communication***

Knowledge translation in health from bench side research to bedside and the community is vitally important in this ever changing world. Historically, technological advancements in the Canadian health care system have been made in isolation to meet unique and current user requirements. Various disciplines in health from health professionals to policy makers are deeply interested in and engaged in KT in their own domain, bringing different terminologies from their specialties to describe their own perspectives on KT.

Health care is delivered by a group of people from divergent backgrounds and disciplines. Because there are so many different disciplines within the health field there is a strong need for effective inter-group communication in order to move forward on future KT and TEKT developments. There is a need for communication between the various levels in an organization as well as for communication between organizations. The TEKT workshop discussed many challenges and opportunities for effective inter-group communication.

### Challenges

In the past, there has been little communication between health disciplines and among levels within health organizations. Currently, there appears to be little precision in the field of TEKT. No inclusive definition is widely accepted by all practitioners; each sub-culture relies on a narrow explanation relevant to its specific field. As a result, communities of practitioners are isolated. Overcoming this historical and invisible barrier is an important step in facilitating communication. Unfortunately, it is often the most difficult barrier to overcome.

One way of facilitating inter-group communication is by using technology to create websites and forums through which people can communicate. While technology can help connect and facilitate communication between groups, many workshop participants felt that there is often a steep learning curve for new technologies. This is often considered a hindrance for practicing professionals as most people have increasingly busy lives and have little to no time to spend learning new programs or technologies.

In the field of Technology Enabled Continuous Quality Improvement (TE-CQI) it is essential to consider the needs and concerns of all health care providers by involving them directly in the process of improving the system. However, workshop participants stated that there is usually little communication between all levels of any given organization. In order for CQI to be effective, there must be “buy in” from all members of an organization or the community as a whole. There is a need for a “champion” in the community who will unite all those in the organization towards a common goal. The challenge is finding a person who is willing to be a “champion”.

In setting policy which eventually effects front-line health care providers, tensions are compounded by the very nature of policy making. Policy making occurs on multiple levels and includes, among others, federal, provincial, and territorial governments, and regional health authorities as well as elected officials, bureaucrats and front-line health care providers. Poor coordination and alignment among these various levels impedes flow and perceived worth of information.

### Opportunities

Workshop participants felt that there were many opportunities to use TEKT to help facilitate effective inter-group communication. The first is to build a national community of practice of TEKT, and establish an effective pan-Canadian TEKT leadership network. The momentum generated at the workshop should continue to grow, building on existing initiatives of key influential and lead agencies, and broadening the net to include the full range of stakeholders in TEKT research and application. A national

community that facilitates communication between disciplines would further the progress of TEKT.

As previously mentioned, engaging and increasing the capacity of community practice of TEKT through continuing dialogues, web portals and sponsored events is an excellent way to open up communication between groups. In order to keep gulfs from forming between different groups, maintaining frequent communication between members that is timely and based on real life solutions is a necessity. Participants recognized the potential of identifying influential organizations and networks to support the development and integration of new technologies. Collaborating with opinion leaders and identifying champions may: 1) provide opportunities to address stakeholder needs during development, 2) facilitate user “buy-in”, and 3) enable more effective distribution and knowledge comprehension that will lead to better communication.

Another area of opportunity is to align TEKT with Health Systems Reform. Implementation needs close coordination with ongoing health reform agendas at multiple levels, including health professionals. Knowledge translation to remote communities through telehealth and telemedicine must be enhanced. There is a need for communication between health disciplines as well as communities. Canada’s geography poses real challenges in terms of providing quality health care to people living in remote/rural areas. In emergencies it is often necessary to airlift patients to a more urban health centre, incurring extraordinary costs and resulting in a delay of the best possible treatment. Connecting communities via the use of telehealth can be an effective solution to these challenges.

### **C. *Accessibility of Knowledge***

One goal of knowledge translation is to make evidence-based research available to frontline workers in a timely and efficient manner. This process enhances the relationship between researchers and health care practitioners to the benefit of the end-user (i.e. the public). But even if there is a large pool of potentially useful knowledge, it cannot be utilised until it is accessed. As such, workshop participants indicated that the creation of a knowledge base with public domain accessibility is a primary concern.

#### Challenges

One of the largest concerns for handling patient data is how to ensure that it is being stored/used/disseminated in a way that is secure and preserves patients’ confidentiality. The security of patient and clinician data has always been of particular concern to health care professionals. With the advent of technology based access methods, traditional security and confidentiality protocols must be revisited to ensure that appropriate precautions are taken. There are a number of challenges which must be overcome to ensure that knowledge is accessible in a secure and confidential manner.

A centralized knowledge base must be accessible from many different locations to be of use to health care professionals. Workshop participants discussed the possibility of using the Internet and the World Wide Web as methods of access. Concerns were

raised as to how the data/information (especially confidential patient data) will be treated. It is important to realise that the use of technology, such as the Internet, raises security and confidentiality concerns which are different from those of established methods. The challenge is to identify and deal with potential problems before the system is brought on line. The issue of security (i.e. protection from unauthorised access) can be handled by technological means such as data encryption, access monitoring, and password authentication.

Confidentiality issues, such as healthcare workers browsing patients' data unnecessarily, will likely be handled in a different manner. Workshop participants stressed the need for the exploration and establishment of coordinated ethical protocols for the effective use and management of data. These protocols should be enacted at the health care professional level to insure data confidentiality.

The creation of a centralized database of health care-relevant information would be useful to health care professionals; however, the logistics of locating and pooling vast amounts of healthcare datum pose some problems. First, there is ambiguity in the definitions of public versus pharmaceutical/private data. Databases of all three kinds hold health care-relevant data, but access to pharmaceutical/private data may be problematic. Discussions in this area focussed on the use of large administration databases such as Statistics Canada and CIHI, which are more or less public. There is a lack of information on the existing levels of use of public databases. It was argued that both under-utilisation of data and high demand for data might be problems. More research is required to determine whether we are making the best use of public data.

The largest obstacle to a centralized database of health care-relevant information is communication. There is currently no inter-communication among healthcare databases. Because no standardised mechanism for querying medical databases exists users must learn multiple interfaces to access data. Workshop participants agreed that there needs to be one type of interface which health care professionals can learn and use to access all different databases. A common interface should be designed (e.g. on the World Wide Web) to allow health care professionals to access data from databases (e.g. paediatrics and oncology) in different locations yet seamlessly integrates search and retrieval methods for the user. Workshop participants acknowledged that formalising user requirements and a body of standards for inter-database communication would be integral to the success of this infrastructure.

### Opportunities

In this time of recent technological advancements and innovations in information and communication technologies, the benefits associated with knowledge base access by health care professionals are numerous.

First, the ability to access a centralized knowledge base from remote locations is now technologically possible. Immediate applications exist for the establishment of telehealth and telemedicine initiatives to link health care professionals to the knowledge (or the expert) that they require to treat patients to a high standard of care. Another application of remote access can be illustrated in a more localized setting. Public access at a building/hospital level gives all staff direct access to patient records

and medical data from all over Canada. This knowledge could be used for everything from determining the history of first-time patients to calculating the risks inherent in an operation. A further benefit of remote access is the opportunity for education and self-enhancement. Health care professionals will have access to a Canada-wide store of the latest e-learning modules to use for their continued professional development and to attain the most advanced methods and protocols. In essence, remote access has the potential to bring health professionals, community participants, and other groups together in a “borderless” community of research and practice where knowledge translation is not limited by geographical or professional isolation.

The establishment of a fast, secure, integrated, comprehensive and remotely accessible centralized base of knowledge will potentially decrease turn-around times on public data requests. Individual practitioners and researchers wishing to use publicly accessible data will benefit from a shorter wait time. New initiatives such as the Health Evidence Canada website ([www.health-evidence.ca/html/htm/home.shtml](http://www.health-evidence.ca/html/htm/home.shtml)) demonstrate the potential benefits of such a knowledge base, supporting an increase in KT speed and efficiency through the use of technology. (This site is particularly focused on promotion of evidence based decision-making.)

In addition to increasing the efficiency of KT through the use of technology, accessible knowledge has the potential to bring health professionals from all levels of the health care community together. The framework required for accessible knowledge translation should also be used as a “common ground” from which these levels of health care professionals can learn and interact with each other.

#### ***D. Learning and Development in Technology Enabled Knowledge Translation***

Knowledge translation in health from researchers to the health professionals is recognized to be an important and necessary step to ensure prompt and effective incorporation of latest evidence into health care delivery, thereby benefiting the population with advances in health research. Modern information and communication technologies, such as the use of computers in electronic health records and in accessing information on the Internet, Personal Digital Assistants, videoconferencing, and other modalities, can play a key role in accelerating KT.

In order to be able to use these varying modern technologies, continued learning needs to take place on different levels. Furthermore, we are able to better understand the issues surrounding KT if we envision KT as having its roots in the field of education. Some of the characteristics of successful educational initiatives are: contact between learners and mentors, reciprocity and cooperation among learners, active learning techniques, emphasis on time spent on task and feedback, high expectations, respect for diverse talents and learning styles.

Various disciplines in health – health professionals, social sciences, systems management groups, policy makers – are deeply interested in and engaged in KT in their own domain, bringing different terminologies from their specialties to describe their perspectives on KT. With this multidisciplinary enthusiasm and exploration comes an inherent danger of misunderstanding of the similarities and differences in usage of similar concepts and descriptive terms by different disciplines. Therefore, there not only needs to be a standardized nomenclature to help everyone achieve a common

understanding in definitions and approaches in this domain but there needs to be the learning of these standards.

Developing course material on KT is mandatory for proper knowledge uptake. Course material, particularly on Technology Enabled Knowledge Translation, should be made easily accessible to educators at all levels via e-learning or other similar modalities. The more training and interest in TEKT that is stimulated among students, the better we will be able to develop competencies which make TEKT a core competency among health practitioners. Often rudimentary material for introductory courses in health disciplines are designed to help people understand the issues of KT and how to improve KT competencies. More advanced courses for managers and researchers have effective KT incorporated into their job performance criteria directly or indirectly. This course material should be updated as we learn more about this area. One strategy to overcome the lack of standardization mentioned earlier would be to make this course material freely available.

### Challenges

There are potential challenges to the learning process of individuals and teams. New technologies often place unnecessary demands on both the user and the entire system. There is often a steep learning curve for implementing new tasks and procedures. This can increase clinician workload and stress ultimately causing a negative financial impact on institutions. Despite the added value of technology, there is the risk of inappropriate use and/or overdependence by clinicians that eventually impacts on quality of care. It is important to note that without the establishment of required protocols, new technology increases the risk of a breakdown in patients' privacy rights. Furthermore, technology can create false impressions. Users often have higher expectations than what the equipment is able to deliver. Alternatively, users unable to learn to use a technology, and/or have no support or guidance, may prematurely abandon an otherwise useful system.

Another barrier is that the time involved in learning new technologies is often considered a hindrance for practicing professionals. Moreover, technology can be thought of as a double-edged sword: great potential with possible pitfalls. For example, a computer system might influence clinician behavior by requiring doctors to prescribe cheaper, generic drugs unless the patient meets very specific clinical guidelines. This is useful in lowering health care costs but it also limits physician choice (e.g. a physician believes that a non-generic drug should be prescribed to a patient but the system does not permit this action).

### Opportunities

There are several potential benefits to using technology to enhance knowledge translation in the health care sector. TEKT has the potential to improve clinician knowledge and skills. For continuing education, TEKT can provide the clinician with an accessible module that would introduce the concept of technology-enabled practice in an incremental and systematic fashion. This allows the clinician to gain experience while simultaneously providing relevant patient information for electronic health records.

Furthermore, TEKT often has a positive impact on the work practice of health care professionals. For example, in a US Veterans' Hospital maintenance of online health care records is mandatory for health professionals. All treating clinicians must record and sign patient entries in a timely matter. This system allows access to important information by all practitioners and therefore enhances better patient records access, communication and ultimately teamwork. Importantly, for safety issues or patients with behavioral problems, records can be flagged in order that other professionals working on those cases are appropriately informed. Moreover, technology is used to quickly provide accurate medical records. For example, health professionals in under-serviced areas can use services such as telemedicine to improve the care of their patients.

Reaching out beyond Canada is another important level of learning. While much of these recommendations are geared toward the developed countries, the needs of the large populations living in developing countries must be considered. Canada has tremendous expertise and knowledge to contribute in assisting developing countries in knowledge translation so as to help in global health improvement. It is also through these global exchanges that Canada can also learn from the best of other countries, and gain insights as to how systems can be improved in our own country. Through engaging in discussions on TEKT with other countries, not only will all of us understand and appreciate what TEKT has to offer, but Canada itself will reach a better understanding of this domain itself.

#### **4. A KT Strategy for Your Grant Application: Considerations**

In recent years many health research granting agencies have increasingly identified KT as part of their mandates. Accordingly, they have sought evidence of effective KT activity by recipients of their funding. This creates new challenges for grant applicants, whose training around KT may have been limited and/or inclusive of only the traditional KT1 to KT3 realms (see Figure 1, page 2). A broader perspective, encompassing KT4 to KT 6 considerations, is required to pursue success in both funding and KT outcomes.

When constructing a KT strategy, grant applicants should consider at least the following six questions, which can fundamentally affect the strategy's nature, choice, and efficacy.

##### **A. “Who does our research try to influence?” – Target Audience**

Prospective researchers wanting to submit grant applications to agencies requiring a knowledge translation (KT) strategy should first consider whether their research outcomes impact individuals or the system. If the research outcomes primarily impact individuals, then a KT strategy aimed at changing individuals' behaviour would be important. However, if the research outcomes are to impact the system, then a system based KT strategy to alter institutional approaches should be considered. Realistically, researchers will find that their outcome knowledge often requires the enactment of both individual and system changes in order to create lasting effects. Such cases require that both individual and system KT strategies be simultaneously considered and/or deployed.

For example, if the research is designed to educate health professionals about the SARS virus and how to deal with SARS patients, then a KT strategy aimed at individual health practitioners to incorporate knowledge of SARS into their everyday practice will be important. On the other hand, if the research is about how to control the spread of SARS in a hospital and/or health region, then the KT strategy should aim at changing hospital and/or public health policies and administrative approaches through systems engagement. In the latter example, even when there is a system KT approach, KT designed to engage practitioners on an individual level, such that their behaviour becomes consistent with system changes, is pivotal to the success of system transformation.

##### **B. “What do we want to say to our audience?” – Nature of the Knowledge**

The type of knowledge that may be generated as a result of the research is an important consideration when building a KT strategy for a grant application. Knowledge emerging from each of the four pillars of research (basic science research, clinical research, health policy research and population health research) warrants a distinctly different KT strategy. One of the factors to consider is whether the research outcome validates previous experience, contradicts current practice, or represents a new discovery.

For example, if the research outcome is a new medication, new management approach to a certain disease entity, or discovery of an unprecedented illness such as SARS,

then the KT strategy needs to focus on raising awareness of the issue, as well as on building capacity in knowledge dissemination and new practice patterns. If the research outcome proves that a new drug works better than the gold standard, or that a new strategy is superior to an old one, then the KT strategy will involve an analysis of what constitutes the “old school,” and methods to change established habits into new ones. Finally, if the research shows evidence contrary to existing understanding, but does not have enough strength to warrant directional change in management, then the subsequent controversy generated from these results needs to be discussed. In this case, the appropriate KT strategy would involve engaging clinicians and tapping into the strength of researchers to clarify the issues. Controversies in hormone replacement therapy would be a fitting example of this last category.

### **C. “What is the audience perspective?” – Cultural Context**

Even if the new knowledge is universally applicable, differences are noticeable among the cultures receiving the benefits of such new knowledge. Political, economical, geographical, and healthcare system cultures are but some of the highly influential factors that lead to variable uptake of the same knowledge.

For example, an international workshop on the management of diabetic patients with hypertension found significant differences in physicians’ approaches to the use of ramipril for cardioprotection, despite the fact that the groups agree on the positive results of the HOPE (Heart Outcomes Prevention Evaluation) study<sup>(6)</sup>. One piece of this puzzle is the fact that German physicians are made directly financially responsible for the medication costs of their patients, while Canadian physicians are not<sup>(7)</sup>.

Beyond cultural differences, social determinants of health (such as education, poverty, nutrition and access to clean water) may also exert indirect or direct influences on the incorporation of knowledge and should be considered when the context is appropriate. For example, despite good evidence for the success of anti-viral agents in the control of HIV infections, many developing countries cannot afford these medications; thereby failing to bring this knowledge into practice.

An additional dimension in the consideration of TEKT is to consider the technological literacy of the audience members. While information and communications technologies (ICT) such as computers and PDAs may be barriers to KT (for example, with older health professionals), these very same tools may act as enablers (for example, with younger health professionals).

### **D. “Is the audience ready for us?” – Target Audience’s Receptivity to Change**

The readiness of an individual or system to change and accept knowledge is another important issue to consider when choosing KT interventions. Adult learners go through stages of learning and change. Both the Pathman and the Prochaska models (see Table 1, page 17) describe these stages in slightly different fashions, but are based on the same underlying adult learning archetype that governs the readiness and speed of knowledge uptake. For example, audience members who are pre-contemplative attitudinally feel that they do not need to know any new pieces of knowledge, and thus a very different KT strategy would be needed to reach them as opposed to individuals in the preparation phase (i.e., where there is a “teachable moment” and they are ready

to receive new information). Controversial knowledge, in itself, also creates hesitancy and resistance in the audience, thus information uptake cannot be expected to be prompt. Rather, audience members may require ample opportunities to debate and validate prior to being able to wholeheartedly understand and absorb the new knowledge. Finally, just because individuals have accepted and learned the knowledge does not automatically mean that they will consistently use the knowledge in their practices (skills transfer). Therefore, KT strategies to aid skills translation and habit formation in practitioners are essential.

In the text “Diffusion of Innovations” by Everett Rogers<sup>(8)</sup>, Rogers described five distinct cohorts of adopters of innovation: innovators that engineer the discovery, early adopters that immediately adopt the new discovery, the early majority that sets the general trend, the late majority that plays catch up in adoption, and finally the laggards that eventually may or may not pay attention to the discovery in the final analysis. Each of these cohorts of individuals needs different KT strategies to engage them in their knowledge and skills transformation.

Again, ICTs may present themselves as a double edged sword here: for those individuals that are technically savvy, ICTs may actually propel them into a readiness state to receive new knowledge. However, for the technically challenged, TEKT may do more damage in adding additional barriers to their acquisition of knowledge and skills. Usage of ICTs should, perhaps, not be deployed on these people.

#### ***E. “How much will they remember?” – Knowledge Retention Capacity***

Knowledge and skills retention is another important aspect to consider when building a KT strategy. The Hawthorn effect<sup>(9)</sup> describes the artificial effect of knowledge uptake during observational studies, but the retention of knowledge does not continue after scrutiny ends. In the same way, KT strategies, while in force, may lead to evidence of knowledge and skills uptake and application. How can we ensure that, beyond the active KT strategy deployment, the individuals and system will continue to maintain and sustain the adoption of the innovation into everyday practice?

ICTs have several advantages that are very useful in this category. ICTs automatically document activities and information so that health professionals do not need to rely on memory to carry out repetitive activities. Habit formation can therefore be encouraged and reinforced through automatic reminder systems using ICTs. Furthermore, reflection on practice patterns (Schon’s premise of reflection on action – see Table 1, page 17) is the basis for adult learners to think about their consistency in knowledge application, which in turn promotes positive habit formation. ICTs, such as one aspect of electronic health record, can assist health professionals in self-audits, thus increasing opportunities for self reflection. In the same way, as described by Frankford (see Table 3, page 19), systems based reflection can also be encouraged through ICTs integration.

#### ***F. “What can we learn by using the knowledge?” – A Learning System***

It is fundamental to note that KT is an iterative process that demands two-way flow of information and knowledge. Researchers may generate new knowledge, but once this information is taken up by practitioners and systems, the KT loop must be pursued and

“closed”. In other words, it is essential for researchers to maintain a dialogue and obtain information back from the end users of their new knowledge to determine if:

- the benefits demonstrated in research are translated into actual health systems benefits;
- there are barriers and challenges to implementation of the new knowledge;
- there are positive or negative unanticipated results beyond what were demonstrated in the research work; and
- there are new domains and complications unveiled by introducing the current new knowledge that need further research.

It is vital that researchers stay connected and in constant communication with their audience and end-users receive feedback on the application of the new knowledge. This, in turn, can lead to new research questions that are grounded in end-user needs and better health services outcomes.

### **G. Framing KT for Your Particular Grant**

Questions to address in your grant application:

1. Once the new knowledge is generated from your study/project/initiative, who do you target to disseminate this information? Individuals? Systems? Both? What are the messages that you want to transmit, and to whom specifically?
2. Having identified your target audience, what are the essential messages that you will provide to them? New knowledge? Old knowledge being reinforced? Controversies for debate?
3. Do you require a system strategy to translate the information into practice? An individual strategy to translate? Both?
4. Based on these questions, what KT archetypes best fit the type of knowledge that you need to choose and apply?
5. What evaluation tools and techniques will you be using to measure KT successes? What is the evaluation framework? In other words, when will we know that KT “got it” regarding the knowledge that you have generated?
6. Is the use of ICT for technology enabled knowledge translation (TEKT) appropriate? Would this add value to the type of audience and the positive characteristics of ICTs, or would this distract the audience from the central message (due to technical literacy or other factors)?
7. What types of resources and partnerships will you need to carry out KT? Educators? Lobbyists? Patients? Hospital administrators? Policy decision makers? Others?
8. Do you have a partner or partners to help you in knowledge diffusion and translation, and if so, are they engaged right at the beginning stage of your research question framing and design already? In order for effective KT to be fully effective and integrated, the KT strategy needs to be embedded into the research strategy right from the beginning, rather than having KT addressed only when the research is finished or near its completion.

## **H. Knowledge Translation Archetypes**

The discipline of systems thinking teaches us that there are certain recurrent patterns of occurrences that can be discerned and predicted based on common behavioural characteristics of the systems and individuals in the systems. These patterns are referred to as archetypes. Recognizing the archetype or ideal example of a type can reveal important insights about assumptions underlying any activity, thus suggesting valuable options and pathways for action or intervention. For example, the same archetype that describes the ways in which people buy stocks in bull markets, and dump stocks in bear markets, can be seen exerting its influence in the sometimes subtle (and at other times obvious) ways many children seen as “winners” are valued more in schools compared to others who are not. The influential business theorist Peter Senge called these recurrent patterns and somewhat predictable system behaviours “systems archetypes” and in his best selling book “The Fifth Discipline” outlined eight such systems archetypes<sup>(10)</sup>.

Why is recognizing archetypes important, and why should we care about them? It is because the tried and true guiding principles in the archetypes reflecting the nature of systems can help illuminate our pathway towards meaningful and successful systems and individual transformation. Conversely, if the fundamental principles are violated, we risk running into barriers and frustrations, with a real prospect of failing to create the meaningful or lasting change we originally intended.

The health literature contains examples of KT models that shed light on emerging and underlying principles, and indeed fundamental archetypes, in the effective adoption of knowledge into mainstream healthcare practices. Tables on pages 17-20 below present summaries of some of the more commonly described KT models, organized according to four thematic categories:

1. KT archetypes intended to help individual health professionals in changing their behaviours, thereby adopting new knowledge into their everyday health practices;
2. KT archetypes intended to help individual patients and health consumers in communities to understand and acquire new knowledge and transform their attitudes and behaviours towards improved self management;
3. Systems based KT archetypes intended to transform organizations in their organizational behaviour, leading to systems-wide adoption of the new knowledge;
4. Systems based KT archetypes intended to encourage innovation and adoption into commercialization.

This list of models is not meant to be exhaustive, and is presented only to qualitatively identify the common KT models as a jumping-off point for further reflection. Readers are not encouraged to incorporate as many of these archetypes as possible into their KT strategy, but to choose which one or two work best for translating the nascent knowledge generated from their research into health practices. By listing these KT models, we can start to identify their commonalities and synthesize the steps to hopefully arrive at some fundamental KT archetypes as we put them into practice.

**I. Clinician-directed archetypes targeting individual behavioural change**

Archetype	Key Words	Core Concept(s)
<p><b>Pathman Model of Adult Learning</b></p> <p>Pathman et al. Med Care 1996;34:873-89. Davis et al. BMJ 2003;327;33-5.</p>	<p>Four stages of adult learning:</p> <ol style="list-style-type: none"> <li>1. Awareness</li> <li>2. Agreement</li> <li>3. Adoption</li> <li>4. Adherence</li> </ol>	<p>4 stages of change for individuals in incorporating new knowledge into permanent behavioural change</p>
<p><b>Prochaska Transtheoretical Model of Stages of Change</b></p> <p>Ruggiero et Prochaska. Diabetes Spectrum 1993;6:22-60.</p>	<p>Five stages of adult learning:</p> <ol style="list-style-type: none"> <li>1. Pre-contemplative</li> <li>2. Contemplative</li> <li>3. Preparation</li> <li>4. Action</li> <li>5. Maintenance</li> </ol>	<p>The five stages of change of adult learners to incorporate new knowledge into habit formation and maintenance.</p>
<p><b>Schon's Model of Adult Learning</b></p> <p>Boudas et al. J Contin Educ Health Prof 2001;21(2):103-9.</p>	<p>Reflect in action, and reflect on action to go from zone of development to zone of mastery.</p>	<p>Adult learners need to reflect on their own practices: reflect in action describes their reflection while interacting with patients, and reflect on action describes the time spent after the clinical encounter. Zone of development describes the knowledge gap identified by the health practitioner, while zone of mastery describes the professional's confidence and comfort in their own level expertise.</p>

## II. Patient-directed archetypes targeting individual behavioural change

Archetype	Key Words	Core Concept(s)
<p><b>Stanford University Patient Self-Management Model</b></p> <p>Lorig et al. Med Care 1999;37 :5-14.</p>		<p>Health belief model specifically targeted for patients and health consumers in which a person's perception of threat leads to prevention and altered behaviour.</p>
<p><b>Community Engagement and development</b></p> <p>Boothroyd P. CHS Research Bulletin February 1991;1-10.</p>	<p>Seven steps of community engagement:</p> <ol style="list-style-type: none"> <li>1. Defining planning tasks</li> <li>2. Identifying goals</li> <li>3. Appraise relevant facts</li> <li>4. Generate action possibilities</li> <li>5. Develop options</li> <li>6. Assess options' pros and cons</li> <li>7. Decide on option to adopt</li> </ol>	<p>Boothroyd describes the steps necessary to engage a community of individuals in moving forward to develop and implement new approaches. This seven-step model can be applied generically to many different community development contents.</p>
<p><b>Pratt's Teaching Perspectives</b></p> <p>Pratt, D. D., Collins, J.B., &amp; Arseneau, R. (2001). Reconsidering "Good Teaching" across the continuum of medical education. <i>Journal of Continuing Education in the Health Professions</i>, 21(2), 70-81.</p>	<p>Five perspectives of teachers in their relationship with their students:</p> <ul style="list-style-type: none"> <li>• Transmission</li> <li>• Apprenticeship</li> <li>• Developmental</li> <li>• Nurturing</li> <li>• Social Reform</li> </ul>	<p>As health professionals attempt to help patients and health consumers in managing their own illnesses, understanding their teaching perspectives prior to interacting with their patients would be important in their effectiveness in influencing the health consumers' ultimate incorporation and adoption of knowledge into their everyday lives.</p>

### III. Systems archetypes targeting system/organizational change

Archetype	Key Words	Core Concept(s)
<p><b>The Ottawa Model of Health Care Research Use</b></p> <p>Logan et Graham. Science Communication 1998;20:227-246.</p>	<p>Potential adopters, evidence based innovation and practice environment inform transfer strategies, adoption and use, and outcome assessment.</p>	<p>The Ottawa model outlines a cyclical feedback loop that starts with adopters engaging within their practice environment in incorporating evidence based innovations. This in turn leads to transfer strategies with corresponding outcome. A continuing assessment and monitoring system evaluate the outcome and provide feedback to improve systems adoption.</p>
<p><b>Brownman, Snider &amp; Ellis Model</b></p> <p>Lomas J. Health Pap 2003;3:24-8</p>	<ol style="list-style-type: none"> <li>1. Design a policy learning forum</li> <li>2. Create champions</li> <li>3. Provide rules for dialogue</li> <li>4. Story telling to uncover barriers</li> </ol>	<p>This model not only lays out the steps in setting up a community of practitioners to share their tacit knowledge, but also engage in anecdotal story telling as an effective way to engage and reveal barriers.</p>
<p><b>Systems-Based Reflection</b></p> <p>Frankford et al. Academic Medicine 2000;75:708-717.</p>	<p>Reflective practices of health professionals supported by institutionalized processes of reflection</p>	<p>The authors argue that in as much as individuals need to reflect on their own practices to learn (re: Schon's model), systems also need to undergo reflection to do the same. When systems reflection is in synchrony with reflection of individual practitioners in that system, an effective learning organization is created.</p>
<p><b>Wenger's Community of Practice</b></p> <p>Wenger E. Communities of Practice: learning, meaning, and identity. 1998. Cambridge, UK: Cambridge University Press</p>	<ul style="list-style-type: none"> <li>• Social theory of learning</li> <li>• Communities of practice</li> </ul>	<p>Wegner's model focuses on a social theory of learning that is broad enough to cover a wide range of human activities, well beyond what we would normally consider to be 'learning'. This 'Communities of practice' model offers a comprehensive framework for understanding and analyzing what people do in the context of their social milieu.</p>

#### IV. Systems archetypes targeting innovation/commercialization

Archetype	Key Words	Key Concept(s)
<p><b>Berwick IHI</b></p> <p>Berwick DM. JAMA 2003;289:1969-75.</p>	<p>Seven recommendations of innovation diffusion:</p> <ol style="list-style-type: none"> <li>1. Find sound innovations</li> <li>2. Find and support innovators</li> <li>3. Invest in early adopters</li> <li>4. Make early adopter activity observable</li> <li>5. Trust and enable reinvention</li> <li>6. Create slack for change</li> <li>7. Lead by example</li> </ol>	<p>The author asserts that, based on three clusters of influences including the people, the environment, and perceptions of the innovation, seven recommendations could be made to stimulate the rate of diffusion of new technologies.</p>
<p><b>Creating a social epidemic in innovation adoption</b></p> <p>Gladwell M. The Tipping Point: how little things can make a big difference. 2000. Little, Brown, and Company</p>	<p>Three key ingredients in creating dramatic social change and innovation adoption:</p> <ul style="list-style-type: none"> <li>• The right types of people (mavens, connectors, and salesmen)</li> <li>• The right context</li> <li>• Stickiness of the issue</li> </ul>	<p>The author argues that often it is the subtle behaviours and “tipping points” that lead to dramatic and rapid social change. These tipping points share some common characteristics in the types of people involved, the circumstances in which the tipping points occur, and the stickiness of the issue at hand. By creating these elements, a social transformation can be found just around the corner.</p>
<p><b>Hewlett-Packard Kuppam i-community Project</b></p> <p>Dunn D, Yamashita K. Microcapitalism and the Megacorporation. In Harvard Business Review Special Issue: Leadership in a Changed World. August 2003. Harvard Business School Publications Corporation.</p>	<p>The four overlapping phases of introduction of sustainable innovation into communities:</p> <ol style="list-style-type: none"> <li>1. Quick start</li> <li>2. Ramp up</li> <li>3. Consolidation</li> <li>4. Transition</li> </ol> <p>Coupled with application of management practices</p>	<p>In successfully introducing an i-community to Kuppam, a rural, poverty, and technically challenged village in India, the authors discuss 6 key management practices that led to this sustainable integration:</p> <ul style="list-style-type: none"> <li>• Unearthing customer needs</li> <li>• Fielding diverse talents</li> <li>• Taking a systems approach</li> <li>• Building an ecosystem of partners</li> <li>• Setting deadline</li> <li>• Solving, stitching, and scaling</li> </ul>

## **5. A Final Word**

Current emphasis on evidence of effective Knowledge Translation by health research granting agencies and various levels of governments, the proliferation of literature on this subject, and enthusiasm of health professionals in this domain have all contributed to the importance of health researchers needing to understand and engage in KT.

The March 2003 Technology Enabled Knowledge Translation workshop served as a highly interactive forum enabling policy makers, researchers, practitioners and other stakeholders in the health care system to work in unison on exploring the role of technologies in facilitating knowledge translation in the health sector. Four themes emerged out of small group discussions and plenary sessions that capture the observations and recommendations generated by the participants.

The need for a common language, information filtering mechanisms, and knowledge brokers to enable knowledge translation emerged from many discussions, as did the need to involve health professionals in the design and early stages of implementation of new technologies. Coordination and cooperation among health professionals is seen as vitally important to the future of technology enabled knowledge translation and the success of the health care system, with effective inter-group communication being an integral component of knowledge translation. The establishment of a fast, secure, comprehensive and remotely accessible health information system has the potential to greatly improve the efficiency of knowledge translation.

It is the responsibility of the current health care leaders to define and build a health care delivery and learning system involving information and communication technologies as effective tools in knowledge translation. Technology enhanced learning opportunities will support the next generation of students and health professionals in their personal learning and clinical practice. We also hope that, through the KT activities and explorations of our health and systems researchers, we will collectively uncover and crystallize the fundamental KT archetypes that will be proven to be effective and enduring guideposts to help all of us in our current and future endeavour in knowledge translation.

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## **8. Feedback and Evaluation**

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The authors and their respective organizations seek your assistance in continuing to build the knowledge base around effective KT practices, and to that end we request your feedback on this document. Please either provide us with your feedback in writing or through fax, or go to our on line feedback form at:

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