Original Research

Knowledge Translation for Research Utilization: Design of a Knowledge Translation Model at Tehran University of Medical Sciences

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Introduction: The present study aimed to generate a model that would provide a conceptual framework for linking disparate components of knowledge translation. A theoretical model of such would enable the organization and evaluation of attempts to analyze current conditions and to design interventions on the transfer and utilization of research knowledge.

Methods: This research, performed in 2006–2007 at the Tehran University of Medical Sciences (TUMS), utilized two distinct methodologies: a narrative review to identify existing knowledge transfer models and frameworks and focus group discussions to determine the views and opinions of researchers and decision makers regarding barriers to knowledge translation within the health system.

Results: A knowledge translation cycle is described, with five domains: knowledge creation, knowledge transfer, research utilization, question transfer, and the context of organization.

Discussion: The knowledge translation cycle offers a theoretical basis for identifying basic requirements and linking mechanisms in the translation of knowledge for research utilization.

Key Words: knowledge translation, research utilization, knowledge creation, education, medical, continuing, learning

Introduction

The importance of using research in health care decision making at the individual and organizational levels is increasingly recognized in industrialized and developing countries, although the latter face additional challenges to knowledge application because of their more limited resources.[1]

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The limited success of dissemination strategies to increase the use of research in decision making suggests that transforming research into practice is a demanding task, requiring intellectual rigor and discipline, as well as creativity, skill, and organizational savvy and endurance.[2]

Paying attention to creative methods, transfer and application of knowledge are important.[3] Research and evidence, however, can have an immense impact on policy and practice, resulting in tangible positive outcomes. In the field of health care, for example, successful incorporation of evidence into practice can save millions of lives.[4] Many models or frameworks of knowledge translation exist, both as knowledge transfer and as research utilization approaches.[5–14] Although these models or frameworks vary in their descriptions and emphases, most authors agree that knowledge translation is a complex and lengthy process.[7,15]

The effect of research on the health system has become more important in Iran. At present, however, we cannot clearly match research activities with the needs of the health sector. The present study aimed to generate a model for knowledge translation in knowledge creation units, or organizations doing research. Since knowledge translation is one of the programs of the Deputy of Research, Tehran University of the Medical Sciences (TUMS), this study was per-

formed at the institution. A framework based on the model was developed for identifying current conditions, and for organizing and evaluating interventions needed in knowledge translation for research utilization in the university.

Methods

This study used two sets of methods. The first was a narrative review to identify and evaluate the various models and frameworks presented in the field of knowledge translation. Literature sources in English and Farsi were searched using Systematic Reviews (CDSR), Database of Abstracts on Reviews of Effects (DARE), Cochrane Database of Methdology Reviews (CDMR), Scientific Information Database (SID), Iranian Information and Documentation Center (IRANDOC), Medline, and Internet search engines. In addition, reference lists were reviewed to identify books and literature regarded as essential in the field. All papers and reports that gave sufficient detail describing the various concepts were included in the review. In all, 650 articles and reports from 1970 to 2006 were reviewed.

The second set of methods consisted of focus group discussions, which sought to gather the views and opinions of 23 researchers and decision makers (10 researchers of medical universities, 5 managers of research institutes, 5 policymakers of the Ministry of Health, and 3 journal chief editors, in three groups) with respect to influential factors and barriers to research-based knowledge translation in the health system. Experts were selected to represent the pull side (research utilization) or the push side (knowledge creation) of a knowledge translation exchange.

The literature provided evidence for development of a focus group discussion guide. The interview schedule revolved around the four main axes of barriers and strategies for improving approaches to knowledge translation. Main axes were research (evidence), decision makers, knowledge transfer activities, and context (environment) of knowledge transfer. Data from the focus groups were analyzed, drawing out common themes and patterns in a thematic framework analysis.

Finally, drawing on the literature review and the focus group discussions, we generated a model, the Tehran University of Medical Sciences knowledge translation cycle.

Results

Review of Studies

Knowledge translation and knowledge transfer are concepts that differ from one another. While some use these terms interchangeably, the latter refers to a linear process through which research is conducted, followed by transfer of the research results to the end users. The unidirectional nature of knowledge transfer has been criticized, and recent studies have demonstrated that such strategies "have not proven to be effective in encouraging the adoption and implementa-

tion of research results." The mere reception of knowledge by the potential user does not confirm its use.[16]

In examining the passive dissemination of consensus recommendations, knowledge transfer alone resulted in few or no behavioral changes by health care providers.[4] In addition, "merely because information was timely, relevant, objective, and disseminated to the right people in usable form did not guarantee its use."[17] Knowledge translation, which guarantees a mutual and collaborative contact between researchers and users of knowledge, was discovered, in part, because of these limitations.

The factors affecting knowledge transfer and translation in organizations are important. Information technology is an influential factor that supports the knowledge processes to a much greater extent than previously. The increased capability and dispersion of technology have increased the opportunities for collaboration by researchers separated by both time and space and for the creation of jointly constructed interpretations and meaning among individuals.[18] Four types of technology must be considered: databases, decision support tools and artificial intelligence, groupware including e-mail and videoconferencing, and Web technology (eg, intranets, extranets, and the Internet).[19]

Cultural factors also are important for knowledge transfer.[20–22] The most common cultural factors inhibiting effective knowledge transfer are lack of trust; different cultural backgrounds, vocabularies, and frames of reference; lack of time and meeting places; narrow ideas of productive work; inappropriate incentive schemes that do not motivate sharing but rather focus on individuals; and lack of absorptive capacity in recipients.[23]

Predictors of the uptake of research by organizations are users' adaptation of research, users' acquisition efforts, links between researchers and users, and users' organizational contexts.[24] Both researchers and decision makers mention the quality of research as influential in promoting its use in policy.[25]

Data on predictors (individual determinants) of research use can be sorted into six categories: beliefs and attitudes, involvement in research activities, information seeking, education, professional characteristics, and other socioeconomic factors.[26] Values and attitudes can have a great influence on the extent of knowledge utilization.[27–29]

Among the factors that can lead individuals and academic units not to give priority to knowledge transfer is the value placed on traditional academic output (eg, publications in peer-reviewed journals, presentations at disciplinary conferences, receipt of research grants from federal agencies), in combination with the limited number of hours in a day. The low priority means that few researchers receive training in or have experience of knowledge transfer, and that little money is available to cover the monetary costs associated with transfer-related activities.[30] Finally, confidentiality concerns and editorial policies may hinder researchers' ability to share research in a timely manner.[31–34]

These organizational barriers originate in the history of the university as a setting for knowledge production. Following World War II, a new research economy emerged in the United States; both government and industry increased their funding for university-based programmatic research, particularly in scientific and technical fields.[35] In the latter part of the twentieth century, that balance was shifted by new information technologies and globalization, such that the university is no longer the primary site of knowledge production, having been challenged by a range of new knowledge producers.[36] The consequences of this competition include an emphasis on the development of new funding alliances involving the university, the state, and private industry, as well as calls for increased accountability of the university to the public.[37]

Lynton and Elman[38] argue that "universities must realize that the effective attainment of their scholarly mission calls for a complex and interactive process with their constituencies . . . [T]o facilitate this new kind of work, universities must make structural and organizational changes that promote three kinds of activities: communication between the producers of knowledge and the users of knowledge, brokering and negotiation of knowledge transfer arrangements, and the delivery of knowledge."

Results of Focus Group Discussions

There were four main themes and a number of subthemes identified by the focus group participants. The results of focus group discussion sessions are summarized in TABLES 1–4. The topics of these sessions were barriers and proposed strategies for improvement of knowledge translation, with the results sorted into four main themes: "university context," "knowledge creation," "knowledge transfer," and "research utilization." We used these themes and subthemes to design the model.

Designing the Model of "Knowledge Translation"

Using evidence from the literature review and data from the focus group discussions, we designed a model, the knowledge translation cycle (FIGURE 1).

This model includes five main domains: (1) knowledge creation, (2) knowledge transfer, (3) research utilization, (4) question transfer, and (5) context of organization.

The first four domains have mutual relationships. These four domains and their relationships are based on the fifth domain, context of organization, which indicates the leadership system, policies, values, and culture present in the organization, Tehran University of Medical Sciences, in this model (see FIGURE 1). All domains derive from focus group discussions and evidence from literature reviews.

We also developed some elements for each domain with the purpose of organizing factors listed in each domain. Each of these domains, apart from context of organization, consists of two elements: knowledge creation consists of characteristics of researchers and research; knowledge transfer consists of resources and strategies; research utilization consists of characteristics of decision makers and context of

TABLE 1. Barriers and Proposed Strategies for Improvement in the University Context

Barriers	Strategies
• Undefined necessary interactions between medical and non-medical universities	• Defining responsible structures for knowledge transfer activities in the university
• Undefined appropriate interactions between universities and industry	• Evaluation of research-based knowledge translation activities at the university level and defining necessary standards for evaluation
• Absence of an evaluative system of research-based knowledge	• Monitoring of quality of knowledge translation activities
• Absence of appropriate lobbies for absorbing research investments	• Promoting the culture of interactions between producers and users of research
• Effect of the international political atmosphere on the absorbance of research projects	• Setting rules for motivating and compelling researchers to interact with users while performing the research
• Presence of a bureaucratic system	• Fitting knowledge transfer activities of academic members into the university's evaluation system
• Absence of appropriate laws for preserving individuals' intellectual rights	• Compilation and clarification of rules for respecting individuals' intellectual rights
• Cultural barriers and absence of favorable conditions such as the culture of study	• Absorbing capable human resources into the university
• Political barriers to the publication of certain research results	
• Low educational level for training researchers	
• Choosing academic members without consideration of required skills	

TABLE 2. Barriers and Proposed Strategies for Improvement of Knowledge Creation

Barriers	Strategies
• Researchers' lack of awareness of the necessity of knowledge transfer • Researchers' lack of perception of a need for knowledge transfer • Inadequate skills of researchers in research • Lack of researcher familiarity with knowledge transfer methods • Research not in accordance with users' needs and priorities • Inadequate time for dissemination and transfer of research results • Lack of researcher familiarity with target audiences • Absence of mutual trust • Some researchers dispersed and lack solidarity • Lack of academic motivation for researchers (eg, professional promotion or gaining degrees)	• Education of researchers in necessary skills ◦ Topic choosing skills based on users' need ◦ Researching skills ◦ Group work skills ◦ Communication skills ◦ Preparation of messages from research results ◦ Designing of systematic reviews ◦ Familiarization with knowledge translation techniques • Fitting the topic of knowledge translation into the academic education of the university • Carrying out necessary research studies in the field of knowledge translation • Education of individuals with knowledge translation skills to help the research team

TABLE 3. Barriers and Proposed Strategies for Improvement of Knowledge Transfer

Barriers	Strategies
• Absence of interactions between knowledge producers and users • Problems existing in the substructure of knowledge translation, such as absence of an appropriate information bank to provide access to research results • Absence of appropriate information banks for provision of thesis results and reports on research projects • Absence of research priorities based on users' needs • Absence of a proper grant system • Inappropriateness of the message conveyed (eg, lack of use by the knowledge producer of a style and language appropriate to the knowledge user) • Publication of results through inappropriate channels (eg, journals not read by research users) • Permanency of the chief editor council and implementation of its specific ideas • Low number of reviewers in each subject • High number of journals and inability to read them • Research result publications not up-to-date	• Defining a custodian of research result transfer activities in the university through creation of a new structure or optimization of present structures • Designing information banks of research results such as theses and research project reports for facilitation of access to research results • Promoting information technology • Designing structures for facilitation of access to research audiences • Research and identification of effective modalities of knowledge transfer for various audiences • Education and promotion of information marketing and defining indicators for their assessment • Valuing and scoring joint research by producers and users • Valuing and scoring knowledge transfer activities • Encouraging knowledge transfer activities by academic members • Showing appreciation for research in the field of knowledge transfer through prizes and awards • Defining necessary standards for messages that result from research • Changing the format of proposals and adding a transfer of results section to them • Absorbing users by announcing the capabilities of colleges • Creating a connecting system between managers allowing them to inform each other of research activities and needs • Classification of journals and publications to facilitate the utilization of research results on a specific topic • Teaching skills to article and project referees

TABLE 4. Barriers and Proposed Strategies for Improvement of Knowledge Utilization

Barriers	Strategies
• Lack of attention to research evidence in decision making	• Convincing decision makers to utilize messages and research results in their decision making
• Lack of need for research felt by decision makers	• Absorbing users through announcing the capabilities of researchers and colleges
• Lack of user trust of research results	
• Lack of user access to research results	• Selecting competent managers and decision makers
• Inappropriateness of research language for users	• Teaching skills on how to utilize research results in decision making
• Lack of policymaker skills in analysis and use of research results	• Identification and announcement of needs and priorities by users and policymakers
• Decision makers' need for fast responses and transfer of research findings to them not recognized by researchers	• Compilation of long-term programs for utilization of research in decision making
• Limitations of budgets and laws for requesting research	• Management of required resources in utilization of research results
• Absence of long-term programs and lack of dedication of managers to these programs, including early replacement of managers	• Simplifying processes through trust, control, and costs in the field of decision making
• Absence of appropriate office structures for requesting research	• Strengthening interdisciplinary, intercollegiate, domestic, and regional relations
• Limited number of users	• Involving users in all steps of research
• Lack of user participation in the research process	• Enlightenment in the field of conflicts of interest and legislating the relative laws
• Conflict of interest between researchers and users	

decision making; and question transfer consists of resources and strategies.

The knowledge creation domain in the knowledge translation cycle starts with the researchers themselves, placing it on the "push side" of the model. The domains "knowledge transfer" and "question transfer" are part of "exchange efforts." The "knowledge utilization" domain is on the "pull side" of the model.

Within each domain, the model includes a series of determinant factors. This model helps us in organizing our knowledge about the relation between domains and position of determinant factors and recognizes the needed interventions. The determinant factors in each of the domains of this model are defined as follows:

Knowledge Creation. The following factors are derived mainly from subthemes in TABLE 2 and the evidence gathered through our review study.

- *Characteristics of researchers.* These include educational level, work record, knowledge, beliefs and attitudes (eg, trusting others' research and/or the possibility of losing research ideas), motivation and interest, skills and familiarity with the research methods, communication skills, adequate time and familiarity with the target audience.
- *Research.* These include the type of research, relevance to user needs, solidarity and accretion of research (in response to needs), appropriate infrastructure of knowledge transfer for proposals, research prioritization (in response to needs), being up-to-date (in response to needs), quality of research, and facilities for the use of equipment necessary for research.

Knowledge Transfer. The factors listed in this domain are derived from subthemes in TABLE 3 and the evidence gathered through our review study.
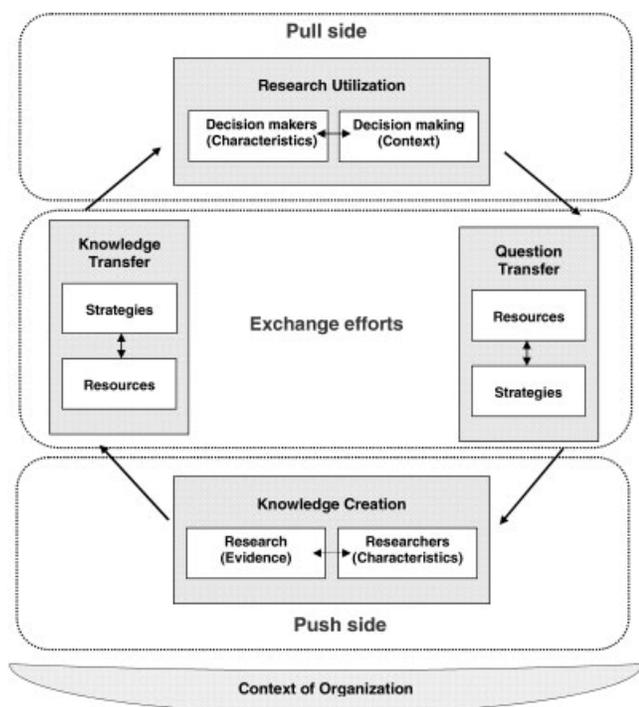

FIGURE 1. The Tehran University of Medical Sciences Knowledge Translation Cycle.

- *Resources.* These include financial investments, equipment and material, scientific journals, media, scientific committees, databases, communication networks (between individuals and between organizations), regulations and individuals (such as knowledge brokers).
- *Strategies.*
  - Provision of executive facilities and financial resources for the better presentation of research results.
  - Promotion of information and technology management (for allowing electronic and nonelectronic access to information banks, journals, theses, research project reports, characteristics of researchers and research groups, etc.).
  - Creation of communication networks (at the individual and organizational levels) and arranging access to these networks.
  - Definition of the structure of actionable messages to knowledge transfer (using the messages when publishing articles, compiling project reports, and presenting research results to decision makers).
  - Preparation of "knowledge translation" guidelines for researchers and decision makers and making them accessible.
  - Facilitation of interactions between researchers and decision-making organizations or organizations such as the mass media.
  - Formulation of training courses and scientific committees for researchers and decision makers to promote their skills in "knowledge translation" and to create a common language among them.
  - Education of knowledge brokers (skilled in transmission of results to decision makers).
  - Promotion of the publication management of scientific journals to provide up-to-date and qualitative research results.
  - Organization of the research required for promotion of the knowledge translation cycle.

Research Utilization. The following factors are derived mainly from subthemes in TABLE 4 and the evidence gathered through our review study.

- *Characteristics of decision makers.* These include educational level, work record, beliefs and attitudes (including attitude toward the necessity for research evidence and trust in research results), technical skills for utilization (appraise and apply the research results), familiarity and trust in researchers and research results, and accessibility to relevant research.
- *Context of decision making.* These include regulations and legislation, financial support sources, official structures, political and cultural conditions, organizational complexity, decision-making processes, other evidence (eg, pertinence of decision making to using research and nonresearch evidence), and the requirement for quick responses.

Question Transfer. Adopting the perspective of research funder,[15,48] a question transfer domain was identified, using the concept of research funder as defined in the model of Canadian Health Sciences Research Foundation. The fol-

lowing factors are extracted from subthemes in TABLE 3 and the evidence gathered through literature review study.

- *Resources.* These include funding organizations, organizations related to research management (eg, in the university, Ministry of Health, and other public and private organizations).
- *Strategies.*
  - Creation of access to information banks of the professional characteristics of researchers and research centers and of the professional characteristics and research needs of decision makers.
  - Formulation of a university's research priorities in regard to decision makers' needs.
  - Creation of trust between researchers and decision makers.
  - Creation of interactions between researchers and decision makers (in the process of defining and performing research).
  - Creation of access to research grants.

Context of Organization. The following factors are derived mainly from subthemes in TABLE 1 and some evidence gathered through our review study.

- Development of standards in the health system for presenting appropriate frameworks of knowledge translation and making them practical.
- Absorption of the required resources for supporting activities related to knowledge management and knowledge translation.
- Preparation of a cultural context in the research sector of the university for the knowledge translation cycle.
- Political and executive support of knowledge translation activities.
- Selection of academic members who possess high scientific and research capabilities (absorbing skilled forces).
- Legislation and regulations necessary to facilitate the knowledge translation cycle in the university.

Discussion and Conclusions

Many studies present conceptual frameworks or models for knowledge translation, knowledge transfer, or research utilization. These models represent the necessary principles and the mediating loops from "knowledge creation" to "knowledge utilization."[7,8,12–14,16,39–52] The model (TUMS model) presented in this article describes programs and strategies needed for knowledge translation in an organization. Compared with other knowledge translation models, the TUMS model et al. appears more focused on the "pull side" of the knowledge translation circle. The TUMS model resembles the Graham et al model[7] and the Canadian Health Sciences Research Foundation (CHSRF) model[48] and considers simultaneously the push side (knowledge creation) and pull side (research utilization) of a knowledge translation cycle. The TUMS model was generated from a review of literature and from focus group data. Therefore, the value of a model such as the TUMS model generated and designed lies in

data collected within the system, not just within an individual country. Such models can facilitate the transfer of knowledge between researchers in various disciplines (eg, clinicians and public health professionals) and a broad range of decision makers (eg, clinicians, policymakers, and researchers), in spite of existing cultural differences. In addition, this model can aid in the design and execution of appropriate interventions in this field, and there should be organizational capacity building strategies for implementation of the knowledge translation cycle; these strategies are dependent upon the social and cultural contexts of individual countries.

This study is affected by a number of limitations. First, what is presented here is only a "recommended" model. The effectiveness of the model cannot be proved unless its implementation can facilitate the transfer of research knowledge to decision makers and give them a better understanding of the existing problems, eventually leading to evidence-based decisions. Second, as we believe that knowledge translation models must be dynamic, modifications might be required in the models' various determinant factors to reflect changing cultural, social, and economic circumstances. This provides the rationale for constant monitoring of these models with regard to their efficacy.

In the authors' experience, the following strategies can make knowledge translation more effective in universities: (1) defining and setting up of a system to assess the knowledge translation cycle; (2) implementation and use of information technology; (3) identification and encouragement of face-to-face interactions between researchers and decision makers; (4) exchanging knowledgeable individuals among centers; (5) creating mutual trust, a common language and culture for the creation of organizational knowledge; (6) using important motivational tools in the university; and (7) using multidimensional methods for knowledge transfer: universities depend primarily on the passive dissemination of knowledge, such as through publications and changing of individual behavior. Passive diffusion of knowledge, however, is not sufficient to guarantee its adoption into practice.[53]

The TUMS model helps to identify barriers and facilitators of knowledge translation in the university and, accordingly, design strategies to improve the current situation. An early use of the model may involve the design of tools for assessment of the present status of knowledge translation.

The knowledge translation process has been described as consisting of multiple stages designed to identify research gaps and plan for evidence-based implementation.[54–56] The multiphase nature of this process suggests the necessity to develop a framework or model for identifying the parts involved in this process and the necessary activities to be undertaken. Also, models are representative concepts for necessary interventions, and the application of these models requires programming with respect to each component. No doubt, the suggested knowledge translation cycle for the university, as for all other models, will need modification following its implementation.

Lessons for Practice

- Models to promote knowledge translation have so far received scant attention in developing countries.

- The Tehran University of Medical Sciences (TUMS) knowledge translation cycle was developed from a review of literature and data collected within the TUMS. It presents push side and pull side components of knowledge creation and research utilization.

- As a model, the TUMS knowledge translation cycle should enable organization and evaluation of attempts to analyze the current situation and design further interventions on the transfer and utilization of research knowledge.

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