COMMENT AND OPINION

Knowledge translation status and barriers

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This comment and opinion piece deals with the origin, concept, models, and practice of knowledge translation (KT), as well as related issues, either in theory or practice. The authors explore these questions: What is KT? How does it work? And what is the role of knowledge translators, health care professionals, and health librarians in KT? We suggest that librarians could have a critical role in organizing and operating a major component of KT, the "knowledgebase."

Knowledge translation (KT) origin, definition, and concept

The origin of KT-related activities goes back to the 1910s as a way to address underutilization of scientific findings in the clinical sector [1]. Keeping up with the latest medical advances and accessing the right information in time for real-time treatment were among the critical issues that were addressed. There was an undeniable delay in the application of knowledge to practice. One report revealed a time lapse of twenty years for advances to become widely incorporated into medical practice [2]. Major issues connected to the inefficient health care system included ineffective continuing education for health professionals, increasing complexity of medical procedures and treatments, inadequate application of evidence to case management, and lack of adequate communication between researchers and policy makers [2]. The report also unveiled that physicians are faced with a rapid and voluminous accumulation of new findings, making it increasingly difficult to follow current knowledge and integrate it into practice [2]. Simply, they could not keep up with the latest findings about diagnoses of, interventions for, and treatments of diseases.

All of this has led to an inefficient health care system with issues that have remained unsolved until current decades [3]. Grimshaw et al. state that, despite billions of dollars each year spent in both public and private sectors on education and research in health and medicine in the United States, the health care system has failed to bring cost-effective services to a portion of those who need them [1]. More adversely, there is evidence that in the US health care system, for example, around 20%–30% of patients may receive care that is not needed or is potentially harmful. Grimshaw et al. believe that people fail to benefit optimally from scientific and medical advances [1].

Such health care problems have been talked about for nearly a century, but it was not until recently that a great deal of effort was devoted to scale up the care system [3, 4]. Consequently, a variety of research was conducted under various titles to propose effective tools for better utilization of research products. One of the proposed titles is "knowledge translation," which we prefer to use. Although it is not among the three most frequently used KT terms in the literature, recently it has received rapt attention (e.g., in Grimshaw et al., Thomas and Steinert, Kitson et al., Armstrong et al., and Graham and Tetroe [1, 5–8], to name a few). Nearly 100 terms other than KT have been coined [9], of which the most frequently used are "knowledge implementation," "knowledge adoption," "quality improvement," and "knowledge dissemination" [10]. This inconsistency in KT terms causes issues, especially during information retrieval activities.

In addition, a variety of definitions have been proposed for KT. The most cited definition of KT, originally developed by the Canadian Institutes of Health Research (CIHR) in 2000, was:

[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. [3]

Another frequently referenced definition of KT was presented by the National Center for the Dissemination of Disability Research (NCDDR) in 2005 and is somewhat similar to that of CIHR [11]. The Wikipedia definition for KT is a remarkable amalgamation of many reviewed definitions.

During a KT activity, research findings (knowledge or evidence) are transferred to health care providers (clinicians) to be applied to health care consumers (e.g., patients). Figure 1 shows a schematic idealistic model of KT involving basic stages and elements. Accordingly, five areas of KT action would be knowledge production, knowledge transfer, knowledge application or utilization, knowledge organization and synthesis, and policy making. These areas are interconnected and integrated within the context. Policy makers are at the heart of the process and potentially could regulate strategies.

KT models

As a tool to deal with health care problems, the KT framework became of intense interest to researchers, clinicians, and policy makers [2]. Meanwhile, various models for the practice of KT evolved, and scholars tried to identify KT stages and activities to undertake. However, the identified stages and elements varied in different studies. For example, Ward et al. studied twenty-eight models and identified five common stages of KT: problem identification and communication, knowledge or research development and selection, analysis of context, knowledge transfer activi-

Figure 1
A conceptual general model for knowledge translation
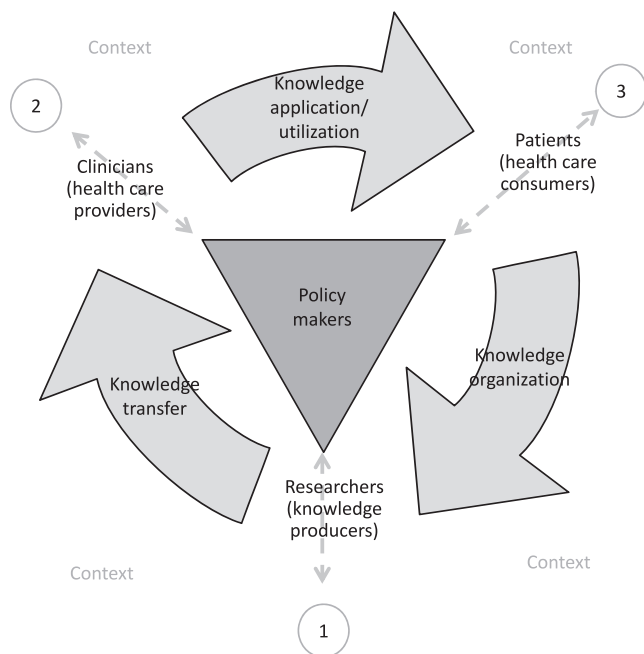
The numbers in the circles depict the knowledge translation (KT) stages. The curved arrows illustrate the process intended by each stage and depict the cyclic nature of KT. The dashed arrowhead lines between the vertices of the triangle and the circles illustrate interaction between KT stages and strategies formulated by policy makers. The three edges of the triangle correspond to the number of KT stages, implying the critical role of policy makers during all stages.

ties or interventions, and knowledge or research utilization [12].

Actually, there are a lot of KT models with different approaches. Armstrong et al. listed some of them, including the classic, knowledge-driven model; the problem-solving, policy-driven model; the interactive model; the enlightenment model; the political model; the tactical model; and the dialogical model [7]. Dagenais et al. also noted a "concept mapping" model [13]. Graham et al. proposed knowledge-to-action and the Ottawa Model of Research Use [9].

KT status in practice

Implementation of KT has been encouraged and in some cases sponsored by international organizations such as the World Health Organization [14]. National organizations, such as CIHR and NCDDR, have been major collaborators in the development of theories and the application of KT [3]. In a country like Iran, implementation of KT is largely supported by the Ministry of Health and Medical Education (MHME) and by major medical universities across the country [15].

Currently, KT has received international attention, and a lot of scholars across the world actively participate in developing, evaluating, and applying KT models. For example, McKibbon et al. reviewed 2,603 KT-related studies performed in 2006 alone [10].

Two types of KT have been recognized by CIHR: (1) the "end of grant KT," which involves intensive dissemination activities to tailor the findings' message for knowledge users (by summary briefings to stakeholders; interactive educational sessions with patients, practitioners, and/or policy makers; media engagement; use of knowledge brokers; and commercialization of scientific discoveries), and (2) the "integrated KT," in which all stakeholders would engage in collaborative research [3] by ongoing interaction of researchers, facility providers, educators, patients [5], and even top-level policy makers.

This promising roadmap has improved the status of KT significantly. However, the overall concession is that the KT solution is not simple and needs the parties' close collaboration.

KT barriers

KT was introduced as a tool to address major issues of an inefficient health care system. It faced barriers across various disciplines. Theoretical and practical controversies included disparities in KT terms and application of models. In addition, there are discussions about the knowledge to be transferred and the roles of key players, such as translators, participants, brokers or facilitators of knowledge, and policy makers (governmental). Baskarada and Kronios restate Falkenberg et al. when they say: "There is a growing concern…about the present situation, where too many fuzzy or ill-defined concepts are used…Scientific as well as practice-related communication is severely distorted and hampered, due to this fuzziness" [16].

Transferred knowledge and knowledge translators

While many scholars in various fields have been focusing on utilizing knowledge, they have paid trivial attention to the content or knowledge that should be translated and the ways it could be collected, organized, delivered, understood, and eventually utilized and synthesized. For example, in a highly cited paper, Lavis et al. asked, "What should be transferred in KT?" [17]. Grimshaw et al. suggested "individual studies" as a proposed unit for a KT process. They asserted this unit is "appropriate" when the targets for KT are other researchers or research funders and "inappropriate when the targets are consumers, healthcare professionals, and/or policy makers" [1]. The unit is controversial because of known fluctuation in types of studies and shortcomings in the nature of scientific publishing and the behavior of scientists. For example, studies that appear first on a scientific problem may receive the most extravagant attention. The

results of some highly cited studies published in core medical journals have been found to be exaggerated or contraindicated with further accumulation of evidence [1]. Even prominent claims with large effects may gradually disappear when more data are accumulated [18]. Instead of this unit, Ioannidis proposed replication and evidence synthesis of studies [18], and Grimshaw et al. suggested a shift of unit from ''individual studies'' to ''up-to-date systematic reviews or other syntheses of global evidence'' [1].

There are also continued controversies that show that not all research findings are knowledge or contain knowledge eligible for the KT process. Actually, there is a general belief that many research results fail to meet eligible criteria to be put into the translation process.

Knowledge translators

The challenge for possible knowledge translators is to identify the key messages for different target audiences in a way that can be easily assimilated [1, 18]. Because the knowledge translator often is not the original author, there are controversies about the accuracy and relevance of the transferred knowledge. However, when translator and author are identical, the transferred knowledge might be more promising.

Austrian-British philosopher Popper believed that two kinds of knowledge exist: implicit or tacit (personal) and explicit (general) [19]. Similarly, Norman states that knowledge has two parts: knowledge in the mind (tacit) and knowledge in the world (implicit) [20]. He states that, for a precise behavior, the knowledge in the mind should match (interact) with the knowledge in the world. He provides the following example: ''A common classroom exercise in the US demonstrates that students cannot recall the pairing of letters and numbers on their telephones.'' Norman states that the reason lies in the fact that not all knowledge is in the head; besides the head, ''it is distributed partly in the world, and partly in the constraints of the world'' [20].

The knowledgebase

The knowledge embedded in a single research study is interconnected with that possessed by its researcher. The knowledge is socially constructed and situation based [16], is interactive and meaningful within the context [21], and yields different results in different situations [22]. Therefore, the KT process differs depending upon the situation, context, and users' orientation. In this regard, an integrated dynamic accumulation of knowledge (''knowledgebase''), which is reflexive to the situation and context and is adaptable and scalable to orientations and needs [23], would be ideal.

This knowledgebase (analogous to database) would be effective using knowledge organization (KO) tools, such as subject-based KO tools, Dublin Core metadata, extensible markup languages (XML), and, especially, semantic web technologies such as the resource description framework (RDF) and ontologies like the web ontology language (OWL). While data are collected in databases and information in infobases, knowledge would be collected in knowledgebases with numerous capabilities, such as extensive cross-referencing, an effective quarry system, and an interface. Time lags can make knowledge outdated or lead to unsuccessful KT [2], and knowledgebases could reduce these lags between KT stages [24].

Knowledge organization: role for librarians

An issue emerges when health care scientists engage in research with little attention to the ways that the knowledge must be organized prior to being implemented in real life. KO is a neglected, essential stage prior to the beginning of KT.

KO is a field widely studied in library and information sciences (LIS) and—with a different approach—in the philosophy of science. KO is about real-world phenomena and concepts, and their semantic relations [25]. Thus, it encompasses the knowledge in both micro (terms) and macro (documents) levels. Organizing terms or documents based on identifying their representative meanings or contents, classification orders, and inter- or intra-relationships helps humans to organize knowledge and the ways it should be successfully classified, related, synthesized, and used. In this regard, some considerations related to KT and KO are:

1. Regarding the exponential increase of research performed in various disciplines, does all research produce knowledge? Have all studies met research standards addressing important issues or questions? Are they all valuable to be preserved and disseminated? Who must judge their qualifications? By whom must they be identified, organized, disseminated, translated, implemented, and be fed back?
2. What are the bases of organizing the produced knowledge (i.e., research findings)?
3. Should we organize all knowledge when it is produced?
4. What are the roles of libraries and knowledgebases as dynamic stacks of organized knowledge? [26]

Conclusion

The path and stages of a KT process are not easy to establish. Almost all research in the health domain has timeframes in transient situations with volatile background components. All forces engaged in the knowledge and care process must be organized, targeted, supervised, and regulated in the research process. Careful attention must be paid to the vital role of the knowledgebase in successful KT and to the role of libraries (no matter what type) as live repositories of information and knowledge. A main issue is that KT has been neglected by LIS experts. Since LIS professionals are dealing with every aspect of information and knowledge, we believe that LIS professionals could be very helpful in KT practice and process; for example, in creating knowledgebases, in organizing knowledge, and in practicing KT as KT facilitators. During a qualitative study to learn about KT issues in a country like Iran (data not shown), we found that, besides the aforementioned issues, there might be several

other problems related to economy, culture, society, and government. Thus, we found that application of KT needs a high degree of expertise and a clear examination of context. Successful KT requires clear understanding of its elements, stages, and process, taking into consideration the situation, context, and orientation and joining the collaboration of health care researchers, clinicians, consumers, and health librarians.

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