Knowledge Management:
Background Paper for the Development of a Knowledge Management Strategy for Public Health in Canada

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About This Paper

WebExtras:

Additional information is available for many of the concepts explored in the paper. Each “extra” is a stand-alone feature to provide readers with more details, examples, and/or alternative perspectives. In the electronic format, this information takes the form of a “WebExtra” and can be accessed by clicking on the ● (the WebExtra will open in a new window). In the hard copy, information and links are listed with the Appendices in an accompanying booklet.

Highlighted text indicates terms that are included in the glossary (Appendix B)

Executive Summary

This background paper on knowledge management (KM) has been prepared for three primary audiences: the six National Collaborating Centres (NCCs) across Canada, the NCC Secretariat at the Public Health Agency of Canada (PHAC), and the NCC Advisory Council. The paper provides an overview of KM and identifies pertinent issues, questions and implications surrounding the potential development of a solid, systemic and strategic approach to KM for public health in Canada. This document is not a systematic review, but rather a summary of the literature that can inform discussions about next steps in knowledge management within the Canadian public health context.

The need for coordinated mechanisms to make use of Canadian population and public health knowledge was identified by Kiefer et al. (2005) in research led by the Canadian Institutes of Health Research, Institute of Population and Public Health. Members of the NCC Advisory Council noted that the issue of KM required attention across the Canadian public health system. On their recommendation, and with the goal of achieving a degree of coordinated opinion and possibly action on this topic, the NCCMT began collecting background information about KM. This paper summarizes the literature searches that generated over 8,700 references, a review of a draft paper by six representatives of the Canadian public health system, six key informant interviews and input from approximately 30 workshop participants.

Managing knowledge is a notion that began as early as Aristotle. Generally, the public sector has been relatively slow to embrace the concept, with the notable exceptions of health care and education. Large corporations have provided significant leadership in this area and offer several “lessons learned” that may be adaptable (with appropriate modifications) to the public sector.

A common language was required as a foundation for discussion. While there is no universally accepted definition of KM, most existing definitions are extremely similar. For this paper, the working definition of knowledge management has been determined to be“... the systematic process by which knowledge needed for an organization to succeed is created, captured, shared and leveraged.” (Clemmons Rumizen, 2002, p.9)

Three labels can be used to describe knowledge: explicit, tact and potential. By far the two most common are explicit and tacit. “Explicit knowledge can be thought of as ‘book knowledge’ – available in a spoken or written form and is the ordering of data and information according to well-defined, formalized procedures or rules. Tacit knowledge resides within the people of the organization and is not formalized into written or documented forms. It can only be made accessible for others’ benefit through conscious efforts, such as interviews and mentoring, to gather insight on how individuals do their jobs” (Association of State and Territorial Health Officials, 2005, p.6). Potential knowledge lies buried in the data that are collected but not yet used. Public health, like many sectors, has typically devoted the majority of effort to gathering data (potential knowledge) and creating explicit knowledge, albeit rarely in an organized or strategic fashion. Much less deliberate work has been related to harvesting and sharing tacit knowledge.

Once understood, the various forms of knowledge need to be managed. The literature con-

sistently reinforces four fundamental components of KM:

1. Culture of the organization that needs to embrace the concept at a corporate level
2. Content that contains both explicit and tacit knowledge
3 Processes that support knowledge sharing
4. Technology that allows for knowledge to be shared electronically.

All four of these components are necessary and inter-dependent. An organizational culture that supports a strategic positioning for KM within the organization and a commensurate investment in a sustainable, rather than project-based, manner forms the foundation. Following the identification of the knowledge to be managed (content) and a strategy for how this will be done (the process), a business plan for the technology necessary to support can be developed. Implicit in the four components of KM is the need for skilled staff attached to each core function. Essentially, within a KM strategy, it is people who shape the culture, manage the content, deliver the process and work with the technology.

KM need not be seen as a new venture; indeed, many concepts and practices related to KM may already exist within an organization, but may be known by a variety of formal or informal terms. Similarly, an organization's KM specialist may be known by any one of a number of titles; ultimately, however, the title is less important than the position within the organization as part of the senior leadership team. The term KM is becoming more common in the public sector, such as with PHAC Regional Staff with portfolios in this area. As well, knowledge brokers, who connect those who need knowledge with the right content in the right way at the right time, already exist within the public health system, without necessarily having this title.

The benefits associated with undertaking KM are relevant to not only individuals, but to organizations and overall systems. Several developments make the consideration of a KM strategy for public health particularly relevant at this time: the release of the Core Competencies (Public Health Agency of Canada, 2008); the establishment of standards and protocols in some provinces; a general demand for accountability in outcomes; and the need to systematically retain knowledge in the face of widespread retirements. Moreover, the increasing mandate to base decisions on evidence intensifies the need for KM, especially when considering practice-based evidence that emphasizes an understanding of and accommodation for context.

Embracing KM also presents some challenges. A successful strategy demands a system-wide understanding the concept of knowledge management; an organizational dedication to KM, including the development of values supportive to KM; and the commitment of necessary time and human resources. Paradoxically, a centralized approach across public health regions, systems and initiatives may offer the economies of scale necessary to address the resource limitations currently facing public health, but introduces new obstacles. Common wisdom suggests that the larger an organization, the more challenging the implementation of KM, particularly for tacit knowledge. As public health organizations expand their coverage areas, the size of their staff increases, creating more tacit knowledge to be managed and rendering technological mechanisms alone less able to meet all the KM challenges. Rather than a comprehensive KM strategy, adopting first a relatively small, practical and relevant

aspect of KM may be more appropriate.

Ultimately, the adoption of a KM strategy for the Canadian public health system may depend on the capacity of the system and a determination of the most appropriate mandates, partnerships and collaborations to address it. This paper offers the Knowledge Management Model developed and in current use by the Alberta Government as an example to consider.

1 Introduction

This background paper on knowledge management (KM) has been prepared for three primary audiences: the six National Collaborating Centres (NCCs) across Canada, NCC Secretariat at the Public Health Agency of Canada (PHAC), and the NCC Advisory Council. The paper provides an overview of KM and identifies pertinent issues, questions and implications to help formulate recommendations regarding the development of a solid, systemic and strategic approach to KM for public health in Canada. The paper is not a systematic review document, but rather a summary of the literature that can inform discussions about next steps in knowledge management within the Canadian public health context.

What are the National Collaborating Centres?

"As a primary goal, the centres will build on existing strengths and create and foster linkages among researchers, the public health community and other stakeholders to ensure the efficiency and effectiveness of Canada's public health system. The National Collaborating Centres will facilitate the sharing of knowledge and help put it into practice at all levels of the public health system across Canada."

(Public Health Agency of Canada, 2004)

What is Knowledge Management?

Knowledge management is understood to be an umbrella term encompassing the many unique but related facets of knowledge – exchange, transfer and uptake among them. While there is no universally accepted definition of KM, most are extremely similar. For this paper, the working definition of knowledge management has been determined to be"... the systematic process by which knowledge needed for an organization to succeed is created, captured, shared and leveraged." (Clemmons Rumizen, 2002, p.9)

Three labels are used to describe knowledge: explicit, tacit and potential. By far, the two most common are explicit and tacit. "Explicit knowledge can be thought of as 'book knowledge' – available in a spoken or written form and is the ordering of data and information according to well-defined, formalized procedures or rules. Tacit knowledge resides within the people of the organization and is not formalized into written or documented forms. It can only be made accessible for others' benefit through conscious efforts, such as interviews and mentoring, to gather insight on how individuals do their jobs" (Association of State and Territorial Health Officials, 2005, p.6). Potential knowledge describes that knowledge buried in the data that are often collected but not yet used.

Knowledge can be thought of as information in action. The hierarchy depicted in Figure 1 identifies the steps taken in transforming data into information, knowledge and finally wisdom. "Knowledge will remain information unless attitudes, systems, and skills exist to retrieve the information and share it in a new context" (Lim, D. & Klobas, J., 2000, p.420).

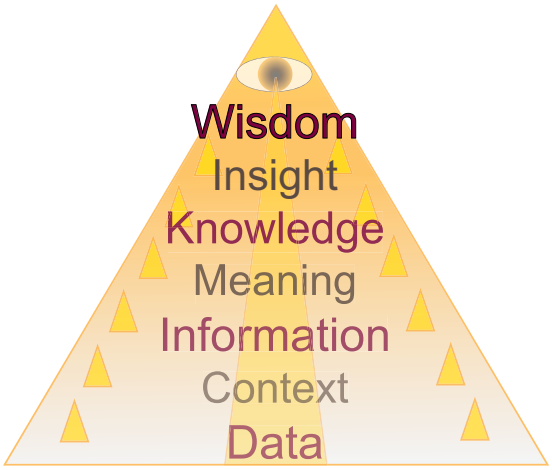


Figure 1 - From Data to Wisdom: a hierarchy of knowledge.

For example:

DATA:	32, 3, 15, 2000
INFORMATION:	32 new cases of tuberculosis have been reported in the last three months which is up from 15 from the same time in 2000.
KNOWLEDGE:	You know this trend is alarming and signals a need to understand it and take corrective action.
WISDOM:	You undertake a literature review, convene an expert panel to generate recommendations for immediate and long-term action.

KM is consistently linked to making good decisions based on available information. “Knowledge is the combination of data and information, to which is added expert opinion, skills and experience, to result in a valuable asset which can be used to aid decision-making. Knowledge may be explicit and/or tacit, individual and/or collective” (CEN: European Committee for Standardization, 2004). The goal of KM is to implement a process to deliver the right content to the person who needs it when they need it (Association of State and Territorial Health Officials, 2005).

Section 5 is a practical discussion of the four critical and inter-dependent components of KM: Culture, Content, Process and Technology. In brief, the culture of the organization needs to be one that holds knowledge in such high regard that there is a strategic and pervasive commitment to managing it effectively. Content is the knowledge, in both tacit and explicit forms that is managed. “[Formalized processes are critical to ensure the effectiveness of the creation, assessment, management, and dissemination of content” (Association of State and Territorial Health Officials, 2005, p.9). Technology is one key means to support knowledge management. Traditionally, applied only to explicit knowledge, technology is now increasingly applied to tacit knowledge through such interactive methods as virtual communities and social networking. Technology plays a relatively small, albeit critically important role in the overall KM process.

According to the UK’s National Health Service, a pioneer in the public health sector’s KM evolution, “an organization’s primary focus should be on developing a knowledge-friendly culture and knowledge-friendly behaviours among its people, which should be supported by the appropriate processes and which may be enabled through technology” (National Health Service, 2005).

Running through the four components of culture, content, process and technology is the vital role that people play within a KM strategy. Section 5.3 explores the human resource trends and implications, including many of the common terms for staff positions dedicated to this work. Of particular interest will be the pervasive links between KM skills and the identified Core Competencies for Public Health Agency in Canada (Public Health Agency of Canada, 2008). We may very well see new positions being created within the public health community. “As knowledge exchange and evidence-based decision-making become a way of doing business, we will witness a growth in ‘knowledge brokerage’. This is the function of linking and exchanging knowledge between those who know and those who need to know.” (Goddard et al., 2004, p.113).

The search that provided a foundation for this paper (described in detail in Appendix A:

Methodology) generated thousands of results. The literature has grown considerably in the past 20 years. “A search for books and articles touching on knowledge management issues returned about 20 responses in 1986, and almost 160 in 1996” (Ruggles, 1998, p.80). KM is certainly not a new concept: Aristotle is credited with exploring the differences between tacit and explicit knowledge – the ‘know how’ and the ‘know what’. Section 2 explores the history of KM. Foundational concepts and models are described in Section 3. These examples come most frequently from such realms as private sector business, health care, education and, increasingly, from public health. Compared to the private sector, there is relatively little history within the field of public health. Certainly, knowledge management in health care is much more common. [1] The National Health Service in the UK, the Centers for Disease Control and Prevention in the US and the Government of Alberta provide particularly informative KM approaches that are potentially applicable to public health in Canada.

There is a sense of urgency to undertaking KM within public health at this time because of the many benefits to be had (further described, along with related challenges, in Section 7). “For front-line public health professionals to work smarter, we need to concentrate specifically on what we are making available and what purpose it is to serve. We tend to focus on data and databases when we think about making material available, but this may be too restrictive. We need to place less emphasis on data, and more on information products that support directly the transfer of useful knowledge to those making decisions” (Goddard et al., 2004, p.112). If public health efforts are to be effective, knowledge about what works and why it works will need to be shared. For this reason, knowledge management is often tied to a discussion regarding best practices. Section 8 focuses on the evaluation of KM which is typically categorized into three main outcomes: retention, enhancing effectiveness and efficiency, and innovation.

2 History of Knowledge Management

"The 'knowledge movement' has now been with us for about two decades, at least if we trace its origins to Ikujiro Nanaka's research on 'organizational information creation' in the 1980's"

(Smoliar, S.W., 2003, p. 337).

Managing knowledge is a notion that began as early as Aristotle. Generally, the public sector has been relatively slow to embrace the concept, with the notable exceptions of health care and education. Large corporations have provided significant leadership in this area and offer several "lessons learned" that may be adaptable (with appropriate modifications) to the public sector.

Charles Savage in Fifth Generation Management writes of the Knowledge Age as the third wave of human socio-economic development (Wikipedia, 2008). "The first wave was the Agricultural Age when wealth was defined as ownership of land. In the second wave, the Industrial Age, wealth was based on ownership of capital (i.e., factories). In the Knowledge Age, wealth is based upon the ownership of knowledge and the ability to use that knowledge to create or improve goods and services. Product improvements include cost, durability, suitability, timeliness of delivery, and security. In the Knowledge Age, 2% of the working population will work on the land, 10% will work in Industry and the rest will be Knowledge Workers [a term coined by Peter Drucker in 1959]" (Wikipedia, 2008) . According to Peter Drucker, "knowledge has become the key economic resource and the dominant – and perhaps even the only – source of comparative advantage" (Drucker, 1995, as cited in Ruggles, 1998, p.80).

Models of KM began to emerge in the literature in the mid- to late-1980's. "KM as a conscious discipline evolved from the thinking of academics and pioneers such as Peter Drucker in the 1970s, Karl-Erik Sveiby in the late 1980s, Nonaka and Takeuchi in the 1990s" (National Health Service, 2006). For many, the modern development of KM began with the dawn of the Internet in 1969. Drucker who coined the term 'knowledge worker' [2] and, in 1966, said "every knowledge worker in [a] modern organization is an 'executive' if, by virtue of his position or knowledge, he is responsible for a contribution that materially affects the capacity of the organization to perform and to obtain results." (Drucker, 1967) Sveiby, whose work is revisited in the Evaluating KM section of this paper, contributed the three elements of the intellectual capital framework (employee competence or human capital; internal structure - structural or organizational capital; and external structure - customer or relationship capital) to early thinking. As early as 1938, H.G. Wells, though never using the actual term knowledge management, described a 'World Brain' which would represent "a universal organization and clarification of knowledge and ideas" (Dalkir et al., 2007, p.12). Of course all of this is pre-dated by "the elder, the traditional healer, and the mid-wife in the village who have been the living repositories of distilled experience in the life of the community for time immemorial" (Dalkir et al., 2007, p.12).

By the early 1990s, the private sector, notably large companies such as IBM, Xerox, Hewlett-Packard, and Chevron, [3] had begun to apply their considerable technological capabilities to managing knowledge. Frequently cited as the beginning of KM, the Association for Information Systems: America's Conference on Information Systems held in Boston in 1993 (http://amcis.aisnet.org/) was specifically devoted to KM. Key themes included attempts, often theoretical, to define KM and differentiate it from data and information. With the exceptions of schools and health care settings, the early adopters of KM beginning in the late

1990's, the public sector has been slower to embrace KM.

Knowledge management is here to stay. "Knowledge and learning have become the new strategic imperative of organizations. At least one half of US companies and up to 72% of overseas firms, have some kind of KM initiative underway… Chief Knowledge Officers and Chief Learning Offices are popping up everywhere" (Bate & Robert, 2002, p.648). While ubiquitous, KM is recognized to be a slow process. In a study undertaken by Szulanski (Jackson Grayson & O'Dell, 1998), even in the best of firms, in-house **best practices** took an average of 27 months to wind their way from one part of the organization to another.

3 Foundational Concepts and Models

> "Organizations must inventory their own structures, processes, and technology with respect to accessing, handling, and utilizing knowledge.
>
> They need to encourage the creation of knowledge, to capture and consolidate knowledge through effective metaphors, analogies and models, to integrate and disseminate knowledge to people throughout the organization, and to present explicit knowledge as experience for vivid learning.
>
> They need to develop and adopt techniques for systematically converting the tacit know-how of individuals into explicit knowledge resources for the organization.
>
> And they need to foster an organizational culture that values knowledge, that values sharing knowledge, and that values innovation and risk-taking in the development of knowledge.
>
> (Carroll et. al., 2003, p. 10)

"Knowledge management is based on the idea that an organization's most valuable resource is the knowledge of its people" (National Electronic Library for Health, 2006).

There are a number of definitions of knowledge management. [4] For the purposes of this paper, a straightforward definition has been selected: "Knowledge management is the systematic process by which knowledge needed for an organization to succeed is created, captured, shared and leveraged" (Clemmons Rumizen, 2002, p.9).

The following two definitions are helpful to increase our understanding of the term:

- "KM promotes an integrated approach to identifying, capturing, retrieving, sharing and evaluating all enterprises information assets. These information assets may include databases, documents, policies, procedures, as well as the uncaptured tacit expertise and experience stored in individual's heads" (Malhotra, Y. & Galletta, D., 2005, p.3).
- "A process used by organizations and communities to improve how business is conducted by leveraging data and information that are gathered, organized, managed, and shared. … By using both explicit and tacit knowledge, knowledge management helps an organization deliver the right information to the right place and the right person at the right time. Organizations can use knowledge management approaches to more fully leverage their information assets. Knowledge management contributes to the integration of systems, tools and processes, fosters the transfer of competence among individuals, and improves individual competence by promoting more efficient use of available information" (Association of State and Territorial Health Officials, 2005, pp. 3,21).

To build on the first preferred definition, a model is useful to illustrate the core components. A number of KM models can be found within the literature. Wong & Aspinwall (2004) suggest KM models fall into three categories:

- Those which describe the knowledge cycle processes of KM
- Those which measure how KM has been performed
- Those with details about implementing KM.

3.1 Knowledge Cycle Processes of Knowledge Management

The most commonly cited model and the one often credited as a foundational model for KM was developed by Nonaka & Takeuchi in 1995 to describe the interaction between tacit

and explicit knowledge. The so-called SECI model focuses on "four different areas of knowledge conversion: socialization, externalization, combination and internalization" (Nonaka & Takeuchi (1995) as cited in Hussi, 2004).

Other knowledge cycle models can be found in a *WebExtra*. [5]

"Individually-held tacit knowledge is a precarious way of storing, maintaining and transferring knowledge as, although individuals can improve their performance as they gain experience with a task, they may not be able to articulate what strategies they used to achieve this improvement (the notion "we know more than we can tell"). Consequently, tacit knowledge is "sticky" and often travels poorly between organizations"

(Bate, S. P. & Robert, G., 2002, p. 649).

3.2 Measurement Models

Models that measure the effectiveness of KM may "provide a reference to facilitate the structuring, analysis and evaluation of the KM initiatives undertaken in various companies" (Wong & Aspinwall, 2004, p.95). Apostolou et al. (1998) and Lai & Chu (2002) (cited by Wong & Aspinwall, 2004) developed models to measure KM performance. [6]

The Balanced Scorecard is one such model to measure KM performance [7] that provides "a performance measurement approach that focuses on linking an organization's mission and strategy to specific measures" (Clemmons Rumizen, 2002, p.228).

3.3 Implementation Models

Implementation models for KM recommend a series of steps an organization can follow during the implementation of KM. These models provide "a structure or set of guiding principles which is depicted in such a way as to provide guidance and direction on how to carry out KM in an organization" (Wong & Aspinwall, 2004, p.95) and can help determine future plans of action.

Based on their research, Wong & Aspinwall (2004) suggest that a KM implementation framework should:

- "Be developed with a clear structure such that it provides directions on how to conduct and implement KM" (Wong & Aspinwall, 2004, p.100). Ideally, these directions are broken into components of planning, executing and evaluating.
- "Clearly delineate the knowledge resources or types of knowledge to be managed because different types of knowledge require different management strategies.
- Highlight the necessary KM processes or activities which are needed to manipulate the knowledge.
- Include the influences or factors that will affect the performance and bearing of KM
- Provide a balanced view between the role of technology and of human beings in KM" (Wong & Aspinwall, 2004, p.100).

Numerous implementation models for KM are presented in the literature (Gillingham & Roberts, 2006; Siemieniuch & Sinclair, 2004; Birkinshaw, 2001; Butler, 2000). [8]

3.4 Recommended Models for Knowledge Management in Canadian Public Health

Two models are recommended for consideration for potential KM action in Canadian public health. The South East Public Health Strategy is an overall framework approach. This knowledge management plan was launched in 2000 by the National Health Service in England and Wales and contains strategic elements that can be adapted for use within the Canadian context. [9]

The Alberta Government Knowledge Management Framework is recommended for adoption/adaptation by the NCCs. This has been selected as a potential implementation model for consideration because it provides a comprehensive picture of the vision, aim and objectives for KM within public health. It is also one of the few implementation models from outside the private sector and one of the only Canadian examples.

The Government of Alberta's KM Framework emphasizes an "all-of-government" approach to addressing public health issues making it relevant to a variety of government departments. [10] The Alberta KM Framework (Figure 2) contains strategies that echo the four key elements found as identified in the literature: Culture, Content, Process and Technology. (see section 5) Moreover, some of the outcomes of the Alberta KM Framework overlap with those required for public health.

Figure 2: Alberta Government Knowledge Management Framework

Knowledge management is a systematic approach to ensuring ready and available access to knowledge and collective expertise in order to carry out the business of the Government of Alberta through capturing sharing, using, and leveraging what people know.				
DESIRED OUTCOME	READY AND AVAILABLE ACCESS TO KNOWLEDGE AND COLLECTIVE EXPERTISE IN ORDER TO CARRY OUT THE BUSINESS OF THE GOVERNMENT OF ALBERTA.			
PRINCIPALS	Integration into Day-to-Day operations	Learning Environment	Intentional Sharing	Access Corporate Memory
	Knowledge management becomes part of the way we do business	Learning and development is supported and encouraged for all roles in the organization.	Knowledge transfer is a priority, occurs openly and becomes part of the expected set of behaviours	Knowledge is documented and shared in order to access corporate memory.
ENABLING FACTORS (What do you need to make this happen?)	• Linked to long-term objectives • Is part of business and operational strategies • Accountability in all roles	• Create a partnership culture encouraging learning and collaboration • Value openness, questioning and exploring • Learning/ teaching organization	• Modeling the way • Integrate into culture • Integrated into business processes • Link knowledge sharing and learning into performance	• Document lessons learned • Benchmark best practices/ processes • Communities of practice • Leverage databases, information and technology
STRATEGIES (Focus Areas)	**PEOPLE**			
	INFORMATION			
	PROCESS			
	TECHNOLOGY			
SUPPORTING LINKAGES	• Ministry and Government business plans • Ministry human resource plans • Succession management initiatives • Ministry business planning processes	• Alberta service learning information • Ministry guidelines and practices • APS Human Resources Plan	• Coaching and mentoring program • Information Management Framework • Performance management process • Leadership development activities	• Corporate and Ministry KM initiatives • Information Management Framework • Information technology
Government of Alberta, April 2004				

4 Knowledge Management in Canadian Public Health Contexts

With an increased emphasis on the use of evidence in decision-making, accountability frameworks, increased use of technology in many program areas, and the significant turnover rates associated with an aging workforce, Canadian public health appears ready for a comprehensive KM strategy.

> "We are seeing a conceptual transition [in Canada] from simply making data available to providing information or knowledge which will serve as effective evidence underpinning program decisions. This affects the information for which access is required and the involvement of knowledge generators, knowledge translators or synthesizers and the end clients" (Carroll et al., 2003, p.118).

Syed-Ikhsan & Rowland (2004) emphasize the importance of partnerships: "the answer to KM in the public sector lies not in a standardized approach to the management of technology, but in a partnership between managers, professionals and service users that is built on a sharing of knowledge and its use and creation" (as cited in Haynes, 2005, p.134). Saussois (2003) suggests that the differences in ideologies between the private and public sectors may favour public sector efforts in KM due to the employee motivation for the public good which can simultaneously support both the organizational objectives and KM efforts. Given the different motivators between the private and public sector for knowledge management, as outlined in Table 1 below, Butler (2000) suggests that different KM models may be required.

Table 1: Drivers for Knowledge Management (Butler, 2000, p.36)

Private sector	Public sector
Competitive	Public service
Leading edge	Controlled innovation and change
Expansion	Staff reductions
Heavy KM investment	Funding constraints
Flexible incentive schemes	Strict reward regimes
Increase profit	Cost reduction
Revenue focused	Productivity focused
Growth focused	Cost focused
Do more with less	Do more with less

There is no one widely accepted method to address KM in the public health sector. (Section 4 explores a variety of models for consideration.) The few documented examples found include a number from the U.S. Association of State and Territorial Health Officials (2005): an e-Health Initiative, Coordinated Information Strategy, Targeted Content, Communities of Practice, Inventorying Knowledge, Cataloging Knowledge, Enterprise Architecture, and the Knowledge Management Dashboard. Work by Health Infoway, the Canadian Partnership Against Cancer and CHAIN Canada are examples from the Canadian public health context.

A pilot project launched by the Centers for Disease Control and Prevention examines myPublicHealth, a decision-support tool that allows agencies to customize the collection, description, management and retrieval of critical public health information. [11] The project,

currently in beta testing for Washington State, provides search mechanisms for people and organizations, articles and journals, laws and regulations, and information from sources such as CDC and WHO. [12] Primarily a source of data and information, rather than knowledge, this is an effort for Canada to watch in the post-pilot phase.

The National Health Service in Great Britain provides a thorough example of a national knowledge management strategy [13] and includes a comprehensive set of supports available to health professionals, largely from health care, as part of the National Knowledge Service. The Knowledge Management Specialist Library provides the best available evidence as well as practical examples of health professionals successfully sharing and applying knowledge and experience to their daily activities.

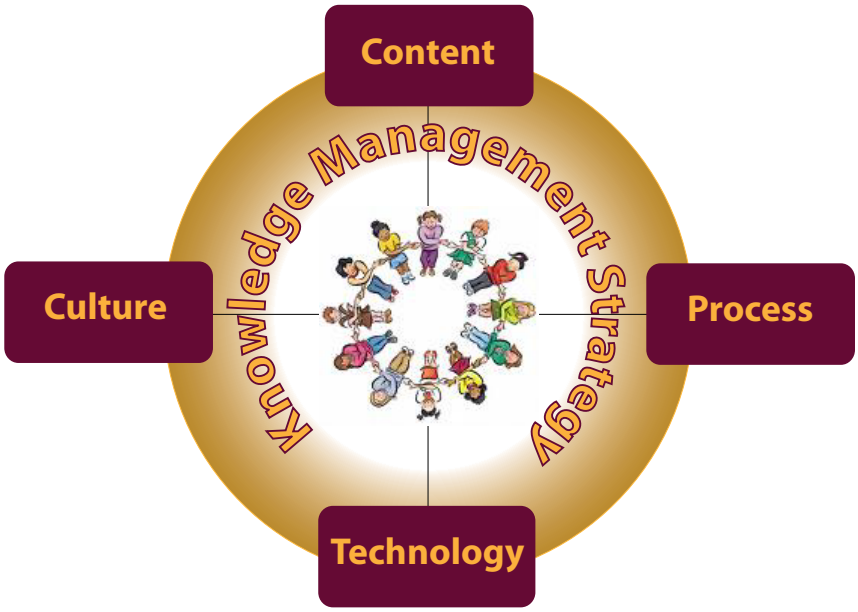
Research in KM in public health is still in the early stages and for that reason much of the current information about KM comes from the business sector. Building on the experience and lessons of the private sector, Canada has the opportunity to provide leadership in the application of KM to public health practice. As highlighted by Dr. Trevor Hancock during a key informant interview, the application of KM to public health in Canada needs to be "practical, relevant and readily acceptable without great expense."

In Canada, an electronic health record (EHR) is widely expected to significantly contribute to public health outcomes. Goddard et al. (2004) predict improvements resulting from an enhanced connection between laboratories, hospitals and physicians. The next 10 years may see better connections, for example between the Canadian Institute for Health Information (CIHI) and provincial data systems. A geographical information system (GIS) infrastructure is evolving in Canada; by 2010 we can expect front-line public health professionals to make routine use of advanced GIS technology (Goddard et al., 2004, p.115).

Canadian public sector work in general could be informed by the pending release of a study centred in Sarajevo, of a full scale national survey of KM adoption in public administration in Bosnia and Herzegovina. [14] Lessons learned from Telemedicine [15] may also provide a source of insight for KM development in Canadian public health contexts.

KM resonates with the growing emphasis on Core Competencies in Canadian public health. Core Competencies [16] are the essential knowledge, skills and attitudes necessary for the practice of public health (focused primarily on individuals, including frontline providers, consultants/specialists and managers/supervisors). They can also serve as a tool to create and assess the best mix of skills needed in an effective public health team or organization. KM is relevant to all 36 identified public health Core Competencies across the seven categories (public health science; assessment and analysis; policy and program planning, implementation and evaluation; partnerships, collaboration and advocacy; diversity and inclusiveness; communication; and leadership) (Public Health Agency of Canada, 2008).

5 The "How Tos" of Knowledge Management: Culture, Content, Process and Technology



Although the terms may differ slightly, there is widespread support throughout the published literature for these four main elements of knowledge management. "There are four core components or characteristics of an organization that must be examined as part of the process of embracing a KM approach. These include the:

1. nature of the organizational culture;
2. processes that are used to collect, manage and disseminate information; and,
3. condition and availability of the content of the organization;
4. technology infrastructure" (Association of State and Territorial Health Officials, 2005, p.8) [17]

Different authors may place varying degrees of emphasis on particular components, but all agree they are inter-dependent. When all four are addressed in a coordinated, strategic manner, the result is often referred to as a Knowledge Management System. Beyond just containing all four components of knowledge management, "an effective KM system is flexible and context oriented, for just as knowledge is 'organic', so too must each KM project be unique" (Wang and Plaskoff, 2002, as cited in DiTienne et al., 2004, p.28).

Of particular importance, and woven throughout the four components, is the role that people play in KM, especially with respect to tacit knowledge.

5.1 Element: Culture of the Organization

"Organizational culture can be defined as the learned way of perceiving, thinking and feeling, shared and transmitted among organizational members." Commonly expressed as 'the way we do things around here,' it is a social / behavioural manifestation comprising such features as:

- The values and beliefs of staff
- How people are and feel rewarded, organized, and controlled
- The work orientation of staff, the way work is organized and experienced

"Organizations must inventory their own structures, processes, and technology with respect to accessing, handling, and utilizing knowledge.

They need to encourage the creation of knowledge, to capture and consolidate knowledge through effective metaphors, analogies and models, to integrate and disseminate knowledge to people throughout the organization, and to present explicit knowledge as experience for vivid learning.

They need to develop and adopt techniques for systematically converting the tacit know-how of individuals into explicit knowledge resources for the organization.

And they need to foster an organizational culture that values knowledge, that values sharing knowledge, and that values innovation and risk-taking in the development of knowledge."

(Carroll et. al., 2003, p.10)

- The degree of formalization, standardization and control through systems
- How authority is exercised and distributed
- The value placed on various functions within the organization
- How much scope for individuality and creative expression, risk-taking and initiative is given
- Notions and concepts on the importance and use of time and space
- The organizational rites, rituals and stories
- Organizational "language" (phrases and words that have a special meaning or significance to that organization). (CEN Part 2: Organizational Culture, 2004, p.9)

For KM to take hold within an organization, it must first be accepted as a core business strategy by the highest levels of governance, which then leads to a commitment for operationalization of this core value. It is important to ground KM in the strategic statements of the organization such as the Vision, Mission and/or Values. Just as importantly, "KM practices must be actively and aggressively endorsed and practiced by the company's leaders" (DeTienne et al, 2004, p.34). KM needs to be pervasive throughout the organization, and not just reside at the upper echelons.

What does an organizational culture that supports KM look like?

According to DeTienne et al. (2004), an effective corporate culture for KM consists of norms and practices that promote the free flow of information among employees and across departmental lines. Cooperative involvement, trust and incentives are three essential components that create cultures conducive to effective KM (DeTienne et al., 2004):

1. One of the most effective ways to increase cooperative involvement and leverage knowledge within particular departments of an organization is to create and participate in communities of practice. For more details, see the Process category of this section of the paper.
2. Knowledge-based trust within a company relies on recurring face-to-face interactions that allow people to get to know one another and to expect how their colleagues will react or behave in various circumstances. Of course, those within the organization must "trust that information about their successes and failures will not be used against them, that administrative decisions will be carefully segregated from instructional ones, and the same level of privacy and protection will be afforded to those engaged in the sharing and self-study activities that are involved" (Carroll et al., 2003, p.13).
3. Incentives can be tangible or intangible, big or small. To benefit from KM programs and initiatives, a company must make the necessary investments by adequately

compensating and rewarding employees for their efforts to share and use knowledge. To do this, the leaders in the organization must not only establish optimal incentives and performance levels, but also set good examples for other employees (DeTienne et al., 2004).

Organizational culture has roots in workplace health where it is a foundational component upon which to build a healthy workplace. [18]

One way to understand what a positive culture looks like is to contrast it with an unsupportive one (shown in Table 2). A tangible manifestation of a supportive KM culture is a senior management position dedicated to this function. This will be explored in more detail in the *People* area of this section.

Table 2: Differences in Cultural Awareness of Knowledge (from CEN Part 2: Organizational Culture, 2004, p.8)

Organizations with low awareness of knowledge	Knowledge-aware Culture
• Limited information distribution	• Wide information distribution
• Many management levels	• Few management levels
• Uneven responsibility	• Shared responsibility
• Rules based	• Principles based
• Formal structure	• Informal structure
• Risk adverse	• Able to take some risks
• Occasional training policy	• Continuous learning policy
• More financial focus	• Multifunctional focus
• Political	• Open
• Knowledge retention	• Knowledge sharing and utilization
• Low emotional intelligence and cultural awareness	• Welcomes influences on organizational culture from the networks in which an organization participates.

How is a supportive KM culture developed?

For a KM intervention to succeed, those involved must feel that participation is important, that mistakes made while learning will be accepted, and that time for change will be allowed. (CEN Part 2: Organizational Culture, 2004, p.19) These features will flow from the leadership of the organization and reinforce the need for trust.

Culture develops at both the individual and the group level. “Organizational culture is created by the cumulative effect of individuals. It is the cumulative effect of contributions and negotiations from those individuals. Their employment puts them in a contractual relationship in which there are expectations and responsibilities. The more supportive the culture, the more productivity, trusting and sharing will be exhibited by individuals” (CEN Part 2: Organizational Culture, p.12).

Strong group beliefs can give rise to restrictive behaviours that impede the changes needed to create a knowledge-aware organization. Working groups can generate the negative

culture of so-called *groupthink*. An organization attempting to create a supportive culture for KM needs to avoid groupthink or transform it into the more positive entity commonly referred to as “community.” This reference to communities will surface repeatedly as a key element of an effective KM system. Connections help foster trust, understanding and collaboration. Beyond building relationships and trust, other factors needed to share knowledge effectively include:

- knowing what the other person knows
- knowing they’ll respond to your request
- knowing they’re good teachers
- knowing we are safe to show weakness. (Cross, Parker, Prusak, & Borgatti, 2001)

What will challenge a positive KM culture?

> “All KM programs involve change and, in order to provoke change, individuals must be motivated sufficiently to be willing to suffer the stress of the change process to find benefit and subsequent commitment”
>
> (CEN Part 2: Organizational Culture, 2004).

Arguably, the biggest barrier to implementing KM practices or procedures is the behavior modification required of employees. Other common barriers to organizational support for KM are:

- time and priority
- differences between management statements and actions
- an enduring notion that knowledge is power
- apathy about sharing knowledge
- “not invented here” syndrome
- reward systems that mitigate against knowledge sharing
- different cultures and subcultures
- knowledge travels via language
- considering the organization to be machine-like
- organizational amnesia
- growth in virtual working (can hinder or help)
- an over-emphasis on technology
- inadequate supporting technology (Nakra, 2000, as cited in CEN Part 2: Organizational Culture, 2004, p.17).

While culture is widely thought to be the most important factor in successful knowledge management, any successful KM strategy will seriously consider content, process and technology.

5.2 Element: Content

This element represents the knowledge to be managed. “Data, information, skills, and expertise can be thought of as the content resources of an organization” (Association of State and Territorial Health Officials, 2005, p.9). Organizations often create content on an ad-hoc basis, without the procedures to make the information accessible beyond those individu-

als who collect and manage it (frequently perceived to be the only users). But, making content electronically available does not necessarily make it useful. Data may need to be reformatted, translated or integrated to optimize use. Organizations may provide their staff and customers with an organizational view of their content (e.g. structured by hierarchy and divisions). While it may add to an understanding of how an organization works, such compartmentalization tends to reinforce information silos and discourage the sharing of information. This structure is also not useful to an outsider who is interested in themes that cross the agency structure. Content should be packaged and presented in targeted ways tailored to the user-specific needs and interests (Association of State and Territorial Health Officials, 2005).

Much of the content or knowledge to be shared is based in "best practice." There is little point in passing on processes or content that either does not work, or that has not been evaluated. Therefore, outcome and process evaluations are key components of a KM strategy. [19]

The knowledge to be identified and shared may include both the explicit knowledge (the things we can write down, share with others and put into a database) and tacit knowledge (know-how, experience, insights and intuition) needed by the organization and the organization's clients. The differences between these two types of knowledge are described in Table 3.

Table 3: Properties of Tacit and Explicit Knowledge

Properties of Tacit Knowledge	Properties of Explicit Knowledge
Ability to adapt, to deal with new and exceptional situations	Expertise, know-how, know-why and care-why
Ability to collaborate, to share a vision, to transmit a culture	Coaching and mentoring to transfer experiential knowledge on a one-to-one, face-to-face basis
Ability to disseminate, to reproduce, to access, and to reapply throughout the organization	Ability to teach, to train
Ability to organize, to systematize; to translate a vision into a mission statement , into operational guidelines	Transfer of knowledge via products, services and documented processes

Most KM systems deal with explicit knowledge (e.g., tangible knowledge that can be categorized and organized). Tacit knowledge tends to be more valuable, but also more challenging to manage, than explicit knowledge. Social networking (described in the "Process" section) attempts to make knowledge more accessible by to cataloguing an organization's human capital. By making that catalogue available to individuals in an organization, tacit knowledge can be captured and transformed into discrete information that can searched and organized. The US Public Health Informatics Institute's "Connections," which helps identify and build "Communities of Practice," is a good example of how tacit knowledge can be organized and accessed (Association of State and Territorial Health Officials, 2005).

When considering how best to share content or knowledge, particularly the tacit variety, selecting the right method(s) for the situation is critical. Ideally, an organization will employ a method that balances the need to connect people to information (usually through technology) with the need to connect people to people in a more interactive, interpersonal process.

Clemmons Rumizen (2002) states that any KM system has three critical activities related to content:

- Collecting the content - should come from both internal and external sources.
- Using the content – including the technology for finding, accessing and delivering the content to users (e.g., search engines).
- Managing the content – organizing it through taxonomies. Key concerns for managing content:
- Collecting the right content
- Finding sources for content
- Selecting the best technology to deliver the content
- Developing ways to organize the content
- Establishing processes to manage the content (Clemmons Rumizen, 2002, p.152).

The Importance of Context

"The salience of context is becoming increasingly apparent to decision makers as they face compressed timeframes for decision-making while at the same time the complexity of problems they face requires bringing together knowledge from experts in many specialized domains. The ability to understand the emergence and transformation of context, and the relationship between context and the sharing of tacit knowledge, is of strategic importance to the success of organizations as they face the pace and the acceleration of operations in the knowledge based economy" (Augier et al., 2001, p.135).

The American Productivity and Quality Center suggests a *Swiss Army Knife* approach whereby those who enable corporate knowledge sharing have a variety of tools at their disposal and then select the right tool for each situation.

5.3 Element: Process

Culture and content are but two of the four components necessary to the success of KM. The processes to support KM are vital to its success. "KM processes are the activities or initiatives you put in place to enable and facilitate the creation, sharing and use of knowledge for the benefit of your organization. Processes also refer to your organization's general infrastructure and ways of doing things and the extent to which these act as enablers of, or barriers to, good KM practice" (National Health Service, 2005, p.57).

The National Health Service in the UK has long been a leader in the KM field as applied to public health. "Organizations often need to make changes to the way their internal processes are structured, and sometimes the organizational structure itself … [and to] look at 'how things are done around here' to identify which processes are barriers or enablers of KM" (National Health Service, 2005, p.58).

Public health professionals identify accessing information as a key process within knowledge management. More specifically, four elements of access are identified: discovery, connectivity, language and permission" (Goddard et al., 2004, p.113).

Public health practitioners contacted by Goddard et al. also note that "alternative methods of connecting will be required to foster cooperation among the 126 or so public health regions in Canada based on shared issues" (Goddard et al., 2004, p.117). This connection is related to the concept of communities of practice.

What are the key roles needed for KM?

The South East Public Health Knowledge Management Strategy (South East Public Health Group, 2005) identifies five processes, that relate to organizational culture, as illustrated in Figure 3. [20]

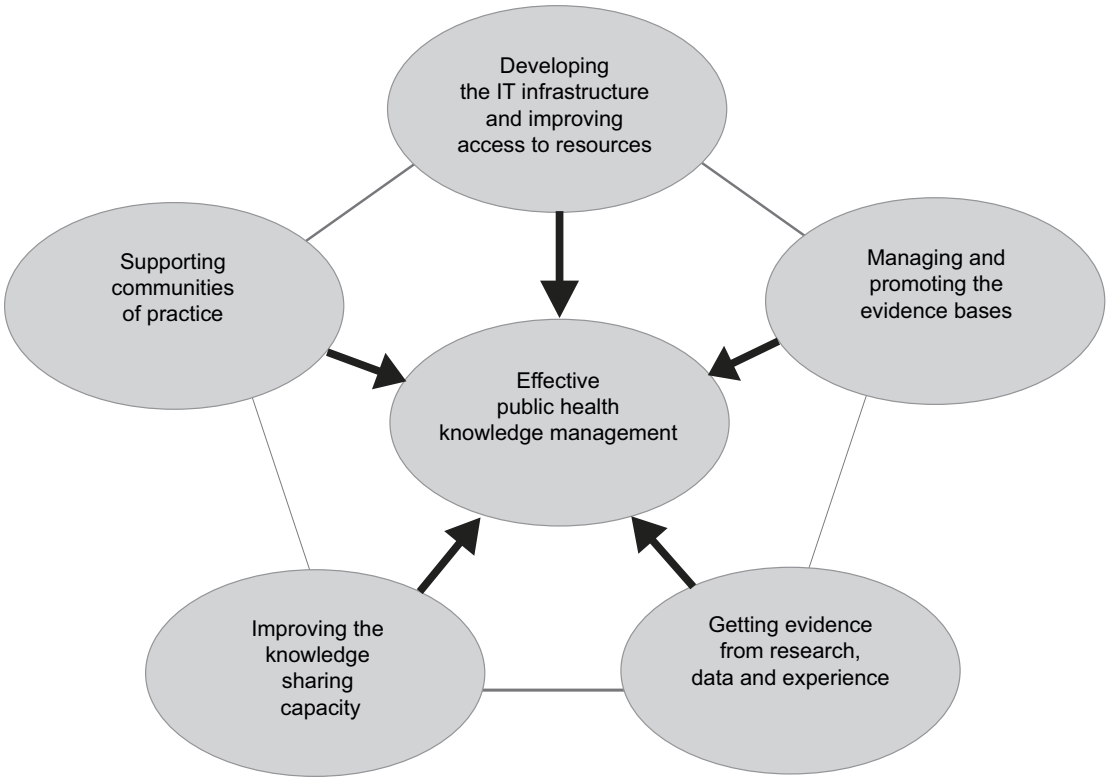
These can be further delineated by the types of employee roles within the KM 'team' that might take on these processes:

- The knowledge engineer or knowledge steward to take the explicit and tacit knowledge and code it into usable and accessible forms.
- The knowledge analyst or knowledge researcher to collect, organize and disseminate the information that has been coded.
- The knowledge manager or knowledge broker to connect people to people and coordinate the various KM activities (The Delphi Group and the IBM Institute for KM, 2002).

"Processes to manage data and information exist in all organizations in a variety of forms ranging from formal to informal. Formalized processes are critical to ensure the effectiveness of the creation, assessment, management, and dissemination of content. Ideally, processes add value that exceeds the burden of implementing the process. The ability to develop and implement processes to support knowledge management is dependent on the organizational culture and business drivers. At the same time, however, changing processes can assist in changing culture to create an environment that better supports knowledge management."

(Association of State and Territorial Health Officials, 2005, p.9)

Figure 3: South East Public Health Knowledge Management Strategy's Core Elements (South East Public Health Group, 2005, p.5)



Deciding where KM belongs in an organization is another key consideration of the process. A common home is the IT department but it could also be found in information management, human resources, research and development, or a separate organization. The bottom line appears to be that KM needs a place in the organization from which it can:

- Decide how to invest for KM
- Get funding
- Gain access to senior leadership
- Ensure that resource allocations are consistent with both the organization's overall strategy and the KM strategy (National Health Services, 2005).

Typically, the process of KM involves the formation of a Steering Committee with representatives from all business units. Individual representatives are those with good reputations, good relationships, and an ability to lead and to generate interest in what is happening.

In what order might an organization address the process of KM?

The key steps in the process of KM most commonly include the following:

1. Establish standards for the KM system
2. Conduct knowledge audits to identify existing knowledge needs, knowledge resources and knowledge flows
3. Create a structure for classifying knowledge
4. Create a KM strategy to guide the overall approach, including specific objectives that contribute to the organization's overall goals and ideally can be measured in the evaluation of the strategy
5. Market the opportunities for knowledge exchange ensuring they are relevant to the needs of the users
6. Connect people with people to share tacit knowledge using approaches such as communities of practice or learning events
7. Connect people with information to share explicit knowledge using approaches such as best practices databases and content management processes to ensure that explicit knowledge is current, relevant and easily accessible
9. Create opportunities for people to generate new knowledge, for example through collaborative working and learning
10. Introduce processes, such as peer assists, to help people seek and use the knowledge of others
11. Teach people to use storytelling techniques as an inspiring way to share knowledge
13. Encourage people to prioritize learning as part of their day-to-day work -- before, during and after the tasks and projects they have performed
14. Continually monitor the fit between the processes used and their usefulness and effectiveness for the user (adapted from National Health Service, 2005, Jackson Grayson & O'Dell, 1998).

The importance of social networks in the process of KM

Social networking analysis seeks to understand and work with the interpersonal connections between members of a network; communities of practice or interest; diffusion of innovations; evidence-informed decision-making; and capacity-building based on Core Competencies. (Prior to any direction-setting for KM, a Knowledge Audit of current status is typically recommended.)

Throughout the literature, the lessons learned and the examples of organizational KM, a common theme persists: interaction between people is vitally important to the transfer of tacit knowledge. "Tacit knowledge can only be 'passed' from one person or place to another if a social network exists. Indeed, the ease of transfer depends entirely on the quality of the source-recipient relationship and the strength and denseness of that relationship. For knowledge exchange of this kind, therefore, there needs to be strong personal connections, a high degree of cognitive interdependence among participants and shared sense of identity and belongingness with one's colleagues and the existence of cooperative relationships" (Bate & Robert, 2002, p.659). This can be as informal and simple as the so-called "Gopher-net" – looking over cubicle walls to see which colleagues are available to discuss an issue (Carroll et al., 2003, p.27).

Much is written about these social networks, most often referred to as Communities of Practice (COP), although the term collaborative also appears. Communities of practice are networks of people who come together on a regular or ad hoc basis to share knowledge. COPs can be made up solely of people internal to the organization or may include members external to the organization. They can be used to collaborate on particular projects, or they can be informal information exchanges focused on sharing and documenting knowledge and looking at practices, policies and decision processes. Communities of practice bring people together without preconceptions about who should talk to whom on a topic of a high learning need (Government of Alberta, 2007).

"Communities of practice are groups of people who share a passion for something that they know how to do, and who interact regularly in order to learn how to do it better."

(Wenger, 2004, p.2)

[21] (*Cultivating Communities of Practice: A Guide to Managing Knowledge - Seven Principles for Cultivating Communities of Practice*)

An example from within the health care sector comes from the Quality Improvement and Innovation Partnership's "Learning Collaboratives." [22] Family Health Teams across Ontario work together to learn with and from one another to improve quality their practices. The groups share a joint virtual office, and participate together in four two-day learning sessions and in monthly collaborative conference calls. The collaborative work takes place over a 12-15 month period.

COPs take many forms, but a defining characteristic is that they cross organizational boundaries. Support for cross-boundary communities is a hallmark of organizations whose success depends on the experience and expertise of their staff. Three common types of communities can be found both within an organization and across organizations:

- Communities of Interest are groups with a mutual interest in a particular topic whose members wish to learn more and develop their interest in the subject.
- Communities of Practice bring together people to share insights, develop expertise

and foster good practice through the exchange and creation of knowledge in a specific area. They are often a focus for building specific capability in their organization and ensuring that this is protected and retained in the organization as people move on.

- Communities of Purpose have a shorter lifespan and are accountable for delivering a specific business goal. These could include project teams, steering groups and task forces (CEN Part 2: Organizational Culture, 2004).

How long does it take to implement a KM strategy?

Predicting a time line for the implementation of a KM strategy is impossible as each situation is unique. However, in examples from the corporate world, KM strategies in two large organizations, HP Consulting and British Petroleum, each took five years to get up and running. According to Clemmons Rumizen, the time line will depend on the

- size, geographic dispersion, uniformity (or the diversity) of the organization
- amount of resources, funds and time available
- complexity of the approaches
- fit of the approaches with the organizational culture (Clemmons Rumizen, 2002, p.264).

The American Productivity & Quality Centre identifies four prerequisites for this process:

1. a compelling need to change
2. a clear-eyed assessment
3. a detailed project design
4. a good implementation plan. (O'Dell, 2008, p.20)

Accessing information is fundamental to the process of KM. "Information is only effective if it can be accessed, and access is a multifaceted issue. Discovery is one consideration: the person making the decision needs to know if the required information is 'out there' and where to find it. Connectivity is a second facet: the user needs to be able to obtain the resource where and when (s)he needs it. The language of the materials is critical: if the provider and the user do not agree on the meaning of other terms then the information is of less value. Lastly, the user will need permission (which may be closely tied to privacy) to use the information. Progress on integrating these facets is slow but essential for moving forward" (Goddard et al., 2004, p.113).

In summary, KM is a complex process and extends well beyond the transfer of computer documents. "Formal processes are essential to the creation and management of knowledge repositories. The processes developed need to be responsive to the organization's business needs as well as implementable within the organizational culture. Individuals within an organization are seldom aware of the complex array of information managed by the agency. Steps to find, understand the quality of, and manage data and information can provide a framework for enhancing agency knowledge" (Association of State and Territorial Health Officials, 2005, p.5).

5.4 Element: Technology

Often assumed to be a major component of KM, the technology used to help manage knowledge, especially explicit knowledge, is typically only about 25% of the equation for a successful KM strategy. However, it is an essential component as it involves responding to the knowledge needs of staff, partners and clients by using appropriate technology to offer easy access at the point of need in a way that is "intuitive and takes into consideration public health workflow" (Revere et al., 2007, p.419).

Technology is key to managing data (content). "The term data refers to a set of facts describing a state or condition. The data refer to the attributes of an object, person or event. If the data identify attributes, they also identify absolutely specific causal relations. Knowledge is precisely this capacity to convert these cold data. The transition from data collection to data interpretation is central to the knowledge management issue. What is important is to give some meaning to these data which, because of their sheer volume, are liable not to be read or simply to expire in the form of statistics that are regularly published but soon become no more than a ritual" (Saussois, 2003, p.115).

No technology product meets every requirement. Before selecting a solution, organizations need to clearly define their KM strategy, scope and requirements, and should evaluate available technology products to identify those that meet their needs. The requirements needed to build a fully functional KM solution include:

- Capture and store
- Search and retrieve
- Send critical information to individuals or groups
- Structure and navigate
- Share and collaborate
- Synthesize
- Profile and personalize
- Solve or recommend
- Integrate with business applications
- Maintenance (The Gartner Group as cited in Bixler, 2002)

"IT systems are "hygiene factors". IT is for KM like a bathroom is for a house buyer – essential because without it, the house is not even considered by buyers. But the bathroom is not generally the vital differentiating factor for the buyer."

(O'Dell, 2008. p.86)

Technology aids in the transition of data from information, to knowledge and ultimately to wisdom. Types of enabling technology tools include (Wenger, 2001, as cited in Guptill, 2005, p.13-14):

- Knowledge bases (content management tools such as Documentum)
- Access to expertise (many incorporated into e-mail tools such as AskMe)
- eLearning spaces (ranging from interactive collaboration tools such as Blackboard to learning management systems such as HealthStream)
- Synchronous interactions (online Web meetings such as WebEx or NetMeeting)
- Discussion groups (ranging from simple listservs to asynchronous discussion boards, products include WebCrossing and Prospero)

- Web site communities (linking people to people as well as to documents, tools like Communispace or, NewSof)
- Project spaces (many of which are linked to Outlook e-mail and incorporate shared folders and project management tools)
- Knowledge workers' desktop tools (customizable Web portals such as Plumtree).

Many of these tools achieve the necessary balance between technological and social approaches, an important consideration as "most technology driven approaches have failed, largely because they ignored the people issues in KM" (Wong & Aspinwall, 2004, p.102).

> "The real challenges lie in the people side of using technology: getting the right end-product for the user, enabling the user to use the opportunities effectively, and changing the way population and public health decisions and actions take place."
>
> (Carroll, et. al., 2003, p. 118)

Information technology (IT) can present the opportunity to store, share, retrieve data and information, but that information only becomes knowledge when there is an opportunity to discuss it. "If technology solves your problem, yours was not a knowledge problem" (Ruggles, 1998, p.88). Customized approaches are necessary (again reinforcing the importance of context in KM) to ensure the right product is used for the right user. Predictably, this area continues to evolve at a rapid pace and additional research is needed to determine the most effective technology for public health professionals (Carroll et al., 2003).

Exciting advances in information technology on the horizon further support KM. "Enterprise 2.0" is a collection of online applications that are used to enable social computing on company intranets and in other business environments. These applications are user-driven, easy to use, inexpensive, open source, spontaneous and self-organizing. [23]

Several forms of social computing, networking and collaborative applications exist, with more being developed almost daily. These include such things as:

- Wikis (e.g. Wikipedia)
- Blogs (e.g. Engadget)
- Social networking (e.g. MySpace, Facebook)
- Peer-to-peer file sharing (e.g. You Tube)
- Social bookmarking and tagging (e.g. del.icio.us)
- Mashups (e.g. Flash Earth)
- Virtual spaces (e.g. Second Life).

A couple of broad rules apply to the use of technology within a KM strategy. In general, technology should represent only about one-third of an organization's total KM budget; explicit knowledge is best shared through technology while tacit knowledge (usually the most valuable) is best shared directly between people; the more valuable the knowledge, the less technology is needed to support it, or "the more tacit the knowledge, the less high-tech the solution" (Jackson Grayson & O'Dell, 1998, p.88). *For "Nine helpful guidelines to ensure your intranet-based KM solution achieves its purpose," see Jackson Grayson & O'Dell (1998), page 90.*

5.5 The Importance of People to KM

An essential thread that runs throughout the four components of KM is the need for skilled staff attached to each core function. Therefore, capacity-building efforts with public health staff through a variety of methods and tools are critical to the success of KM. “Learning and knowledge are not organizational functions. They happen to and through individual people. An organization only ‘learns’ when an individual is able to impart the understanding to or change the behaviour of the organization as a whole” (Thelen, 2004, p.1).

While culture, content, process and technology are important, “they do not do knowledge management. Unless you are able to involve practitioners actively in the process, your ability to truly manage knowledge assets is going to remain seriously limited. It is their knowledge” (Wenger, 2004, p.1).

Ultimately, people are at the core of KM: skilled IT staff are necessary to manage the technology and managing tacit knowledge is all about accessing and managing the knowledge within people. As described by Dalkir, “A KM dream team would collectively possess the skills of communication, leadership, expertise in KM methodology/processes/tools, and negotiation and strategic planning, together with the following attributes: know the organization, remain connected to the top, adapt a systems view and be an intuitive risk taker” (Dalkir, 2005, p.285). Ideally, an organizational culture that supports KM will be personified by an individual at the senior corporate executive level (sometimes called the Chief Knowledge Officer) who has responsibility to lead the KM program. (See also Jackson Grayson & O’Dell, 1998, p.110.)

The skills associated with KM are diverse, complex and will not be found in any one individual within an organization. In 1999, TFPL (a UK-based company that provides KM-related services to both the public and private sectors, including research, recruitment, consultation and training) asked over 500 international organizations involved in implementing KM to identify the roles they had created, the skills needed in those roles and the additional skills required across the organization. The project was jointly funded by TFPL and the UK government’s Library and Information Commission. A knowledge management skills map was one key result of that extensive research project. [24]

Everyone within the organization is part of the KM process in some way or another. Clemmons Rumizen (2002) describes “Personal Capital” as our own knowledge comprising

- stock of knowledge (our store of tacit and explicit knowledge),
- knowledge currency (ways we acquire or share our knowledge)
- knowledge flow (the choices we make about processing knowledge). (Clemmons Rumizen, 2002)

DiTienne refers to the Chief Knowledge Officer (CKO) as an “evangelist” (DiTienne et al., 2004) with several roles: “integrating diverse functions or groups, developing cultures conducive to knowledge sharing and creation, leveraging corporate-wide learning, establishing partnerships with senior managers, and championing all knowledge management issues. The roots of most CKOs are in human resources, organizational development, or sales and marketing” (DiTienne et al., 2004, p.37). Others refer to “Knowledge Managers [who] plan,

organize and coordinate a mix of knowledge, information, and data, and people or knowledge workers who own the expertise" and they can be categorized into two major groups: "explicit knowledge managers" and "tacit knowledge managers" (Asllani & Luthans, 2003, p. 54).

In summary, while the titles for the KM specialist may differ across various organizations, there appears to be widespread agreement on several details of the position: the individual should be a senior manager, be designated to work in KM (i.e., knowledge officer, manager or broker), and have the support of colleagues engaged in the implementation of KM. Essentially, within a KM strategy, it is people who shape the culture, deliver the process, manage the content and work with the technology.

6 Potential Methods and Tools for Knowledge Management

Methods and tools are needed to capture, process and share both explicit and tacit knowledge.[25] A list of potential methods, tools and technologies is shown in Table 4 below (examples are available for some as WebExtra). These offer possibilities for uptake in many contexts.

Table 4: Major KM Techniques, Tools and Technologies (adapted from Dalkir, 2005, p.220; National Electronic Library for Health, 2005)

Knowledge Creation, Capture & Synthesis Phase	Knowledge Sharing & Dissemination Phase	Knowledge Acquisition & Application Phase
Content Creation	***Communication and Collaboration Technologies***	***E-learning Technologies***[37]
• authoring tools[26] • templates[27] • annotations[28] • blogs[29] • after-action reviews[30] • white pages[31] • best practice systems[32]	• telephone • chat rooms • instant messaging[33] • wikis[34] • workflow management • corporate yellow pages[35] • knowledge café[36]	
Content Management	***Networking Technologies***	***Artificial Intelligence***
• personal knowledge management plan[38] • metadata tagging • archiving	• intranets • web browsers • knowledge repository[39] • portal[40] • knowledge centres[41] • storytelling[42]	• push/pull technologies[43] • knowledge maps[44] • visualization • text analysis – summarization
Other possibilities		
	• developing a KM strategy[45] • communities of practice[46] • knowledge audit tools[47] • social network analysis[48] • peer assists / mentoring and coaching[49] • exit interviews[50]	

As mechanisms for linking people together to share knowledge about a defined theme, Communities of Practice are repeatedly emphasized as a key tool for knowledge management. The National Health Service (2005) describes communities of practice as “the killer application” (Clemmons Rumizen, 2002. p.85). Clemmons Rumizen devotes a full chapter to them and Goddard et al. (2004) suggests that “KM has some important lessons for the public health community … Given our understanding of KM is still rudimentary and given that the resources of public health are relatively sparse, KM will probably take place primarily through socialization in communities of practice” (Goddard et al., 2004, p.113).

7 Benefits and Challenges of Knowledge Management

"If knowledge is a strategic asset, then it has to be managed like any critical organizational asset. It is too important to be left to chance."

(Wenger, 2004, p.1)

The benefits of developing, implementing and evaluating a knowledge management strategy within an organization or system are significant; nevertheless, the associated challenges are real and need to be acknowledged and addressed.

This section presents some of benefits identified across the spectrum of sectors that have been involved in the KM field with a particular emphasis on those most relevant to public health and other public sectors. Additionally, some common challenges to the implementation of KM are identified and discussed.

7.1 Why KM is Critically Important? What are the benefits?

The US Association of State and Territorial Health Officials identify "three critical reasons for public health agencies to adopt a KM approach:

1. Capture and respond to more of the critical knowledge needed to ensure public health preparedness.
2. Manage and integrate the information that already exists through indexing, cross-referencing and sharing.
3. Enable virtual teams to work collaboratively with access to shared knowledge" (Association of State and Territorial Health Officials, 2005, p.12).

"The problem is the same for all organizations affected: how to identify, capture, and transfer important knowledge before all those folks box up their pictures and coffee mugs, have their farewell lunch, and boogie out of the parking lot for the last time."

(Clemmons Rumizen, 2002, p.108)

This sentiment is echoed by the Institute of Medicine's The Future of the Public's Health in the 21st Century report, whose "recommendations spanned multiple aspects of public health (e.g., surveillance, client health services, water inspection, disease investigation, public health policies) and concluded that public health officials must have the most up-to-date information to conduct analyses, to report and disseminate pertinent information, and to collaborate with other agencies" (Association of State and Territorial Health Officials, 2005, p.12).

Presupposing that KM is a critical strategy in our information age, the following additional reasons to embrace the concept, while possibly originating in other sectors or organizations, are applicable or adaptable to public health:

- Supporting Public Health Core Competencies: Public Health Core Competencies are the essential knowledge, skills and attitudes necessary for the practice of public health in Canada. These skills are common to public health professionals at all levels across the country and transcend the boundaries of individual disciplines (Moloughney, 2004, as cited in Public Health Agency of Canada, 2008-2). These Core Competencies represent the content that public health agencies need to manage. KM is required to operationalize these competencies in practice through effec-

tive processes and appropriate technologies.

- Succession Planning: The Government of Alberta (2007) emphasizes the importance of "harnessing the knowledge … gained through experience as a critical component to succession management". Using knowledge management to help with succession planning "ensures that the business of providing services …continues in an efficient, effective and uninterrupted way. It leverages what we know and impacts our capacity to continue to shape the future in an environment of rapid and continuous change" (Government of Alberta, 2007).
- Escalating Time Pressures: Increasingly complex work environments and escalating time pressures demand that organizations capitalize on lessons learned. KM can alleviate these pressures by organizing information and transforming it into knowledge that fosters understanding, establishes linkages and establishes context (Duffy, 2000). "Effective public health is information intensive and the impact of emerging knowledge management and ICT [information and communication technologies] solutions will be significant" (Goddard et al., 2004, p.111).
- Addressing Changing Business Drivers: KM can affect the four business drivers identified by Dalkir (Dalkir, 2005) – globalization, leaner organizations, corporate amnesia (a mobile workforce creates problems of knowledge continuity), and technological advances (which have radically changed expectations). In fact, KM can be a business driver based on a Value Proposition that articulates the fundamental business reasons and expected benefits that drive the organization to pursue KM (Dalkir, 2005).
- Reaching More: In schools, the libraries of classroom resources created by teachers in one Community of Practice (COP) can be disseminated to become part of the discourse of best practices for other teacher communities, and can serve as models for pre-service teachers. Codifying and sharing more peer-based resources and lessons learned can also help teachers to coordinate with other stakeholders in public education (Carroll et al., 2003).
- Enhancing the Use of Evidence: KM enables organizations to respond systematically to the increased emphasis placed on using evidence, and sharing expertise, experience, tools and practices with colleagues within organizations, across agencies and across communities.

Within organizations, KM typically occurs at and influences three levels: the individual, the community of practice and the organization (Dalkir, 2005). The benefits associated with KM at each level are illustrated in Table 5, adapted from Dalkir's work.

Table 5: Benefits of KM for the individual, the community of practice and the organization (created from Dalkir, 2005, p.20)

For the Individual	For the Community of Practice	For the Organization
• helps people do their jobs and save time through better decision-making and problem solving • builds a sense of community bonds within the organization as workers feel valued for their contribution • increases employee satisfaction • helps people to keep up to date • provides challenges and opportunities to contribute.	• develops professional skills • promotes peer-to-peer mentoring • facilitates more effective networking and collaboration • develops a professional code of ethics that members can follow • develops a common language	• helps drive strategy • solves problems quickly • diffuses best practices • improves knowledge embedded in products and services • cross-fertilizes ideas and increases opportunities for innovation • enables organization to stay ahead of the competition better • reduces redundancy • reduces research and development costs • improves the internal processes of work • reduces mistakes • enhances the diversity of views in business decisions by engaging workers • builds organizational memory by retaining intellectual capital

Specific to the public health sector, these benefits can define success. A panel of public health professionals, convened to discuss advances in the areas of KM and information technology achievable by 2010, determined that “[e]ffective public health is information intensive and the impact of emerging knowledge management and Information and Communication Technologies solutions will be significant to public health” (Goddard et al., 2004).

7.2 Challenges that Simply Must Be Addressed

The challenges identified in the literature to the implementation of a KM strategy fall into two categories: those encountered at the macro or strategic level within an organization, and those at the micro or operational level. Both represent equally important areas of consideration and are presented in Table 6 below.

Table 6: Strategic and Operational Barriers (Ernst & Young, 2006; Association of State and Territorial Health Officials, 2005; Clemmons Rumizen, 2002; Gillingham, 2006; Carroll et al., 2003; Gladstone, 2000 as cited in Haynes, 2005)

Strategic Barriers	Operational Barriers
• **organizational culture** • lack of leadership commitment • lack of middle management engagement • lack of ownership • lack of equitable resourcing for people, process and technology	• poor KM processes • lack of appropriate technology and skills • issues with the scope of the KM content (too large, inadequately representative) • continually learning and incorporating the needed and accessible knowledge into practice • the physical layout of the work environment does not match the **collaborative** intent of the KM strategy. (Are there more cubicles than communal space? Are office doors closed more often than open?)

Challenges specific to public health "include the need to identify emerging issues more quickly and clearly (i.e., to make health surveillance rapid and effective). Once an issue is clarified (and often the front-line public health professional faces many at the same time), evidence is required to develop options for intervention in a particular content. Another key challenge is the need to clarify and then address other factors that can influence the decision (for example, capacity, ethics, values, and priorities) before a decision can be made" (Goddard et al., 2004, p.112).

In addition to the organizational perspective, barriers to KM implementation include a resistance to the sharing of knowledge at the individual level:

- It's not convenient.
- They don't know what they know.
- They don't know the value of what they know.
- They believe knowledge hoarding is job security.
- They don't get credit for it.
- They don't have the time. (Taylor Gates, 2006)

Accordingly, workers become more likely to share, when:

- They take pride in their expertise.
- They enjoy interacting with peers.
- They wish to learn.
- They expect others to reciprocate.

- They want to contribute to the common good.
- Their culture encourages sharing.
- They are loyal to the organization.

Although there are challenges associated with undertaking a KM strategy for public health in Canada, the available information suggests that those challenges are outweighed by the benefits. To summarize, while the potential gains to public health are significant, the challenges are surmountable.

8 Evaluating Knowledge Management

The European Committee for Standardization notes that “measuring knowledge (management) is not a science as ‘exact’ as accountancy” and recommends that efforts “to evaluate the impact of KM should produce insights into how the organization is managing to develop and use its knowledge assets” (CEN Part 4: Guidelines for Measuring KM, 2004, p.7). As with the evaluation of any program, evaluation of KM should be considered and a plan developed early in the planning process. Clemmons Rumizen (2002) provides the following tips for evaluating KM efforts:

- Revisit the goals
- Know the audience for the measures
- Define the measures
- Decide what data will be collected and how it will be collected
- Analyze and communicate the results
- Review the measures to see how they are working. (Clemmons Rumizen, 2002, as summarized in National Health Service, 2005).

Additional advice from the European Committee for Standardization includes:

- “Measuring for the sake of measuring is a waste of time – be sure that you are measuring for a specific purpose.
- Be sure that some kind of action or decision will be taken as a result of your measures.
- Don’t try to measure everything; instead, focus on what is important” (CEN Part 4: Guidelines for Measuring KM, 2004, p.11).
- Use existing organizational measurement systems to measure KM (CEN Part 4: Guidelines for Measuring KM, 2004).

Since KM efforts, especially within the Process component, should consist of collecting (efforts to link people with explicit information) and connecting (efforts to link people who need to know with those who do know, related to tacit information), measures should gather information about efforts in both areas (National Health Service, 2005).

There are three types of measures typically tracked to evaluate KM:

1. “outcomes measures that reflect attainment of financial, clinical or operational performance targets;
2. process measures that track activity that is expected to yield results (e.g., number of participants in COP, quantity and quality of knowledge sharing activities and depth of organizational involvement in knowledge sharing processes;
3. satisfaction measures that track improvements in employee attitude, physician engagement, and consumer satisfaction with the care process” (Guptill, 2005, p.13).

Karl-Erik Sveiby is credited with identifying a classification of four types of methods for measuring intellectual capital (or the tacit knowledge) of an organization:

- “Direct intellectual capital method (DIC) – estimate the value of intangible assets

by first identifying their various components. Then the components are evaluated, either singly or together.

- Market capitalization method (MCM) – calculated by estimating the difference between a company's market capitalization and its stockholder's equity (e.g., market-to-book value).
- Return on assets method (ROA) – average earning from intangible assets calculated by dividing the pretax earnings of a company by the average tangible assets. The result is compared to the industry average, and the difference is multiplied by the company's average tangible assets to get the average annual earning of intangibles.
- Scorecard Method (SC) – identify various components of intangible assets. You then generate indicators or indexes and report these on scorecards as graphics" (Clemmons Rumizen, 2002, p.240).

The ROA and MCM methods are focused primarily on financial aspects of an organization and are least relevant to the public sector. The Balanced Scorecard is highlighted with further detail by the National Health Service and may have more promise for measuring KM within public health. The Canadian Institute for Clinical Evaluative Sciences has adapted the industry-oriented Scorecard to produce a performance measure that could form the basis of a public health KM model for Canada. [51]

The Intangible Assets Monitor (Clemmons Rumizen, 2002; CEN Part 4: Guidelines for Measuring KM, 2004) is a DIC method to measure intellectual assets and consists of three categories:

1. Human competence – asserts that people are the profit generators for any organization; looks at people's capacity for action to generate value in various situations; includes values, experience, social skills and educational background.
2. External structure – describes how the organization is regarded externally, including brand names, and image; encompasses relationships with customers, suppliers and partners.
3. Internal structure – is the structural capital -- what's left at work when the people go home; belongs to the organization, including databases, processes, models and documentation as well as intellectual property such as patents and trade secrets.

Recognizing the challenges associated with directly measuring the impact of KM activities, the European Committee for Standardization (2004) indicates it is "useful to make the organization's efforts (instead of just its results) in the area of KM more transparent (e.g., when reporting, the management of an organization could indicate the effort that has been undertaken to support KM processes)" (CEN Part 4: Guidelines for Measuring KM, 2004, p.19). Evaluation efforts should collect and report on what has been "done to stimulate the right processes and organization, to build a supporting (technical) infrastructure and, most importantly, to instill the right culture and the right set of behaviours within the organization" (CEN Part 4: Guidelines for Measuring KM, 2004, p.19). The European Committee for Standardization suggests using a tool related to the McKinsey 7s Model (Waterman, Peters & Philips, 1980) comprised of seven diagnostic questions which focus on Strategy, Shared

Vision, Style, Staff, Skills, Structure and Systems and relate to the organization as a whole. The tool does not focus on the knowledge aspects in isolation thereby allowing the organization to assess the relative strength of its collective knowledge management activities (European Committee for Standardization, 2004). (See Jackson Grayson & O'Dell, 1988, p. 227, for a Knowledge Management Assessment Tool.)

In summary, while evaluation of KM strategies needs to be customized to the specific approach adopted within a given organization, there are several useful models and approaches developed from which to choose.

9 Implications for Consideration

This section seeks to process the information gathered and discuss the effect of developing and implementing a strategy for KM, specifically within public health in Canada.

First and foremost, organizations in Canada, including public health at all levels, are already in the KM business, albeit often with no identified focus or strategy. Although they may not use the term, many organizations regularly and creatively engage in knowledge management: Every meeting that brings staff together to share and learn from each other; every database created to organize data; every orientation session held for new or re-positioned staff reinforces a KM approach. While these discreet efforts yield tangible benefits, a more deliberate, managed KM strategy may offer significant and measurably greater results. Prior to the implementation of a KM strategy for public health in Canada, the following points should be considered:

- There is a need to identify, recruit and equip KM champions, especially among the Medical Officers of Health and within academic circles.
- Consider the terminology – keep language as simple as possible, using terms currently in use rather than inventing a whole new taxonomy.
- When it comes to sharing knowledge, size in important: small organizations (with fewer than 150 employees) are more successful than large ones. In small organizations, people tend to know one another. When they need to know something they know who in their organization to go to. In this environment, workers typically share a strong sense of connection and trust, which facilitates knowledge sharing (Taylor Gates, 2006).

  As organizations grow larger, people tend to form isolated groups (silos), which can impede knowledge sharing. The anonymity of a large organization hinders personal relationships and stifles trust, both essential elements to knowledge sharing. As public health services are increasingly organized into larger, rather than smaller, units such as regional health authorities and amalgamated health units, the need for effective KM grows, but so do the challenges.
- Currently, public health standards, technology and practices vary greatly across Canada, within a province, and sometimes even within a region. Disparities are understandable in a sector that encompasses a variety of subjects and individuals, and recognizes valid regional and discipline-specific differences. However, standards and common solutions are necessary to exchange data and to share programs and technologies across these various jurisdictions. Adopting a unique solution or universal standard abruptly is not realistic. A more pragmatic approach will rely on collaborations where appropriate and an incremental path toward uniform standards and solutions (Carroll et al., 2003, p.117). A determined KM strategy will advance this process through the sharing of content, as exemplified by “best practices” on public health protocols and programs, and the linked technology and initiatives planned by Canada Health Infoway.
- Consider implementing one aspect of KM result in “quick wins” – easily identifiable positive outcomes for multiple practices or problems in public health -- rather than tackling the entire scope of KM.

- Significant economies of scale are achievable when the developmental costs of a KM system are shared among many. Reducing duplication should be a key goal.
- Delaying a national KM strategy increases the likelihood that individual public health agencies will have pursued KM independently.
- There is an opportunity to identify emerging nodes (related or comparable public health organizations that could profitably work together) and support them with the infrastructure needed to collaborate efficiently. These nodes may transcend geographical and political boundaries, being founded instead on common goals and challenges (i.e., public health regions in northern Alberta and Saskatchewan may have more in common than do those within northern and southern Manitoba) (Carroll et al., 2003).
- There is an opportunity, if not a responsibility, to manage the knowledge that exists within public health to reflect the identified Core Competencies in Public Health.
- Existing jurisdictional barriers and structural issues within the public health system in Canada inhibit the implementation of a comprehensive KM strategy.
- The roles of the public health-NGO associations need to be identified if this strategy moves forward.
- As outlined in section 4, different drivers motivate KM in the private versus the public sectors. As an initial step in the development of a KM strategy for public health in Canada, the key motivations should be established.
- Central and sustained leadership is key so that KM is seen as a long-term commitment and not as a short-term project.

The following are presented for consideration and discussion as possible roles for leaders, including the NCC infrastructure, in Canada in the area of knowledge management. The most appropriate level at which these initiatives could be implemented (i.e., local, regional, provincial/territorial and/or federal) should be decided early in the KM planning process.

- Provide an Audit Tool to assess organizational culture in order to evaluate readiness for knowledge management (knowledge audits).
- Identify potential champions at the individual and/or organizational level to act as mentors.
- Create a Business Case for KM in Public Health that would outline the risks/barriers and benefits/enablers of KM systems; this could include a prediction of resistance to change (attitudes and change management).
- Identify and provide tools to build a culture within public health that cultivates intentional information sharing, addresses KM myths and realities, and reinforces the value of incentive strategies.
- Provide checklists or criteria to identify essential and relevant tacit and explicit knowledge.
- Provide learning links to the Core Competencies for public health practice as a key component of tacit knowledge.
- Identify necessary privacy protections as information is shared; develop methods to

ensure security of data and information.

- Decide what content can/should be standardized and establish minimum requirements to ensure consistency.
- Create a template and provide examples of a KM Strategy.
- Provide a method by which a KM Strategy could be created in a public health organization and create a guide, manual, toolkit for such.
- Provide tools to create a knowledge inventory.
- Provide tools to add, update, archive and save knowledge (Content).
- Provide access to IT support to assist in using or adapting current technological mechanisms for KM.
- Provide prototypes for portals and other similar access points for information.
- Facilitate purchase of and training for KM software.

In our Information Age, knowledge is arguably our most valuable resource. Managing that resource is a corporate and a social necessity. This requires a recognition that, while people are the core of the entire knowledge management endeavour, the four fundamental components of KM must be addressed:

1. Is there a strategic commitment to managing the knowledge as a core business driver? (Culture)
2. What knowledge needs to be managed? (Content)
3. How will it be managed? (Process)
4. What technology is required to support access to the knowledge? (Technology)

Although public health, generally lags behind the corporate sector in addressing KM, there are examples – several from health care, some from education, and even a few directly from public health -- that can serve as sound starting points.

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Wong, K.Y., & Aspinwall, E. (2004). Characterizing knowledge management in the small business environment. *Journal of Knowledge Management*, 8(3), 44-61.

Wikipedia (2008). *Knowledge worker.* Wikimedia Foundation, Inc. [On-line]. Retrieved February, 2008, from http://en.wikipedia.org/wiki/Knowledge_worker

Appendix A: Methodology

This paper provides an overview of knowledge management, identifying the pertinent issues, questions and implications to help formulate recommendations for the potential development of a solid, systemic and strategic approach to KM for public health in Canada. The paper is not a systematic review document, but rather a summary of the literature.

The following is a description of the process undertaken to develop this Background Paper:

(i) Search Strategy

A broad range of information related to knowledge management was sought in order to develop a solid understanding of the topic from the perspective of a variety of sectors (e.g., private and public). A wide net was cast during the search with text word searches for 'knowledge management'.

The original search was conducted in September 2007 and was limited to English documents published since 2000. This resulted in:

- 632 references from CINAHL
- 346 references from MEDLINE
- 243 references from EMBASE
- 3,084 references from the business database, Business Source Complete.

The search results from the business database were further refined by specifying 'not communities of practice' and 'not networks' in the text word search and by retrieving only journal article references.

An additional search of the social science literature was conducted in February 2008 using the text word search 'knowledge management.' This resulted in:

- 1,128 references from PsycINFO and ERIC using Scholar's Portal
- 2,385 references from the Social Science Citation Index using the Web of Knowledge.

To ensure the most up to date information was captured through the search, the search above was repeated in early July 2008. An additional 1251 references were found.

A few additional references were suggested by reviewers of the draft paper and subsequently accessed.

(ii) Reviews of Drafts

Between October 2007 and August 2008, various iterations of the paper were reviewed by:

- NCCMT staff
- Six specifically selected public health representatives
- Six key informants who were interviewed.
- Speakers involved in the NCCMT Knowledge Management Conference (November 3 and 4, 2008)

- Other invited peer reviewers

(iii) Key Informant Interviews

The literature search identified a shortage of information available on the application of KM in a public health context. To supplement the published information, a total of six key informant interviews were conducted during the summer of 2008. The key informant interviews lasted an average of 30 minutes and were structured around the following questions:

1. In your opinion, is there a need for KM in public health? Why or why not?
2. What specific examples of KM within a public health context are you aware of? Any examples from other contexts that you feel could be readily transferred to public health in Canada?
   PROBE: If yes, tell me more about these please, including any contact names.
3. What practical "lessons learned" would be important to consider when developing or implementing a KM system or strategy for public health in Canada?
4. Anything else you would like to add that would help us apply the KM literature to the public health context in Canada?

(iv) NCC Summer Institute Participants

In August 2008, the NCC Summer Institute program included a session during which Nancy Dubois (on behalf of the NCCMT) presented an overview of KM, based on the Background Paper. At the conclusion of the session, participants completed a written questionnaire that asked the same four questions as the Key Informant interviews. Ten of the 30 workshop participants completed the forms. Their responses are incorporated in the final version of the paper

Appendix B: Glossary

Wherever possible, the definitions below have been taken from the Glossary of Health Knowledge Management Terms provided through the UK's National Health Service Knowledge Management Specialist Library.

Balanced scorecard

A management tool, developed by Kaplan and Norton, to measure organizational performance against both short and long-term goals. The balanced scorecard is designed to focus managers' attention on those factors that most help health care organizations reach the targets set by internal and/or national strategies. Some organizations have used the balanced scorecard model in setting and measuring knowledge management strategies.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Best Practices

There is no single "best practice" because what works best in one context may not be the best for everyone. Best practices are those that have been shown to produce superior results; selected by a systematic process; and judged as exemplary, good or successfully demonstrated. Best practices are then adapted to fit a particular organization or context.

Source: American Productivity and Quality Centre (1999)

Collaborative

A group of people who work jointly in an intellectual endeavor. In scientific studies, it usually refers to several teams working together to do a study.

Source: New York City Health and Hospitals Corporation, Glossary of Terms

Communities of interest

Networks of people who share a common interest in a particular topic, either work-related or peripheral to work, and who come together informally to share knowledge on that topic. Related term: Communities of practice.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Communities of practice

Networks of people who work on similar processes or in similar disciplines, and who come together to develop and share their knowledge in that field for the benefit of both themselves and their organization(s). They may be created formally or informally, and they can interact online or in person.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Community of Purpose

A group of people who are going through the same process or are trying to achieve a similar objective. Such communities serve a functional purpose, smoothing the path of the member for a limited period surrounding a given activity. For example, researching a topic on Wikipedia.org, buying a car on autobytel.com, antique collectors on icollector.com or individual investors on fool.com. Members of the community assist each other by sharing experiences, suggesting strategies and exchanging information on the process in hand.

Source: Wikipedia <http://en.wikipedia.org/wiki/Community_of_purpose>

Explicit knowledge

Information that is formally recorded and stored where people can access it.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Human capital

The value to the organization of the employees and their abilities and expertise.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Implicit Knowledge

Knowledge that is not documented, but is in an individual's mind, for example, understanding, intuition, wisdom, expertise, ideas, competence.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Information

Data that has been organized within a context and translated into a form that has structure and meaning.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Information audit

A method of reviewing and mapping information in an organization. An information audit looks at things like what information is needed, what information there currently is, where it is, in what forms, how it flows around the organization, where there are gaps and where there is duplication, how much is it costing, what its value is, how it is used etc.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Information literacy

A term which encompasses the identification of information need and the ability to find, evaluate and use information to meet that need.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Information management

The management of an organization's information resources in order to improve the performance of the organization. Information management underpins knowledge management, as people derive knowledge from information.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Intellectual capital

The value, or potential value, of an organization's intellectual assets (or knowledge assets). An attempt by organizations to place a financial value on their knowledge. Intellectual capital is often defined as the combination of three sub-categories: human capital, structural capital and customer capital.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge

There are many definitions of knowledge. A dictionary definition is "the facts, feelings or experiences known by a person or group of people" (Collins English Dictionary). Knowledge is derived from information but it is richer and more meaningful than information. It includes familiarity, awareness and understanding gained through experience or study, and results from making comparisons, identifying consequences, and making connections. Some experts include wisdom and insight in their definitions of knowledge. In organizational terms, knowledge is generally thought of as being 'know how', 'applied information', 'information with judgement' or 'the capacity for effective action'.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge audit

A method of reviewing and mapping knowledge in an organization including an analysis of knowledge needs, resources, flows, gaps, users and uses. A knowledge audit will generally include aspects of an information audit but is broader than an information audit.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge broker

A person who facilitates the creation, sharing and use of knowledge in an organization. Many organizations have created knowledge broker roles such as 'Knowledge Coordinator'. The term knowledge broker is also sometimes used to describe companies or individuals

that operate commercially as knowledge traders or provide knowledge-related services.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge harvesting

A set of methods for making tacit knowledge more explicit - getting people's knowledge into documents, so that it can be more easily shared with others.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge Management

Knowledge management is the systematic processes by which knowledge needed for an organization to succeed is created, captured, shared and leveraged"

Source: Clemmons Rumizen, 2002, p.9

Knowledge management strategy

A detailed plan outlining how an organization intends to implement knowledge management principles and practices in order to achieve organizational objectives.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge repository

A place to store and retrieve explicit knowledge. A low-tech knowledge repository could be a set of file folders. A high-tech knowledge repository might be based on a database platform.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Knowledge worker

A term coined by Peter Drucker in 1959, as an employee whose role relies on his or her ability to find and use knowledge.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Learning organization

An organization that views its success in the future as being based on continuous learning and adaptive behaviour. It therefore becomes skilled at creating, acquiring, interpreting and retaining knowledge and then modifying its behaviour to reflect new knowledge and insights.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Lost knowledge

Expertise that is not collected because knowledge management procedures are not in place.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Organizational culture

In short, ‘the way we do things around here’. An organization’s culture is a mixture of its traditions, values, attitudes and behaviours. Different organizations can have very different cultures. In knowledge management, an organization’s culture is extremely important - if it is not based on qualities such as trust and openness, then knowledge management initiatives are unlikely to succeed.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Organizational learning

The ability of an organization to gain knowledge from experience through experimentation, observation, analysis and a willingness to examine both successes and failures, and to then use that knowledge to do things differently. While organizational learning cannot happen without individual learning, individual learning does not necessarily produce organizational learning. Organizational learning occurs when an organization becomes collectively more knowledgeable and skilful in pursuing a set of goals.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Organizational memory

The knowledge and understanding embedded in an organization’s people, processes and products or services, along with its traditions and values. Organizational memory can either assist or inhibit the organization’s progress.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Social network analysis

A tool which analyses how people work together to solve problems and come up with new ideas.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Tacit knowledge

The knowledge or know-how that people carry in their heads. Compared with explicit knowledge, tacit knowledge is more difficult to articulate or write down and so it tends to be shared between people through discussion, stories and personal interactions. It includes skills, experiences, insight, intuition and judgement. Note: Some authors draw a distinction between tacit and implicit knowledge, defining tacit knowledge as that which cannot be written down, and implicit knowledge as that which can be written down but has not been written down yet.

In this context, explicit knowledge is defined as that which has already been written down.

Source: National Library for Health. Glossary of Health Knowledge Management Terms

Value Proposition

A Value Proposition articulates the fundamental business reasons and expected benefits that drive the organization to pursue Knowledge Management. States the payoff to the organization. It is the driving force (the “business driver”) that provides energy to manage knowledge systematically and fund KM initiatives; Focuses KM on the value chain; Is the basis for measuring results; Leads to senior leadership support

Source: Taylor Gates, O. (2006)

WebExtras 1 - Links

1. SEARCH Light newsletter for members of Community of Practice; KM resources and tools; a “Knowledge Infostructure” Search Canada available at www.searchca.net
   South East Public Health KM Strategy available at http://www.sepho.org.uk/viewResource.aspx?id=9443
2. United Nations Public Administration Network (UNPAN) has adopted and placed in their reference library the manuscript titled *How to Think Like a Knowledge Worker*. This document is available for free download at the following URL: http://unpan1.un.org/intradoc/groups/public/documents/unpan/unpan031277.pdf
3. Examples of KM from the private sector (link to WebExtra 2.3)
4. KM Definitions : A list of various KM definitions (link to WebExtra 2.4)
5. Knowledge Cycle Processes of KM (link to WebExtra 2.5)
6. Models That Measure How KM Has Been Performed (link to WebExtra 2.6)
7. The Balanced Scorecard http://www.balancedscorecard.org
8. Implementation Models: Implementation Models (link to WebExtra 2.8)
9. South East Public Health KM Strategy Healthcare KM example: South East Public Health KM Strategy: http://www.sepho.org.uk/viewResource.aspx?id=9443
10. This Government of Alberta web page provides access to knowledge management and knowledge transfer guides, and provides an overview of KM activities in the Alberta public service and resources to get staff started on KM initiatives: http://www.im.gov.ab.ca/index.cfm?page=imtopics/Knowledge.html
11. myPublicHealth: http://myph.org/
12. KM Strategies This document provides an overview of and links to the documents for the WHO KM Strategy and the South East Public Health KM Strategy. Web Extra Documents\KM Strategies.doc (link to WebExtra 2.12)
13. Knowledge Management Specialist Library: http://www.library.nhs.uk/KnowledgeManagement/
14. Results of a national survey of KM adoption in public administration in Bosnia and Herzegovina: http://www.palgrave-journals.com/kmrp/journal/v6/n1/full/8500163a.html
15. Telemedicine: http://en.wikipedia.org/wiki/Telemedicine (EN) http://fr.wikipedia.org/wiki/T%C3%A9l%C3%A9m%C3%A9decine (FR)
16. Core Competencies in Public Health http://www.phac-aspc.gc.ca/ccph-cesp/index-eng.html
17. U.S. Association of State and Territorial Health Officials (2005) This paper by the U.S. Association of State and Territorial Health Officials outlines KM concepts, relates the KM concepts to public health activities and goals and describes key activities to guide implementation of KM in public health. The paper is available for free download at http://www.astho.org/pubs/ASTHO-Knowledge-Management.pdf

The ASTHO also provides a pdf document of examples of KM in Public Health Practice. The document is available at http://www.astho.org/pubs/Examples-KM-Public-Health-Practice(2).pdf

18. Organizational Culture as a basis for Workplace Health: http://www.thcu.ca/workplace/documents/influencing_org_envir_infopackv_1.1.FINAL.pdf Influencing the Organizational Environment to Create Healthy Workplaces
19. Process and Outcome Evaluations THCU Evaluation Workbook http://www.thcu.ca/infoandresources/publications/EVALMaster.Workbook.v3.6.08.15.07.pdf
20. South East Public Health KM Strategy available at http://www.sepho.org.uk/viewResource.aspx?id=9443
21. Cultivating Communities of Practice: A Guide to Managing Knowledge - Seven Principles for Cultivating Communities of Practice http://hbswk.hbs.edu/archive/2855.html
22. Quality Improvement & Innovative Partnership's "Learning Collaborative" for Family Health Teams: http://www.qiip.ca/what.php
23. Web 2.0 and KM: Themes from an APAQ Consortium Benchmarking Study: www.apqc.org/portal/apqc/ksn
24. TFPL The Skills Map of Competencies: http://www.tfpl.com/skills_development/skills_competencies.cfm
25. Information about KM Tools:The Improvement & Development Agency outlines ten knowledge management tools and techniques. http://www.idea.gov.uk/idk/core/page.do?pageId=8152469
    The National Library for Health Toolbox – Inventory of Tools and Techniques http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=93792&tabID=288&catID=12417

Content Creation Tools

26. Authoring tools: http://www.learningcircuits.org/2002/mar2002/harris.html
27. Templates: http://office.microsoft.com/en-us/templates/TC011948111033.aspx?CategoryID=CT101043361033&av=ZXL000
28. Annotations: http://ftp.informatik.rwth-aachen.de/Publications/CEUR-WS/Vol-360/paper-10.pdf
29. Blogs: http://knowledgemanagement.ittoolbox.com/blogs/
30. After Action Reviews: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=70306&tabID=290
31. White pages: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=94140&tabID=290
32. Best practice systems: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=87817&tabID=290
33. Instant messaging: http://research.ittoolbox.com/white-papers/datamgt/km/instant-messaging-2909

34. Wikis: http://knowledgemanagement.ittoolbox.com/wiki/#Wiki
35. Corporate yellow pages: http://www.library.nhs.uk/knowledgemanagement/SearchResults.aspx?searchText=yellow%20pages&tabID=288
36. Knowledge Café: http://www.idea.gov.uk/idk/core/page.do?pageId=8155478

E-learning Technologies

37. Skills Enhancement for Public Health online continuing education modules: http://www.phac-aspc.gc.ca/sehs-acss/training_modules-eng.php

Content Management

38. Personal Knowledge Management Plan: http://www.knowledgeboard.com/item/447

Networking Technologies

39. Knowledge repository: http://it.toolbox.com/wiki/index.php/Knowledge_Repository
40. Portal: http://cbpp-pcpe.phac-aspc.gc.ca/
41. Knowledge centres: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=93812&tabID=290
42. Storytelling: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=93580&tabID=290

Artificial Intelligence

43. Push/pull technologies:http://ecommercetechnology.org/english/data/70.htm
44. Knowledge maps: http://www.wdv.com/KnowledgeMapping/KG/

Other possibilities

45. Developing a KM strategy: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=148714&tabID=291
46. Communities of practice: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=88442&tabID=290
47. Knowledge audit tools: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=282134&tabID=291
48. Social network analysis: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=94092&tabID=290
49. Peer Assists / Mentoring and Coaching: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=125167&tabID=290
50. Exit Interviews: http://www.library.nhs.uk/KnowledgeManagement/ViewResource.aspx?resID=93605&tabID=290
51. Developing a Balanced Scorecard for Public Health: http://www.ices.on.ca/webpage.cfm?site_id=1&org_id=31&morg_id=0&gsec_id=0&item_id=2052

WebExtras 2 - Documents

3. Examples from the Private Sector

The literature search identified many examples of KM within the private sector. The following examples were selected because of their potential applicability to public health:

Jackson Grayson, C. & O'Dell, C. (1998). If Only We Knew What We Know: The Transfer of Internal Knowledge and Best Practice. New York, NY: The Free Press.

- Part Four: Reports from the Front Lines: Pioneer Case Studies within this book highlights presents examples of KM in the business world. Five chapters in this section each documents a separate case study.

Carroll, J. M., Choo, C. W., Dunlop, D. R., Isenhour, P. L., Kerr, S. T., MacLean, A. et al. (2003). Knowledge management support for teachers. Etr&D-Educational Technology Research and Development, 51, 42-64.

- CoWeb (http://homepage.mac.com/juggle5/WORK/publications/CoWebChapter.pdf) (Guzdial cited in Carroll et al., 2003, p.18)
- MOOsburg (http://www.teco.edu/locationws/8.pdf) is a web-accessible collaborative environment developed as a place-based framework for community collaboration, including school-community collaboration. (Carroll et al., 2003, p.28)

Clemmons Rumizen, M. (2002). The Complete Idiot's Guide to Knowledge Management. Indianapolis, IN: Alpha Books.

- Texaco (before merger with Chevron) had a corporate yellow pages system called PeopleNet (Clemmons-Rumizen, 2002, p.99)
- Ernst & Young's "PowerPack" (Clemmons-Rumizen, 2002, p.115) equips every consultant with a laptop loaded with standard applications (part of their Knowledge Web) and a selection of templates and best examples (organized so consultants can find things easily) including:
    - proposals
    - presentations
    - competitive information
    - models
    - specialized tools
    - articles
    - workplans
    - a variety of other business resources.

IBM Research Website - http://www.research.ibm.com/journal/sj/404/thomas.html

- Additional information about the IBM software Babble

TFPL KM Strategy Resources

- Case study of customized workshops developed in the UK for use in Europe and the US (http://www.tfpl.com/results/results1.cfm?casestudy=39)

- Developing KM Competencies (http://www.tfpl.com/results/results1.cfm?casestudy=71)

Kankanhalli, A., Tanudidjaja, F., Sutanto, J., & Tan, B. Y. (2003). The Role of IT in Successful Knowledge Management Initiatives. Communications of the ACM, 46, 69-73.

- summarizes a number of examples of knowledge management tools used in various companies.
- suggests that a company's most helpful type of KM tool depends on whether that company is either product-based or service-based. Companies are further categorized into those that work in a low-volatility context and those that work in a high-volatility context. The table below is from that paper (p.72 with additional details provided in the paper from pp. 70-72).

	Low-Volatility Context	High-Volatility Context
Product-Based	Definition: "Do not compete on the basis of products alone – these organizations often compete on other grounds" Examples: Expert Directories • Connect (British Petroleum) – "a knowledge yellow pages that helps employees locate required expertise" • Expertise Directory (Shell) – "acts as a clearinghouse and signpost for both knowledge seekers and contributors" COP • K'Netix (Buckman Laboratories) – "global e-communication network that links specialists to field staff" • Global Networks (Shell) – "comprised collaboration tools like LiveLink and Microsoft Exchange"	Definition: "Produce products in a rapidly changing environment where the rate of innovation and speed of new product development is crucial" Examples: Expert Directories – "yellow pages that map topics with experts – use these systems to locate colleagues with relevant expertise on specific problems and then utilize more personal forms of communication to gain knowledge from the experts" • Expert Directory (Microsoft) • Knowledge Map (Siemens Infineon Technologies) • Connex (Hewlett-Packard) Direct Exchange • Phone and videoconferencing (Siemens Infineon Technologies) • People-transfer (Hewlett-Packard) – "physical transfer of people across geographical locations to facilitate knowledge exchange" Repositories • Electronic Sales Partners (Hewlett-Packard) • Eureka (Xerox) – "access to technical tips" • Internal Technical Education (Microsoft) – "online learning, live class schedules, and white papers"

	Low-Volatility Context	High-Volatility Context
Service-Based	Definition: “services that are relatively stable over time” Examples: Repositories – “knowledge is codified, stored electronically and made available to employees via common technological platforms throughout the entire organization” • Center for Business knowledge (Ernst & Young) – “central repository holding its 40 areas of operational knowledge” • kWorld (kPMG) • SAP R/3 (Siemens Business Services) • kPMG and Siemens ones use “common technological platforms such as MS Office, Lotus Notes and Web browsers”	Definition: “Highly dynamic nature of their businesses – need new and unstructured knowledge effectively exchanged so that custom-made solutions can be tailored for their clients” Efforts focus more on people than IT – done through brainstorming sessions and personal conversations Examples: Direct Exchange • Phone and videoconferencing (Mckinsey) • People transfer (Mckinsey and Skandia)

4. Knowledge Management Definitions

Definitions of knowledge management abound. For the purposes of Knowledge Management: Background Paper for the Development of a Knowledge Management Strategy for Public Health, the following simple yet thorough definition was selected:

> **"Knowledge management is the systematic processes by which knowledge needed for an organization to succeed is created, captured, shared and leveraged"**
>
> **(Clemmons Rumizen, 2002, p.9).**

Additional definitions of knowledge management found during the literature search are presented below (in alphabetical order by author):

- "A process used by organizations and communities to improve how business is conducted by leveraging data and information that are gathered, organized, managed, and shared. … By using both explicit and tacit knowledge, knowledge management helps an organization deliver the right information to the right place and the right person at the right time. Organizations can use knowledge management approaches to more fully leverage their information assets. Knowledge management contributes to the integration of systems, tools and processes, fosters the transfer of competence among individuals, and improves individual competence by promoting more efficient use of available information" (Association of State and Territorial Health Officials, 2005, pp. 3,21).
- "KM refers to organizational policies, practices, and tools that allow individuals to better understand and to help define the bigger picture of which their work is a part, and to more easily benefit from and contribute to the work of others in the organization" (Carroll et al., 2003, p.10).
- "KM is a framework for designing an organization's goals, structures, and processes so that the organization can use what it knows to learn and to create value for its customers and community" (Choo, C.W., n.d.).
- "A conscious strategy of getting the right knowledge to the right people at the right time and helping people share and put information into action in ways that strive to improve organizational performance" (O'Dell and Grayson, 1998 as cited in DiTienne et al., 2004, p.28).
- "KM promotes an integrated approach to identifying, capturing, retrieving, sharing and evaluating all enterprises' information assets. These information assets may include databases, documents, policies, procedures, as well as the uncaptured tacit expertise and experience stored in individual's heads" (Malhotra, Y. & Galletta, D., 2005, p.3).
- "Knowledge management refers to the ability to develop, share, deposit, extract and deliver knowledge such that it may be retrieved and used to make decisions or to support the processes" (Nakra, 2000 as cited in DiTienne et al., 2004, p.28).

- "Knowledge management is based on the idea that an organization's most valuable resource is the knowledge of its people" (National Electronic Library for Health, 2006).
- Knowledge conscious management – To achieve knowledge conscious management consider the following: Knowledge = Information x Competencies x Context (if any of the three are zero, knowledge is zero!) (Oxbrow, N. & Abell, A., 2002, p. 5).
- "Knowledge Management is the capability by which communities within an organization capture the knowledge that is critical to them, constantly improve it, and make it available in the most effective manner to those people who need it, so that they can exploit it creatively to add value as a normal part of their work" (Royal Dutch/Shell, 2001 as quoted by South East Public Health Group, 2005).

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Association of State and Territorial Health Officials (2005). *Knowledge management for public health professionals*. Washington, DC: Association of State and Territorial Health Officials.

Carroll, J. M., Choo, C. W., Dunlop, D. R., Isenhour, P. L., Kerr, S. T., MacLean, A. et al. (2003). Knowledge management support for teachers. *Etr&D-Educational Technology Research and Development,* 51, 42-64.

Choo, C.W., (n.d.). *FAQs*. Retrieved on February 1, 2008 from http://choo.fis.utoronto.ca/whatisKM.html.

DeTienne, K., Dyer, G., Hoopes, C., & Harris, S. (2004). Toward a model of effective knowledge management and directions for future research: Culture, Leadership, and CKOs. *Journal of Leadership & Organizational Studies (Baker College)*, 10, 26-43.

Malhotra, Y. & Galletta, D. (2005). A multidimensional commitment model of volitional systems adoption and usage behavior. *Journal of Management Information Systems*, 22, 117-151.

National electronic Library for Health (2006). *What is knowledge management?* Retrieved Accessed on December 6, 2006 from http://www.library.nhs.uk/knowledgemanagement/ViewResource.aspx?resID=88741.

Oxbrow, N. & Abell, A. (2002). *What next? Life after knowledge management.* Retrieved on January 25, 2008 from http://www.tfpl.com/assets/applets/What_next._Information_Outlook_180202.pdf.

South East Public Health Group (2005), Department of Health, UK. *The south east public health knowledge management strategy*, Retrieved August 25, 2008, from http://www.sepho.org.uk/viewResource.aspx?id=9443

5. Examples of Knowledge Cycle Processes for Knowledge Management

Goddard, M., Mowat, D., Corbett, C., Neudorf, C., Raina, P., & Sahai, V. (2004). The impacts of knowledge management and information technology advances on public health decision-making in 2010. Health Informatics Journal, 10(2), ate.

Within the article, Goddard et al., describe the following:

- Discovery – the person making a decision needs to know if the required information is “out there” and where to find it.
- Connectivity – the user needs to be able to obtain the resource where and when she or he needs it, be it by the Internet, a telephone call or some other way.
- The language of the material is critical – the provider and the user need to agree on the meaning of terms otherwise the information is of less value.
- Permission to use the information (p. 113).

Malhotra, Y. & Galletta, D. (2005). A multidimensional commitment model of volitional systems adoption and usage behavior. Journal of Management Information Systems, 22, 117-151.

- In their paper, Malhotra & Galletta describe a model for structured information processing and unstructured ‘sense making’

McAdam, R., & Reid, R. (2000). A comparison of public and private sector perceptions and use of knowledge management. Journal of European Industrial Training, 24(6), 317-330.

- Within the article, McAdam & Reid (2000) describe a model modified from one created by Demarest in 1997 which can be captured in the knowledge cycle process. The model describes four dimensions:

    1. Knowledge construction – construction of knowledge within the organization

    2. Knowledge embodiment – constructed knowledge then embodied within the organization; not just through explicit programs but through a process of social interchange

    3. Knowledge dissemination – the process of dissemination of the knowledge throughout the organization and its environment

    4. Knowledge use/benefit – knowledge seen as being of economic use for organizational outputs (p. 318)

6. Examples of Models That Measure How KM Has Been Performed

Handzic, M., Lagumdzija, A., & Celjo, A. (2008). Auditing knowledge management practices: model and application. Knowledge Management Research & Practice. 6, 90–99.

- One of the most detailed descriptions of various KM models is found in this article. Handzic et al., describe the following types of models within the article:
    - Knowledge-oriented models
    - Process-oriented models
    - Models focused on social and/or technological enablers of knowledge processes
    - Models which "question the widely held belief that knowledge processes and tools and methods for promoting the creation, sharing and leveraging of knowledge are universally appropriate" (p. 91)
    - Models which emphasize the evolutionary nature of KM.

Handzic et al., present a KM audit model in their paper. They indicate that their model "extends the core knowledge—process–enabler framework by incorporating additional driver and outcome elements, as well as contextual contingencies" (p. 92).

Apostolou, D. & Mentzas, G. (1998). Towards a Holistic Knowledge Leveraging Infrastructure: the KNOWNET Approach. Proceedings of the 2nd International Conference on Practical Aspects of Knowledge Management. Basel, Switzerland, 29-30 Oct. 1998.

- The article describes how they supported three steps: knowledge diagnosis, knowledge transformation and performance evaluation.

Lai, H. & Chu, T. (2000). Knowledge Management: A Review of Theoretical Frameworks and Industrial Cases. Proceedings of the 33rd Hawaii International Conference on System Sciences.

Lai & Chu describe seven activities of an integrated KM framework and contrast these seven activities with 12 other KM frameworks. The seven activities described are: initiation, generation, modeling, repository, distribution & transfer, use and retrospect.

8. Examples of Implementation Models

Gillingham, H. & Roberts, B. (2006). Implementing Knowledge Management: A Practical Approach. Journal of Knowledge Management Practice, 7(1).

Gillingham & Roberts outline the following steps for a KM implementation model:

- Identify the business vision/goals and knowledge objectives.
- Complete a knowledge assessment by identifying what knowledge processes and systems are already in place to enable companies to take stock of what is currently in use and where improvements can be made.
- Leverage best practices which have been identified inside and outside the company.
- Start small and where it is likely to have an impact and make a difference to the business. This could be a pilot project from which the business can learn from the outcomes and update the process for the next phase.
- Identify and involve knowledge management champions to promote knowledge sharing practices.

12. KM Strategies

The following two KM strategies are helpful documents to guide the development of KM strategy for public health in Canada.

World Health Organization. (2005). World Health Organization: Knowledge Management Strategy. Accessed on August 27, 2008 at www.who.int/kms.

The World Health Organization (WHO) KM Strategy identifies its vision as “global health equity through better knowledge management and sharing.” The mission is “to help bridge the “’know-do gap” ‘ in global health by fostering an environment that encourages the creation, sharing, and effective application of knowledge to improve health.”

The WHO document identifies specific core functions associated with each of the following five KM strategic directions:

- Improving access to the world’s health information
- Translating knowledge into policy and action
- Sharing and reapplying experiential knowledge
- Leveraging e-Health in countries
- Fostering an enabling environment

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The South East Public Health KM Strategy vision is “To develop a public health workforce that has the skills to exploit, appraise and contribute to the public health knowledge base. To promote an environment and culture that is conducive to knowledge sharing.” The document outlines the following components as critical for effective public health KM:

- Developing the IT infrastructure and improving access to resources
- Managing and promoting the evidence base
- Getting evidence from research, data and experience
- Improving the knowledge sharing capacity
- Supporting communities of practice

South East Public Health Group (2005), Department of Health, UK. *The south east public health knowledge management strategy*, Retrieved August 25, 2008, from http://www.sepho.org.uk/viewResource.aspx?id=9443