The knowledge-value chain: a conceptual framework for knowledge translation in health

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Abstract This article briefly discusses knowledge translation and lists the problems associated with it. Then it uses knowledge-management literature to develop and propose a knowledge-value chain framework in order to provide an integrated conceptual model of knowledge management and application in public health organizations. The knowledge-value chain is a non-linear concept and is based on the management of five dyadic capabilities: mapping and acquisition, creation and destruction, integration and sharing/transfer, replication and protection, and performance and innovation.

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يمكن الاطلاع على الملخص بالعربية في صفحة 602.

Introduction

The golden era of modern research, which started after the Second World War, was a period during which research findings outside strategic government projects were published[1] and passive diffusion followed. The 1970s saw the birth of evidence-based medicine, which used a "push strategy" of both active dissemination of practice guidelines and education for their local interpretation and adaptation; technology assessment also emerged at a time when private industry took over most of the research and development of products. At the time, conceptual frameworks derived from the social theory of the diffusion of innovation included those of research transfer and research utilization; the private sector developed value-chain models and marketing strategies. The success of evidence-based medicine, however, plateaued in the 1990s and the new millennium dawned bringing fresh thinking to this old frontier. In Canada, for example, as the institutions were reorganized or created, the term "knowledge translation" was coined and it emphasized models of linkage and exchange.[2]

The concept of knowledge translation (KT) is developing at a time when unprecedented global investments in health research have generated a vast pool of knowledge that is underused and not translated rapidly enough into new or improved health policies, products, services and outcomes. KT comes at a time when the gap between what is known and what gets done (the know–do gap) is highlighted by shortfalls in equity (for example, as underscored by the Millennium Development Goals)[3] and quality (resulting in the development of the patient safety movement) in health services. However, there is a limited interpretation of KT as a linear transaction between research "producers" and "users" who trade knowledge as a commodity. Knowledge can be created without science and KT is not research: it moves from responding to curiosity to focusing on purpose and problem solving. It is defined as "the synthesis, exchange and application of knowledge by relevant stakeholders to accelerate the benefits of global and local innovation in strengthening health systems and improving people's health".[4] More concretely, KT is about creating, transferring and transforming knowledge from one social or organizational unit to another in a value-creating chain: it is a complex interactive process that depends on human beings and their context. The transfer of knowledge from one community or organizational unit to another usually faces five problems: knowledge access, knowledge incompleteness, knowledge asymmetry, knowledge valuation and knowledge incompatibility (Box 1).[5–8]

The knowledge-value chain

Knowledge management studies tend to adopt the organization as their focus of attention, thus looking at how organizational characteristics affect the translation and implementation of knowledge in the solving of public health problems. The management literature considers knowledge to be the resource with the highest strategic value for organizations. For public health organizations, such as WHO, the capability to acquire, create, share and apply knowledge represents their most significant capability in terms of solving public health problems. Two characteristics arise from such a perspective on knowledge and organizations. The first characteristic is related to the process of knowledge application. The second characteristic is related to the aim of knowledge application, which is to create value for organizations.

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These two characteristics suggest that knowledge should be managed and used as a resource that adds value to the activities undertaken in the production and delivery processes of public health organizations. In management literature, this idea of value creation is often approached through the concept of a knowledge-value chain. The arguments that follow describe the framework presented in Fig. 1 (the arrows linking the components of the chain indicate the non-linear nature of the knowledge-value chain).

In this paper, the concept of a knowledge-value chain is developed in three stages. First, we look at what the word "knowledge" could mean for public health organizations. Second, we consider the value characteristics of knowledge. Third, we review the five dyadic capabilities supporting the concept of a knowledge-value chain in public health organizations.

What does knowledge mean for public health organizations?

Knowledge constitutes an intangible resource that takes multivariate forms. Blumentritt & Johnston have reviewed the most frequently cited typologies of knowledge.[9] Their review shows that there is an overlap between typologies. Clearly, there is no consensus about the level of analysis at which knowledge is a valid concept. For the sake of this paper it is useful to categorize knowledge according to its articulability and its holders. Articulability refers to the differentiation between explicit (or codified) knowledge and tacit knowledge. Explicit knowledge is knowledge that can be consciously understood and articulated, for example, in the form of scientific articles, books, guidelines and electronic records. It includes explanatory knowledge and explicit propositions. Tacit knowledge is knowledge that the knowledge holder is not aware of. For instance, the knowledge holder may know how to ride a bicycle but could articulate this know-how only with great effort.

When addressing issues related to knowledge application, technical experts have the inclination to depend almost exclusively on explicit knowledge. The realm of biotechnology research and evidence-based medicine is dominated by the intensive use of explicit knowledge. By comparison, practitioners in the health professions, policy-makers and managers of public health organizations rely on the use of complementary types of knowledge in a context where explicit research knowledge does not usually dominate. The lesson that can be derived from examining the different types of knowledge used is that sound decisions and professional practices must be based on multiple types and pieces of knowledge that bring complementary contributions to problem solving.[10] Explicit and tacit knowledge are especially important with respect to knowing how to perform a particular task, solve problems and manage change in unique, complex or uncertain circumstances. Additionally, organizations are necessary to provide the infrastructure in which individuals can coordinate the integration of their specialized knowledge in order to solve problems.

What are the value characteristics of knowledge?

Knowledge is information whose certainty is context-dependent and that gives individuals and organizations the capacity to act. Knowledge is the result of a series of three successive transformations.

1. **From reality to data:** This transformation allows individuals and organizations to develop instruments to represent, collect, record, and store discrete facts about reality.
2. **From data to information (also called "know-what"):** This transformation allows individuals and organizations to process and organize data in order to create a message, such as by producing reports.
3. **From information to knowledge (also called "know-how"):** This transformation allows individuals and organizations to interpret information in order to derive an action.

Knowledge carries characteristics that increase or decrease its value. In the field of public health, one can associate four value-increasing characteristics with knowledge: (1) the deployment of knowledge is possible at the same time in multiple sites around the world; (2) knowledge increases in value when used by multiple knowledge holders; (3) knowledge brings increasing returns (instead of diminishing returns as tangible assets may) — the more we use it, the better we use it and the better

are the outputs and outcomes; and (4) knowledge creates future opportunities — using knowledge improves learning which, in turn, creates opportunities for future action and interventions.

Conversely, knowledge also carries value-decreasing characteristics that public health officials need to consider: (1) knowledge assets are more difficult to manage than tangible assets such as medical equipment; (2) investments in knowledge assets aimed at developing or improving public health programmes and interventions are risky due to their role in the early stages of innovation; (3) knowledge assets are difficult to measure; and (4) valuing knowledge assets is difficult. These last two characteristics mean that collecting solid evidence on knowledge investment and returns from investments in public health programmes and interventions is usually not easy.

From knowledge to the knowledge-value chain

By defining knowledge as the capacity to act, we postulate that the combined use of knowledge and other resources gives organizations their capabilities for action. There is no consensus with respect to the critical capabilities required to manage knowledge productively.[11] In public health, five dyadic capabilities appear to be of critical importance: (1) the capabilities of mapping and acquisition complement each other; (2) creation is partly associated with destruction; (3) integration is dependent on sharing and transfer; (4) replication is related to protection; and (5) performance assessment is linked with innovation. Knowledge creation is the capability that has received the most attention from the research community. The other capabilities are less well documented but the management literature has something to say about all of them.

From an organizational perspective, the interdependence of such dyadic capabilities generates a knowledge-value chain that moves from knowledge mapping and acquisition up to the production and delivery of new or improved public health programmes and interventions delivering added value for people.[12–14] The mission, vision, goals and strategies of a public health organization or social enterprise drive the knowledge-value chain. The higher the knowledge performance related to dyadic capabilities, the higher the value generated (Fig. 1).

Knowledge mapping and acquisition

The internal knowledge mapping in a public health organization allows it to learn what it knows. It refers to the understanding and self-awareness that an organization has with respect to its knowledge resources and their limitations.[15] Internal knowledge is especially important because it is unique, specific to the organization, tacit and therefore difficult to reproduce by knowledge holders located outside the organization. On the other hand, external knowledge acquisition refers to a capability for external awareness, more specifically to the capacity for identifying and acquiring knowledge from external sources and making it suitable for subsequent use by the organization. Knowledge mapping and acquisition involve many specific capacities — for example, locating, accessing, valuing and filtering pertinent knowledge; extracting, collecting, distilling, refining, interpreting, packaging and transforming the captured knowledge into usable knowledge; and transferring the usable knowledge within the organization for subsequent use in problem solving.[11] External knowledge may provide new ideas and contexts for benchmarking internal knowledge; this type of knowledge is more explicit and more costly to acquire but it is easily available from other similar public health organizations.

Based on the results of the knowledge mapping and acquisition diagnostic, one could attempt to look into the knowledge gap that may exist between what a public health organization has to know to implement its mandate and what it currently knows. This assessment may lead to one of three conclusions: (1) the organization faces a situation where there is an internal knowledge gap if it does not know enough to implement its public health mandate; (2) the organization has an external knowledge gap if it knows less than what other public health organizations know in order to implement similar mandates; (3) the organization has no knowledge gap if it knows enough to implement its mandate or if it knows more than other public health organizations know in order to implement similar mandates.

Knowledge mapping and acquisition may rely on one of four organizational modes: undirected viewing, conditioned viewing, informal search and formal search.[16] In undirected viewing,

a public health professional is exposed to information when he or she has no specific public health informational needs in mind. Undirected viewing is an informal strategy that can be useful for the early detection of emerging problems. In conditioned viewing, a public health professional directs his or her viewing on information regarding selected public health topics or issues. During the informal search process, a public health professional looks for information that will improve his or her understanding of a specific public health issue. Finally, in a formal search a public health professional engages in a systematic search for ideas, information and knowledge about a specific public health issue. This last mode includes conducting systematic reviews and external surveys as well as training and hiring employees (in order to bring knowledge into the organization). The

other mapping and acquisition modes are more likely to rely on identifying and acquiring ideas, information and knowledge through informal networks.

Knowledge creation and destruction

The size of internal and external knowledge gaps influences knowledge-creation efforts. The knowledge-creation capability refers to the capacity to combine knowledge (tacit, explicit, individual and collective, internal and external) in order to develop new knowledge.[17,18] Knowledge creation is usually associated with research and development activities. However, it should also be understood to include activities such as solving a public health problem, devising a public health promotion strategy, discovering a pattern, developing a public health programme or intervention, or conducting

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> **Box 1. Knowledge translation problems**
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> **Knowledge access**
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> At its root, KT is often pre-empted by basic access to key information and expertise. This applies both to the ability to learn of the existence of knowledge and the ability to retrieve it in a timely and usable form. The end results are wasted opportunities and reinventing of wheels. The sheer volume of information available is itself a challenge, as are the digital divide and the exclusionary nature of expensive intellectual property. Indexes, search engines, expertise locators and social networks are making it much easier today, as are various public and private efforts to facilitate affordable access to premier information and know-how.
>
> **Knowledge incompleteness**
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> When the attributes of the knowledge in a given transfer transaction are not completely specified, knowledge incompleteness happens. Research knowledge represents abstract principles dealing with fundamental relations between causes and effects. There might be a gap between these abstract principles and their concrete application in new or improved products and services. Proof that abstract principles work is frequently not provided to the recipients of knowledge transfer. The probability that recipients of knowledge transfer receive usable technical solutions decreases as research knowledge becomes more complex.
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> **Knowledge asymmetry**
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> Knowledge asymmetry occurs when knowledge "users" know more about the problems that need solving and knowledge "producers" know more about the solutions. There exists a cognitive distance between the sources of a given knowledge transaction and its targets. Knowledge users may be sceptical about the multiple solutions offered, while knowledge producers might feel undervalued. The development of trust between users and producers can go a long way towards facilitating KT; this trust may pass through intermediaries or entrepreneurs who find a timely angle to turn a given asymmetry into a worthy challenge and gradient of opportunity.
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> **Knowledge valuation**
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> This is a central issue in knowledge exchange and technology transfer. People exchange knowledge when the value gained by the parties is greater than the costs involved. In addition to the cases of information encoded in patents or embedded in technologies and devices traded on the private market, it is usually difficult to put an overall value on knowledge because it is often intangible, largely uncodified or spread over groups of people. Importantly, valuation brings up issues of trading intellectual and financial capital or some other utilitarian currency. Often, however, social capital is involved to facilitate knowledge transactions more efficiently.
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> **Knowledge incompatibility**
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> Knowledge incompatibility arises when knowledge producers or intermediaries attempt to transfer to organizations or communities knowledge that is not compatible with their mission, historical context, values, skills, resources and prior investments in technologies. The contributions of languages and dialects to knowledge incompatibility grow as the limits of geographical borders and distances fall in the era of information and communication technology.

monitoring and evaluation activities. Only individuals can create knowledge. Organizations support and amplify the knowledge created by individuals.[13]

We know little about the knowledge-destruction capability, which is the capacity to eliminate pieces of knowledge or disentangle the interconnectedness of pieces of knowledge.[19] Two examples of knowledge that are frequently targeted for destruction include professional behaviour based on experience and organizational routines.[20] Knowledge destruction frequently paves the way for knowledge creation and innovation. However, the adoption of budgets for or spending on restructuring and re-engineering shows how difficult it is to abandon old knowledge. The literature on evidence-based medicine also shows to what extent it is difficult to destroy old knowledge and replace it with the implementation of new knowledge (for example, replacing old clinical guidelines with new).

Knowledge integration and sharing/transfer

Knowledge integration is the capacity to transform a public health organization's knowledge resources (tacit, explicit, individual, organizational, internal, external) into actionable knowledge by taking into account the organization's strengths, weaknesses and opportunities as well as threats to the organization.[13] Over time, public health organizations develop more or less explicit processes to synthesize the internal knowledge accumulated and to integrate it with knowledge acquired from other organizations or other external sources (such as scientific publications or clinical guidelines). Organizations integrate the knowledge accumulated over time, developing and delivering programmes, interventions and services using knowledge from external sources.

Integrating disjointed pieces of raw knowledge into actionable knowledge is necessary but not sufficient to solve public health problems; knowledge must also be shared and transferred. Knowledge sharing refers to the capacity to make available pertinent knowledge to others within an organization, a programme, a project or an intervention.[21] Knowledge sharing is more demanding than knowledge reporting.[22] Reporting involves disseminating information through codified formats (such as an IT system) to target groups within a public

Fig. 1. **The knowledge-value chain**
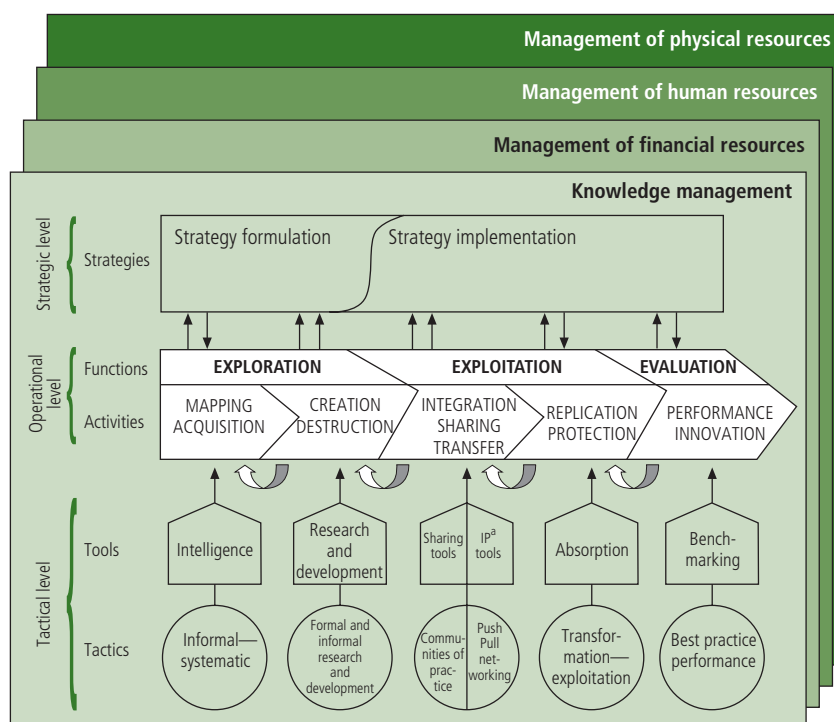
a IP = intellectual property.

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health organization. By contrast, sharing implies person-to-person interactions during which one individual converts his or her (individual and often tacit) knowledge into a form that can be understood by other members in the organization.[23] Knowledge sharing provides the mechanism to transform individual knowledge into organizational knowledge that can be redeployed to create value and solve problems at the organizational level. Knowledge sharing is a social process that may lead to the emergence of communities of practice.[24] In public health, such communities exist at the local, regional, national and international levels.

Knowledge transfer complements knowledge sharing. Like Ipe,[21] we associate sharing with an exchange of knowledge between individuals and we associate transfer with the exchange of knowledge between organizations or departments or divisions within organizations. The literature has identified many factors that contribute to the successful sharing and transfer of knowledge: the type of knowledge, the formal and informal mechanisms linking the sources and recipients of knowledge that provide opportunities to share and exchange, and organizational factors, which include the culture of the work environment.[21,25–27]

Knowledge replication and protection

The knowledge that has been shared or transferred provides a template or a guideline for decisions and actions. Knowledge replication is the capacity to identify the attributes of the knowledge that are replicable, how these attributes can be recreated, and the characteristics of the contexts in which they can be replicated successfully.[28] Replicating templates and guidelines is never easy. There are always significant differences between the attributes of the knowledge and the context of the action and decisions described in the templates and guidelines, and a real public health context. Moreover, the knowledge that is shared and transferred is never provided with "how-to" manuals appropriate to fit all local conditions. The many idiosyncratic features of the local context in which public health organizations operate make the precise replication of templates and guidelines difficult, if not impossible. Knowledge replication must be guided by the attributes of the local context of actions and decisions, especially with respect to public health.

The capacity to replicate knowledge improves the efficacy and efficiency of public health programmes and interventions. However, knowledge replication

is limited by many legal mechanisms of knowledge protection, such as patents, copyrights, trademarks and confidentiality agreements. Public health organizations aim to facilitate knowledge replication in a context in which the biomedical industry frequently places the emphasis on knowledge protection (patent protection).

Knowledge performance and innovation

The assessment of knowledge performance is the capacity to assess to what extent the replication of knowledge delivers the desired outputs and outcomes. Assessments are usually undertaken for one or a combination of perspectives that aim to balance the financial and non-financial outputs and outcomes.[29–31] These perspectives assess:

1. **value for money** — the public health benefits arising from investments in the creation, sharing and application of knowledge;
2. **knowledge users** — the extent to which public health policy decisions, community enterprises and professional practices are based on sound evidence and the extent to which evidence-based policy decisions and evidence-based professional practices contribute to the development of new products and services or improve them;

3. **final beneficiaries of knowledge translation** — the extent to which evidence-based policy decisions and evidence-based professional practices are translated into new or improved products and services and superior public health outcomes;
4. **internal organizational process** — to provide an account of the activities and processes that public health organizations must develop and excel at to achieve a milieu of superior knowledge creation, sharing, transfer and replication for evidence-based policy decisions and evidence-based professional practices and to achieve superior outcomes for the final beneficiaries of knowledge application.

The performance-assessment capability is oriented towards the short term. It should always be complemented by an innovation capability that is more future-oriented. The innovation capability is the capacity to develop a better understanding of the knowledge application process to enhance the future use of research evidence and other sources of knowledge in the development and improvement of products and services and to achieve superior outcomes for the final beneficiaries of knowledge translation.

Conclusions

Any knowledge-management strategy should address these five perspectives and formulate objectives and success factors for each perspective. However, each public health organization or community will arrive at its own particular trade-offs between the five perspectives in order to achieve its strategic knowledge-translation goals.[29] The learning and innovation perspective is likely to be the primary driver in achieving superior outcomes for the final beneficiaries of knowledge application. Such a perspective is supported by improved policy and managerial processes which, in turn, contribute to enhancing evidence-based decision-making and evidence-based professional practice. As a result, the enhanced use of evidence contributes to achieving superior outcomes for the final beneficiaries of knowledge translation, which in return, generate value for money invested in knowledge and, through a feedback process, enhance learning and product and service innovation and development. ■

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Résumé

La chaîne de valeur des connaissances : un cadre conceptuel pour la mise en pratique des connaissances en santé

L'article présente brièvement la mise en pratique des connaissances et recense les difficultés que rencontre cette opération. Il utilise ensuite la littérature disponible sur la gestion des connaissances pour développer et proposer un cadre du type chaîne de valeur, visant à fournir un modèle conceptuel intégré de la gestion et de la mise en pratique des connaissances dans les organismes de santé publique. Ce modèle est non linéaire et repose sur l'organisation de cinq couples d'activités : cartographie et acquisition, création et destruction, intégration et partage/transfert, reproduction et protection, et performances et innovation.

Resumen

La cadena de revalorización de los conocimientos: un marco conceptual para la traslación de conocimientos en materia de salud

En este artículo se analiza brevemente la traslación de conocimientos y se enumeran los problemas asociados. A continuación se hace uso de las publicaciones existentes sobre la gestión de los conocimientos para desarrollar y proponer un sistema de cadena de revalorización de los conocimientos con miras a ofrecer un modelo conceptual integrado de gestión y aplicación de los conocimientos en las organizaciones de salud pública. La cadena de revalorización de los conocimientos es un concepto no lineal, basado en la gestión de cinco capacidades binarias: mapeo y adquisición, creación y destrucción, integración e intercambio/transferencia, replicación y protección, y desempeño e innovación.

ملخص

سلسلة المعارف والقِيَم: إطار عمل مفاهيمي
لترجمة المعارف الصحية إلى عمل

المعارف والقِيَم مفهوم غير خطِّي يستند على إدارة خمسة من القدرات الديناميكية، وهي رسم الخرائط واكتسابها والخلق والإتلاف، والتكامل والتقاسم والنقل، والنسخ والحماية والأداء والابتكار.

يلخص هذا المقال ترجمة المعارف إلى عمل ويعرض قائمة بالمشكلات التي تصاحبها، ثم يستفيد من النشريات حول إدارة المعارف لإعداد واقتراح إطار عمل سلسلة المعارف والقِيَم وتطبيقها في تنظيم الصحة العمومية. إن سلسلة

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