December 2003

Making Explicit the Implicit Knowledge Assets in Healthcare: The Case of Multidisciplinary Teams in Care and Cure Environments

Graydon Davison
University of Western Sydney

Nilmini Wickramasinghe
Cleveland State University

MAKING EXPLICIT THE IMPLICIT KNOWLEDGE ASSETS IN HEALTHCARE: THE CASE OF MULTIDISCIPLINARY TEAMS IN CARE AND CURE ENVIRONMENTS

Graydon Davison
College of Law and Business
School of Management
University of Western Sydney
g.davison@uws.edu.au

Nilmini Wickramasinghe
James J. Nance College of Business Administration
Cleveland State University
n.wickramasinghe@csuohio.edu

Abstract

Research in Australia and the United States offers evidence of sophisticated, implicit, knowledge assets in two diverse healthcare environments, care and cure. Two case studies are presented, a palliative care organization in Australia and a spinal care unit in the United States, both based around multidisciplinary service delivery, to demonstrate the existence of implicit knowledge assets. Yet the full potential of these knowledge assets is not being realized. A knowledge management infrastructure model is proffered as a way of making explicit the elements of these knowledge assets in both case studies. In addition, this model provides a systematic and robust approach to structuring the conceptualization of knowledge assets across a range of healthcare environments.

Keywords: Knowledge management, knowledge management infrastructure, knowledge assets, multi-disciplinary teams, healthcare

Introduction

A sound knowledge management infrastructure is a critical consideration in healthcare as this industry tries to wrestle with the current challenges of escalating costs and a shift from disease management to evidence-based and preventative medicine. Healthcare organizations are information rich and have an implicit capacity to create or access the knowledge necessary for the successful delivery of their services and yet they have, apparently, been slow to embrace the concepts of knowledge management or demonstrate visible knowledge assets. This seems somewhat surprising given the large proportion of healthcare workers that are knowledge workers. We present case study data to demonstrate the existence of implicit knowledge assets in two healthcare settings; a palliative care organization in Australia and a spinal care unit in the United States, both based around multidisciplinary service delivery. Given the implicit nature of these knowledge assets their full potential is likely not to be realized. While they may be known and understood at the points in the care/cure process at which they are utilized this does not automatically translate into their being recognized organizationally, leading to a loss of opportunity to manage them as an organizational resource. The implicit nature of these assets also tends to hide them, and the lessons that accompany their generation and usage, from a broader audience inside and outside the healthcare industry that may benefit from understanding them. We introduce a knowledge management infrastructure model to provide a systematic and robust approach to structuring the implicit knowledge assets we identify in the respective case studies. We contend that by using such a model it is possible to make explicit the knowledge assets in both case scenarios and thereby enable the full potential of these knowledge assets to be realized.

Case Study A[1]

Case A focuses on a palliative care organization on Australia's Eastern seaboard. It serves some 800 patients in an average year with a multidisciplinary staff of . The organization's catchment includes hospitals, specialists and general practitioners (family doctors). Multidisciplinary staffing consists of the following disciplines: medicine, nursing, social work, spiritual care, physiotherapy, occupational therapy and grief counseling. This organization operates ward-based inpatient teams and home care teams. These teams act as pools from which members appear to self-select for care of a particular patient. Selection is based on the patient's situation at any given time. Interestingly, team members interviewed note that patients sometimes self-select team members and this selection is also based on the patient's situation at any given time. The palliative care environment is one of "active and compassionate care primarily directed toward improving the quality of life for people who are dying, and toward supporting patients and families as they incur multiple losses" (McDonald and Krauser, 1996); hence we refer to this as a care environment. The following serves to furnish the key elements of this environment as they pertain to knowledge management, its benefits and applications in this setting.

Background

In Australia, there is formal acknowledgment of the need for structural change to healthcare systems. This includes the introduction of systemic information management techniques and integrated whole of life patient care as a response to increased demand and rising patient costs (New South Wales Health Department, 1999; New South Wales Health Council, 2000). Healthcare in Australia is in transition. It was traditionally managed as a number of systems with an episodic focus, advocating technical interventions in the course of a disease or illness presenting in the form of a patient, containing rigidly structured paradigms of professional relationships and hierarchies. The new concepts for the structure, delivery and management of healthcare are intended to deliver a coherent system with a population based whole-of-patient-life focus utilizing highly integrated care facilities, techniques and technologies to systemically service a population. Requirements of healthcare capabilities are changing, as they are for healthcare professionals, regulators and administrators. The expectations of those who use the healthcare system are also changing. New rules and requirements for decision making are being introduced, embodied in the concepts of clinical governance and evidence-based decision making.

Palliative care appears to be located at the fringe of this healthcare system, just as it seems to be located at the conscious fringe of society. However, it appears that palliative organizations already utilize a number of the techniques advocated for the new healthcare structures. For example, the focus of palliative care is non-episodic, coherent and based on a whole-of-patient view. The focus of all disciplines is common. Multidisciplinary teams deliver care, paradigmatic barriers are very low and levels of communication between the disciplines are very high.

Understanding Palliative Care

The arrival of a patient at an end-of-life experience requiring palliative care brings the certainty that life will end, generally within a relatively short period of time. Uncertainty is the basis of the end-of-life experience (Davison and Hyland, 2002), with each patient experiencing the end-of-life on two distinct levels, the conscious and the unconscious, and the depth of the experience at each level varies from patient to patient (Kearney, 1992). For the professions involved, this creates a working environment requiring ongoing work-based learning, governed by an uncertain direction of care that must follow a trajectory of need, of which the patient is the major informant (Henkelman and Dalinis, 1998). This learning is related to the multidisciplinary based efforts to preserve or achieve a particular quality of life for the patient's end-of-life experience and includes the patient and patient-based carers and is based on cross-functional learning rather than discipline specific learning. Despite their wide spread use and popularity in many types of organizations, collaborative cross-functional teams do not automatically operate or function as well as intended (Jasawalla and Sashittal, 1999). In palliative care the consequences are reductions in the effectiveness of care, resulting in deterioration in the quality of life of the patient and increases in the levels of uncertainty accompanying the patient.

[1]The interviews to gather data for case study A occurred during 2001 and 2002. They were unstructured and contained questions based on a wide-ranging literature review. A total of 12 interviews occurred in three separate palliative care organizations. In each organization 3 different groups were interviewed, management teams consisting of the head of each discipline practicing at the organization, multidisciplinary ward-based patient care teams and multidisciplinary home care teams. Management teams were interviewed about capabilities and levers, multidisciplinary patient care teams were interviewed about behaviors. As well as comprising a management team, heads of discipline are also commonly members of multidisciplinary patient care teams.

This has major implications for the carer team's group efficacy, a group's belief in its ability to perform effectively. It is to the benefit of the palliative team, including the patient, to consciously work to lower the levels of uncertainty. This is addressed with individualized care for patients and their personally based support systems, using cross-functional, collaborative, multidisciplinary teams that include the patient and patient-based carers.

Technologies

Palliative care is not as technologically dependant as, say, the care provided in an acute hospital. As the focus of palliative care is the relief of distress in the patient and patient-based carers, regardless of the cause, at the end of life the technologies employed can be relatively simple. Palliative care staff participating in research in Australia refer to technology as primarily a provider of comfort for patients. This is usually a reference to medication delivery technologies, for example morphine pumps. However, much simpler technologies are also considered in the same way, for example physiotherapists interviewed consider an aluminium walking frame a very useful technology, and a provider of comfort, if that's what the patient's situation requires.

Structure

This case study organization is structured around the need to provide a multidisciplinary response to changing patient situations, using multidisciplinary pools from which patient care team members apparently self-select, according to a patient's situation.

The use of multidisciplinary teams in the complex, dynamic environment of palliative care, where it is common to quickly deploy mixed groups of professionals in response to particular situations, is reminiscent of Mintzberg's (1989) Innovative organization. Palliative care organizations, while trying to focus on what is central; namely, the patient, must also contend with persistent uncertainty as well as issues that challenge differing ethical and philosophical perspectives (Rose, 1999; Henkelman and Dalinis, 1998; Pierce, 1999; McDonald and Krauser, 1996; Lewis et al, 1997; Rose, 1997; Higginson, 1999; Rose, 1995; Kearney, 1992). In palliative care, decision making is at times decentralized to individual patient management teams and these teams include any person relevant and available to assist in fulfilling the patient's needs (McDonald and Krauser, 1996). This includes family and friends of the patient (Lewis et al, 1997; Rose, 1997). The need to continually address the patient's situation on more than one level; i.e., at the clinical, social and conscious levels, frequently (Rose, 1995) means that patient care team membership must also be reassessed as frequently and changed when necessary.

Knowledge Management in Case A

Successful palliative care is heavily dependent on an ability to manage knowledge and information in real time as an enabler and facilitator of care. Palliative care delivery is fundamentally based on an understanding of the patient's situation, which includes all of the drivers of that situation. The scope of drivers capable of influencing a patient's situation, ranging from the clinical to the spiritual, social and conscious/unconscious, demands a multidisciplinary approach. Managing knowledge in palliative care requires a dynamic knowledge management system that is capable of working in real time and across organizational, team and professional boundaries.

Such a system is described by Davison (2003) as an essentially anthropocentric system because the required dynamism, flexibility and outreach components are provided by palliative carers, including patients and patient-based carers. Case Study A, and other palliative care organizations participating in research in innovation management in Australia, appear to consciously establish and maintain an environment and practices that enable the real time management of knowledge in this dynamic environment. This is accomplished with three elements: 1) A set of organizational capabilities that ensure the delivery of multidisciplinary care (Davison and Hyland, 2001). 2) A set of levers that are situationally applied to the care environment (Davison 2003) to enable the application of 3) a set of individually based behaviors that are displayed in the operations of multidisciplinary patient care teams (Davison and Sloan, 2002). These are described in Table 1 below.

Table 1. Elements For Managing Knowledge

Elements for Managing Knowledge	Description
Capabilities[a]	C1, managing knowledge; C2 managing information; C3 multidisciplinary operations; C4 collaborative operations; C5 managing technology; C6 managing change and its effects
Levers[b]	L1, Collaboration to enable the integration of resources, access to knowledge and the management of multidisciplinary communications; L2, Balancing access to knowledge with the ability to use it, team and discipline identities and cohesion, and team diversity; L3, Absorptive Capacity, of the individual team members, with regard to an ability to recognize the value of and utilize knowledge and information available to, and from, the team, know where to look for useful external information and to position knowledge and information, and to learn; L4, Use of a common Language between members of interdisciplinary teams to facilitate the exchange of knowledge and information; L5, Trust to create and maintain an environment that promotes and supports the use of openness, dialogue and double loop learning in knowledge and information generation and management; L6, Power
Behaviors[c]	B1, Using artifacts such as role credibility of professional carers and organizational reputation and experience to quickly generate trust between patients, patient based carers and professionals as the patient is introduced to the palliative system; B2, Rapidly including the patient and patient-based carers in a socially stable structure and culture; B3, Addressing values based issues to generate meaning from the palliative experience; B4 Understanding the patient's situation as a basis for care. B5 Working in teams; B6 Collaborating within the patient management process; B7, Managing ambivalence.

[a]Within the six identified organizational capabilities confirmed at interview there is an obvious priority for the accessing, creating, applying and managing knowledge and information.
[b]Six levers have been identified and also confirmed at interview. All of these are related to the management of knowledge.
[c]Seven individual behaviors were identified as operating within multidisciplinary teams, and confirmed at interview, are as follows. Of these, the first five are directly concerned with enabling the generation of knowledge and information upon which to base care.

Within Case Study A it becomes apparent that the organization is structured to promote and manage knowledge assets but this is not the conscious focus of the structure. This is a structure designed to deliver situationally specific multidisciplinary care for changing situations. Participants in this process understand and articulate the importance of cross-discipline communications, learning and transfer of information. They also acknowledge that they work consciously at depressing functional and discipline-based boundaries to enable these things to occur. However, the focus for all of these efforts is not the management of knowledge it is the relief of distress in the patient and patient based carers. The concept of explicitly managing knowledge to add value to the care process is generally not considered.

Case Study B[2]

The second case study, which we call Case B, focuses on a well renowned Spine Unit in the US. We define this environment as a cure environment since a key goal of the Spine Unit is to return patients to normal life activities. The following serves to furnish the key elements from this environment as they pertain to knowledge management, its benefits and applications in this setting.

Background for Case B

In the U.S., the healthcare industry is in a state of flux (Applegate et al, 1986; Chandra et al, 1995; Malhotra, 2000; Wolper, 1995). 'The rate of the rise in healthcare costs has been variable. The shocking increases experienced in the early 1990s, has slowed in the mid-and late 1990s, but there is no guarantee that they will continue to do so' (Kongstvedt, 1997, pp xvii). In other market places buyers are sensitive to the price of the product and undertake cost-benefit analysis. 'In the medical market place, however, the buyers and users of medical services and technologies have been relatively insensitive to the cost of these services' … 'The traditional financing and reimbursement policies of the healthcare industry are felt to be largely responsible for this price insensitivity, inhibiting the forces of competitive supply and demand economics' (Applegate et al, 1986, pp. 80). As a result, there is increased pressure on providers of medical care to develop ways to control and manage costs as well as increase productivity without compromising quality. In an attempt to stem the escalating costs of healthcare, managed care has emerged. It is aimed at creating value through competition in order to combat '…an extremely wasteful and inefficient system that has been bathed in cost-increasing incentives for over 50 years' (Enthoven, 1993, p. 40). The intended result is to provide adequate quality healthcare and yet minimize, or at least reduce, costs.

Managed Care Organizations (MCOs) contract with individuals, employers and other purchasers to provide comprehensive healthcare services to people who enroll in their health plans. The essential difference between MCOs and more traditional types of medical care is connected with the distribution of financial risk among the purchaser of healthcare, the provider of the care and the insurer (Knight, 1998). 'MCOs typically reduce this financial risk for the purchaser of healthcare insurance by guaranteeing a comprehensive range of services at a fixed price to them. To do this of course, the MCO must keep the use of healthcare resources within a budget; thus making critical a focus on managing medical care' (Wickramasinghe & Silvers, 2001). This then represents a radical change to the traditional healthcare environment where quality irrespective of cost was the goal. The new goal is cost effective quality care and thus also demands a more competitive healthcare environment.

Spine Care

Nearly everyone experiences back or neck pain at some time during their life. Pain or disability can be caused by injuries sustained at home or work, while involved in sports or recreation, during accidents or falls or from medical conditions , such as arthritis, osteoarthritis or osteoporosis. The Spine Unit that makes up Case B is part of a large multispecialty group practice and academic medical center located in the Midwest of the US. This Center is actually made up of surgeons and medical staff from the department of Neurology and Neurosurgery and the department of Orthopedics. A co-operation of the surgeons of these two departments has led to the Spin Unit where more than 9,000 patients with spinal problems are treated annually. The multidisciplinary team in this setting consists of experienced spine surgeons, well trained psychologists, physical therapists, OR personnel and laboratory pathology experts. The multidisciplinary team works with well-established proven protocols. Naturally with back and neck complaints the process can not be the same for every patient, rather is dependent on the specific complaint the patient has. Figure 1 however, depicts the overall process of a patient entering and exiting the system will encounter.

[2]The empirical support comes from case study research conducted in a large healthcare organization located in the Midwest of the US. In collecting the data, information was gathered from several sources including semi structure interviews, observation and analysis of archival documents; thus enabling triangulation among different data sources (Eisenhardt, 1989). Extensive thematic analysis was then conducted to analyze this qualitative (Boyatzis, 1998; Kavale, 1996).

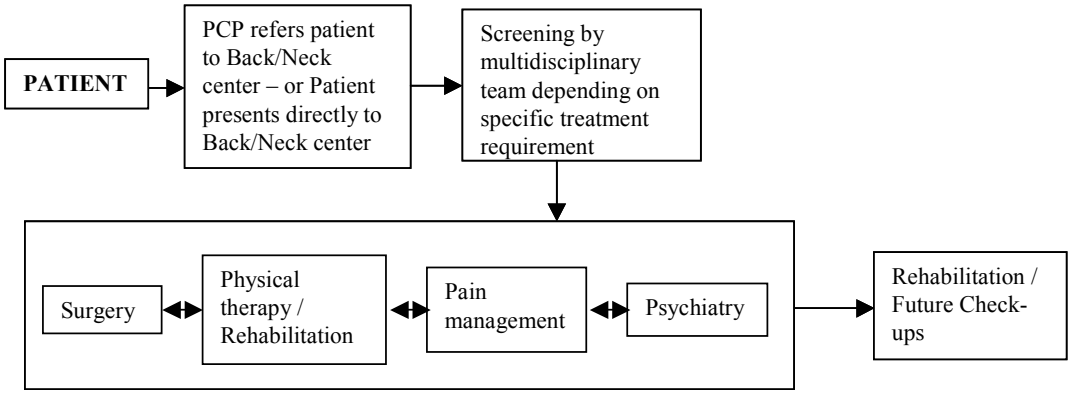

Figure 1. Process Flow for Spine Patients

Technologies

In order for the Spine Unitto achieve its goal of providing high quality treatment to patients suffering from various back and neck complaints many key factors must be addressed concerning both the clinical and practice management issues. Technologies of various types play a key role in enabling effective and efficient high quality treatments at the Center. The clinical technologies include the laboratory and radiology facilities to enable best possible detection of the specific complaint, as well as the technologies to support the treating of this complaint especially if surgery is the course of action; for example the use of image-guided spinal navigation to facilitate the accuracy, precision and safety of spinal instrumentation and reduction in operative time or laparoscopic or endoscopic procedures to minimize invasive spinal surgery. On the practice management side the technologies include the HMIS (Hospital Management Information System) in place. Table 2 describes the systems that comprise the HMIS.

Table 2. Systems Comprising HMIS

System	Description
HIS (Hospital Information Systems)	provide integrative medical and clinical information support services using a variety of computer services that are linked with high speed networks
ES (Expert Systems)	provide expert consultation to end-user for solving specialized and complex problems.
CMS (Case Management Systems)	evolved recently as a result of a growing trend of integrating health service delivery both vertically (coordinating clinical care across providers i.e., between surgeons and physical therapy) and horizontally (linking institution providing the same types of treatments). Another feature of these systems is that they enable case mix applications and thus provide the capability and flexibility of integrating financial and clinical data. The benefits of this cannot be understated.
HDBMS (Health Database Management Systems)	have been used extensively in some hospital settings. HDBMS refer to a repository of logically organized facts and figures which query facilities. A typical example of such a HDBMS is the automated patient record system. These systems also enable data mining and other data analysis techniques to be used with the help of OLAP (on-line analytic processes) features so that it will be able to analyze cumulative treatments and thus update, revise or adjust practice protocols as required. This will of course ensure the Spine Unit maintains its high standard of offering best possible services to its patients.
GDSS (Group Decision Support Systems)	involve the use of interactive, computer based systems that facilitate the search for solutions to semi-structure and unstructured problems shared by groups. Once again these systems will benefit the quality of the patient treatment by supporting decision making processes regarding patient treatments made within the Spine Unit

Structure

The spine is a very complex part of the human anatomy. Bones and nerves play a central role in the well functioning back and neck. Given the inherent complexity with the spine, it is understandable that for high class spine care a multidisciplinary team made up of neurology, neurosurgery and orthopedics is central to the care of spine patients. In addition to these disciplines, it is also important to incorporate other disciplines such as physical therapy, pain management and psychiatry as depicted in figure 1. Thus what we can see is that in spine care as in the case of palliative care, the use of multidisciplinary teams is critical to the cure process.

Knowledge Management in Case B

Modern medicine generates huge amounts of heterogeneous data on a daily basis. For example, medical data may contain SPECT images, signals like EKG, clinical information like temperature, cholesterol levels, etc., as well as the physician's interpretation. Add to all of this the daily mountains of data accumulated from a healthcare organization administrative systems. Those who deal with such data understand that there is a widening gap between data collection and data comprehension and analysis. The HMIS in place at the Spine Unit help physicians as well as administrators - address this problem. At the clinical level, for example, the HMIS help in early detection of diseases from historical databases of symptoms and diagnosis – thus providing an early warning system that leads to a much more effective quality treatment. At the hospital administration level, for example, the HMIS help in tracking certain kinds of anomalies, which may reveal areas of improvement and may help realignment of certain kinds of resources (e.g., equipment, personnel...). The major reason for the specific HMIS in place is to support delivery of quality healthcare in a cost-effective manner. These systems are considered to be very sophisticated systems in the current healthcare market. The systems uses NCQA (National Committee for Quality Assurance) standards and data gathered by the Back and Neck center; i.e., findings from key medical journals such as The New England Journal of Medicine or Journal of American Medicine, as well as data generated and analyzed from Center's own data base of patient history. These standards are continually updated and revised as new findings become available.

The systems therefore, not only enable the physicians to perform their work more effectively and efficiently as well as render high quality services to their patients, but also provides them with care parameters. This helps to enforce practice guidelines; in addition, it provides peer data on providers which enables benchmarking for specific treatments in terms of costs, length of stay and other key variables to be calculated. The systems also enable the center to understand the occurrence of outliers; i.e., physicians' practice patterns can be studied to understand why they are outliers and then, if necessary, to change inappropriate behavior and thereby support effective and efficient delivery of healthcare. Physicians play an active role with defining the criteria and characteristics of the functions of the systems. This is an example of a knowledge creating/renewal aspects enabled and supported by the system. In addition, the systems facilitate the sharing of knowledge, enabling discourse and discussion between physicians and other members of the multidisciplinary team.

Establishing a Knowledge Management Infrastructure

The most valuable resources available to any organization are human skills, expertise, and relationships. Knowledge Management (KM) is about capitalizing on these precious assets (Duffy, 2001). Most companies do not capitalize on the wealth of expertise in the form of knowledge scattered across their levels (Hansen et al., 2001). Information centers, market intelligence, and learning are converging to form knowledge management functions.

A KM infrastructure forms the foundation for enabling and fostering knowledge management, continuous learning and sustaining an organizational memory (Drucker, 1999). An organization's entire "know-how", including new knowledge, can only be created for optimization if an effective KM infrastructure is established. Specifically, the KM infrastructure consists of social and technical tools and techniques, including hardware and software that should be established so that knowledge can be created from any new events or activities on a continual basis. In addition, the KM infrastructure will have a repository of knowledge, systems to distribute the knowledge to the members of the organization and a facilitator system for the creation of new knowledge. Thus, a knowledge-based infrastructure will foster the creation of knowledge, and provide an integrated system to share and diffuse the knowledge within the organization (Srikantaiah, 2000) as well as support for continual creation and generation of new knowledge (Wickramasinghe, 2002). A knowledge management infrastructure can then be said to contain, at least, the elements displayed in Figure 2 and described in Table 3.

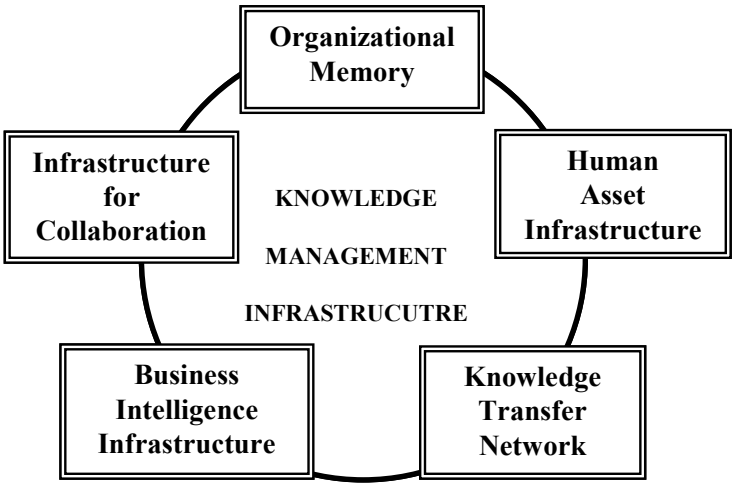

Figure 2. Key Elements that Constitute the Knowledge Management Infrastructure
(adapted from Sharma & Wickramasinghe, 2002)

Discussion

Both Case Study A and Case Study B deal with multidisciplinary teams in two radically different areas of healthcare, palliative care and spine care. In both settings, the healthcare environments are in flux and experiencing change, for Australia this is evidenced by the move to change structures, delivery and management of healthcare to focus on "whole-of patient-life" and utilize highly integrated care facilities, techniques and technologies while in the US, the major factor impacting the healthcare environment is Managed Care. In both settings however, these changes are being made in an attempt to address escalating costs and inefficiencies in the respective systems. Hence, the macro environments in both case studies are experiencing the same challenges. Let us now look at the micro environments of the two different multidisciplinary teams and understand the way knowledge management is occurring in these settings. From the case descriptions we can see that in both case studies knowledge management is an integral component yet it is actualized or approached very differently. The following highlights the main features of the respective micro environments in terms of the Knowledge Management Infrastructure model in Figure 2.

Analysis of Case A in Terms of the Elements of a Knowledge Management Infrastructure Model

While the research in palliative care in Australia is centered on the management of innovation in multidisciplinary patient care teams it is apparent that the organizations studied, characterized by the Case Study presented here, have structures, environments, influencers and practices that are highly related to knowledge management. In addition, these elements are almost entirely rooted in the people who populate the organization. A great deal of the knowledge management that occurs does so "on the run" with repeated references at interview to the high frequencies of communication between team members, formally at shift hand over and team meetings, and informally with the patient and patient based carers, between team members and within disciplines. This is driven by the large number of potential drivers of a patient's situation and the frequency with which that situation can change.

It is possible to see that the organization presented as Case Study A can be represented within the knowledge management infrastructure model proposed earlier in this paper. This is displayed in Table 4 below.

Table 3. Elements of the Knowledge Management Infrastructure

Element of the Knowledge Management Infrastructure	Description
Infrastructure for Collaboration	The key to competitive advantage and improving customer satisfaction lies in the ability of organizations to form learning alliances; these being strategic partnerships based on a business environment that encourages mutual (and reflective) learning between partners (Holt et al. , 2000). Organizations can utilize their strategy framework to identify partners, and collaborators for enhancing their value chain.
Organizational Memory	Organizational memory is concerned with the storing and subsequent accessing and replenishing of an organization's "know-how" which is recorded in documents or in its people (Maier et al 2000). However, a key component of knowledge management not addressed in the construct of organizational memory is the subjective aspect (Wickramasinghe, 2002).[a] Organizational memory keeps a record of knowledge resources and locations. Recorded information, whether in human-readable or electronic form or in the memories of staff, is an important embodiment of an organization's knowledge and intellectual capital. Thus, strong organizational memory systems ensure the access of information or knowledge throughout the company to everyone at any time (Croasdell, 2001).
Human Asset Infrastructure	This deals with the participation and willingness of people. Today, organizations have to attract and motivate the best people; reward, recognize, train, educate, and improve them (Ellinger et al., 1999) so that the highly skilled and more independent workers can exploit technologies to create knowledge in learning organizations (Thorne and Smith, 2000). The human asset infrastructure then, helps to identify and utilize the special skills of people who can create greater business value if they and their inherent skills and experiences are managed to make explicit use of their knowledge.
Knowledge Transfer Network	This element is concerned with the dissemination of knowledge and information. Unless there is a strong communication infrastructure in place, people are not able to communicate effectively and thus are unable to effectively transfer knowledge. An appropriate communications infrastructure includes, but is not limited to, the internet and intranets for creating the knowledge transfer network as well as discussion rooms, bulletin boards for meetings and for displaying information.
Business Intelligence Infrastructure	In an intelligent enterprise various information systems are integrated with knowledge-gathering and analyzing tools for data analysis, and dynamic end-user querying of a variety of enterprise data sources (Hammond, 2001). Business intelligence infrastructures have customers, suppliers and other partners embedded into single integrated system. Customers will view their own purchasing habits, and suppliers will see the demand pattern which may help them to offer volume discounts etc. This information can help all customers, suppliers and enterprises to analyze data and provide them with the competitive advantage. The intelligence of a company is not only available to internal users but can even be leveraged by selling it to others such as consumers who may be interested in.

[a]Knowledge as a subjective component primarily refers to an ongoing phenomenon of exchange where knowledge is being shaped by social practices of communities (Boland & Tenkasi, 1995), in the tradition of a Hegelian/Kantian perspective where the importance of divergence of meaning is essential to support the "sense-making" processes of knowledge creation (Wickramasinghe & Mills, 2001).

Table 4. Relevant Case A Elements in Terms of the Knowledge Management Infrastructure Model

Element of the Knowledge Management Infrastructure	**Case Study Element**
Infrastructure for Collaboration	C3 multidisciplinary operations C4 collaborative operations L1 Collaboration to enable the integration of resources, access to knowledge and the management of multidisciplinary communications B1 Using organizational artifacts to quickly generate trust between patients, patient based carers B5 Working in teams B6 Collaborating within the patient management process B7 Managing ambivalence
Organizational Memory	C3 multidisciplinary operations C4 collaborative operations C5 managing technology L3 Absorptive Capacity, of the individual team members, with regard to an ability to recognize the value of and utilize knowledge and information available to, and from, the team, know where to look for useful external information and to position knowledge and information, and to learn B4 Understanding the patient's situation as a basis for care
Human Asset Infrastructure	C6 managing change and its effects L5 Trust to create and maintain an environment that promotes and supports the use of openness, dialogue and double loop learning in knowledge and information generation and management L6 Power Sharing between the disciplines to maintain the centrality of the patient in the care process and to enable access to relevant competence, knowledge and information
Knowledge Transfer Network	C1 managing knowledge C2 managing information L2, Balancing access to knowledge with the ability to use it, team and discipline identities and cohesion, and team diversity L4 Use of a common Language between members of interdisciplinary teams to facilitate the exchange of knowledge and information B1 Using organizational artifacts to quickly generate trust between patients, patient based carers B2 Rapidly including the patient and patient-based carers in a socially stable structure and culture B3 Addressing values based issues to generate meaning from the palliative experience B5 Working in teams
Business Intelligence Infrastructure	C1 managing knowledge C2 managing information B4 Understanding the patient's situation as a basis for care L3 Absorptive Capacity, of the individual team members, with regard to an ability to recognize the value of and utilize knowledge and information available to, and from, the team, know where to look for useful external information and to position knowledge and information, and to learn

The result of this exercise is to produce a different picture of Case Study A. In this picture, it is possible to see the integration of capabilities, levers and behaviours necessary in terms of the operation of a knowledge management infrastructure. It is important to understand that none of what is displayed in the table is new to Case A. What is new, is the way in which these existing elements are combined when attempting to specifically understand the management of knowledge within this organization. An understanding of this makes a number of things clear. One is that the management of knowledge, even in a knowledge rich organization that acknowledges it is highly dependent upon the use of knowledge and information in its daily operations, is not a simple thing. Another is that the successful management of knowledge requires a multi-level integration of elements, some personally held by team members and some created and held organizationally. This can be a challenge to organizations as it requires that the organization and its staff share at least some common goals that are held by both to be valuable.

Analysis of Case B in Terms of the Elements of the Knowledge Management Infrastructure Model

Case B has a significant investment in technology both at the clinical and practice management levels. On the clinical side there are various technologies that facilitate speedy detection and then enable the subsequent cure to be effective and efficient; hereby, ensuring a high standard of quality treatment is experienced by the patient. On the practice management side the HMIS are crucial. When we analyze the Spine Unit through the lens of knowledge management, the relevant technologies become those on the practice management level; namely the technologies that make up the HMIS. These various technology systems described in Table2 form the collection of key data and information and then through various interactions of members of the multidisciplinary team with these technologies, protocols and treatment patterns are changed or developed. Table 5 identifies each relevant case element in terms of the Knowledge Management Infrastructure Model presented earlier.

What we have then, is a very heavy investment in the business intelligence infrastructure; i.e. HMIS which are facilitating the knowledge transfer, maintaining the organizational memory and enabling the collaboration of the multidisciplinary team in a very effective and efficient fashion. The Spine Unit has highly trained specialists who are encouraged to always keep at the cutting edge of new techniques for achieving better results and higher quality outcomes, with a strong emphasis on continuous improvement, they impart and exchange the knowledge and skills gained via interacting with the GDSS and the HIS components of the HMIS .

Table 5. Relevant Case B Elements in Terms of the Knowledge Management Infrastructure Model

Element of the KM Infrastructure	Case Study Element
Infrastructure for Collaboration	Primarily via the HIS – the system provides the forum for the exchanging of patient data and medical information between members of the multidisciplinary team Also the GDSS – this provides the opportunity to share and discuss treatment options amongst members of the multidisciplinary team in an efficient and effective fashion
Organizational Memory	HDBMS – the database stores large volumes of data pertaining to treatments, key protocols and statistics regarding cure options as well as lessons learnt pertaining to various cure strategies
Human Asset Infrastructure	Multidisciplinary spine care team – the combination of highly trained specialists from neurology, neurosurgery and orthopedics as well as psychologists, physical therapists OR personnel and lab/radiology experts are all vital to ensuring a proper cure outcome
Knowledge Transfer Network	Primarily via the GDSS – the creation of new knowledge as well as the possibilities to discuss and debate appropriate cure strategies to various cases is enabled and facilitated Also via HIS – the ability to access complete medical records and their by develop a clear understanding of the patients true history is supported via the HIS, in addition it is possible to access the latest medical findings via this system
Business Intelligence Infrastructure	CMS – the case mix data and information stored on this system as well as the ability of the system to link both vertically and horizontally enables integration across the Spine Unit resulting in supporting the business infrastructure.

From Table 5 we can see that in this cure setting the knowledge management infrastructure is established and sustained through the technologies in place. By explicitly identifying the components of the knowledge management infrastructure in the Spine Unit case study, we are making explicit the knowledge assets currently in place and are thereby, able to better manage these knowledge assets as well as maintain and update the knowledge management infrastructure itself. Technologies are continuously changing and when new technologies are added to the Spine Unit it will then be possible to also evaluate their role in sustaining and supporting the existing knowledge management infrastructure. Furthermore, by making explicit the elements within the knowledge management infrastructure as they occur in Case B it is possible to get a feel for the relative complexity of various tasks and processes that are evidenced in the Spine Unit and thus be able to evaluate these to identify if modifications are required or how best to support them. It is therefore, not only possible to identify elements of the knowledge management infrastructure within the Spine Unit, but by doing so we can ensure that the knowledge management processes that occur are supported and enhanced so that the primary goal of cure for the patient is indeed realized.

Conclusion

Healthcare globally is facing many challenges including escalating costs and more pressures to deliver high quality, effective and efficient care. We believe that by nurturing knowledge management and making their knowledge assets explicit, healthcare organizations will be more suitably equipped to meet these challenges; since knowledge holds the key to developing better practice management techniques, while data and information are so necessary in disease management and evidence–based medicine. Knowledge assets implicit in both cases were described as separate, though related, elements. In both cases, the complexity of the service delivery process, driven by the complexity of the issues being dealt with by the teams, requires that many disciplines create and share knowledge to enable the delivery of a high quality care. The need for shared knowledge is a fundamental requirement for both case studies. A model of the elements of a knowledge management infrastructure was presented and used to structure implicit knowledge assets as explicit and integrated within a framework that allowed analysis of the knowledge management infrastructure extant in each case study. On comparing and contrasting the case study data in terms of the knowledge management infrastructures we have demonstrated that all constructs of the framework were evidenced. However, in Case A, the infrastructure was supported through people, in particular through capabilities and levers, while in Case B, technology, in particular the HMIS, provided the underlying support for the infrastructure. Thus, what we evidence is that in multidisciplinary teams in healthcare, knowledge management can be supported either through people or technology, depending on the requirements of the service delivery process. The reason for the different approaches seems to be rooted in the fact that Case A is a care environment, while Case B is a cure environment. These findings are indeed significant, since they demonstrate that in healthcare not only do different approaches to managing knowledge in multidisciplinary teams in order to render high quality treatment occur, but the goal of the treatment has a bearing on the chosen approach.

Another group of findings is also apparent. These concern the use of the knowledge management infrastructure model. As a result of the grouping of knowledge assets in an explicit infrastructure framework several important issues become evident. Among them is the capability of the model to demonstrate the complexity of the organization's knowledge management infrastructure. This is useful in making decisions about resourcing the infrastructure, identifying potential difficulties to be overcome and understanding the timelines involved. As well, the model is capable of indicating the gaps in the knowledge management infrastructure; hence, useful in making decisions on resourcing, difficulties and timelines.

Given the importance of knowledge management, understanding the means available to support knowledge management and explicitly develop and design an appropriate knowledge management infrastructure is indeed of strategic significance. We believe that this is not only important for healthcare but also of significance to other industries.

References

Applegate, L., Mason, R. and Thorpe, D. "Design of a Management Support System for Hospital Strategic Planning", Journal of Medical Systems (10:1), 1986, pp. 79-94.

Boland, R and Tenkasi, R. "Perspective Making Perspective Taking", Organization Science (6:35) 1995, pp. 0-372.

Boyatzis, R. 1998. Transforming Qualitative Information Thematic analysis And Code Development, Sage Publications, Thousand Oaks.

Chandra, R., Knickrehm, M. and Miller, A. "Healthcare's IT Mistake", The McKinsey Quarterly (5) 1995.

Croasdell, D.C., "IT's role in organizational memory and learning", Information Systems Management (18:1) 2001, pp. 8-11.

Davison, G. "Managing knowledge on the run: the role of temporary communication infrastructures in managing knowledge in a complex, dynamic and innovative environment", in Creating Knowledge Based Healthcare in Organisations, Wickramasinghe, N., Gupta, J.N.D. and Sharma, S.K., (eds) Forthcoming

Davison, G., and Hyland, P. "Palliative Care Teams and Organisational Capability", Team Performance Management Journal (8:3/4) 2002, pp. 60-67.

Davison, G., and Sloan, T., 'Individual behaviours in interdisciplinary teams in a complex and complicated environment: palliative care', Proceedings of the Hospital of the Future Conference Chicago, 2002

Drucker, P. "Beyond The Information Revolution", The Atlantic Monthly, Oct 1999, pp. 47-57.

Duffy, J. "The KM technology infrastructure", Information Management Journal (34:2) 2000, pp. 62-66.

Duffy, J. "The tools and technologies needed for knowledge management" Information Management Journal (35:1) 2001, pp. 64-67.

Eisenhardt, K. 1989. Building Theories from Case Study Research. Academy of Managmenet Review, vol 14, pp. 532-550.

Ellinger, A.D., Watkins, K.E., and Bostrom, R.P., "Managers as facilitators of learning in learning organizations", Human Resource Development Quarterly (10:2) 1999, pp. 105-125.

Enthoven, A., "The History and Principles of Managed Competition", Health Affairs 1993, pp. 25-48.
Hammond, C. "The intelligent enterprise", InfoWorld (23:6) 2001, pp. 45-46.
Hansen, M.T. and Oetinger, B.V. "Introducing T-shaped managers: Knowledge management's next generation", Harvard Business Review (79:3) 2001, pp. 106-116.
Henkelman, W.J. and Dalinis, P.M., "A protocol for palliative care measures", Nursing Management (29:1) 1998, pp. 40-46.
Holt, G.D., Love, P.E.D., and Li, H. "The learning organization: Toward a paradigm for mutually beneficial strategic construction alliances", International Journal of Project Management (18:6) 2000, pp. 415-421.
Jassawalla, A.R., and Sashittal, H.C., "Building collaborative cross-functional new product teams", Academy of Management Executive, (13:3) 1999, pp. 50-63.
Kavale, S. 1996. Interviews An Introduction to Qualitative Research Interviewing, Sage, Thousand Oaks.
Knight, W., "Managed Care: What It Is and How It Works", Aspen Publication, Maryland 1998.
Keaney, M., "Are patients really consumers?", International Journal of Social Economics (26:5) 1999, pp. 695-707.
Kearney, M., "Palliative Medicine - just another specialty?", Palliative Medicine; (6) 1992, pp. 39-46.
Kongstvedt, P., "The Managed Healthcare Handbook.", Aspen Publication, Maryland, 1997.
Lewis, M., Pearson, V., Corcoran-Perry, S. and Narayan, S., "Decision making by elderly patients with cancer and their caregivers", Cancer Nursing (20:6) 1997, pp. 389-397.
Maier, R. and Lehner, F., "Perspectives on Knowledge Management Systems Theoretical Framework and Design of an Empirical Study" in Proceedings of 8th European Conference on Information Systems (ECIS) 2000.
Malhotra, Y., "Knowledge Management & New Organizational Form", in Knowledge Management and Virtual Organizations, Malhotra, Y. (ed), Idea Group Publishing, Hershey 2000.
McDonald, K. and Krauser, J., "Toward the provision of effective palliative care in Ontario", in Latimer, E. (Ed), Excerpts from OMA Colloquium on Care of the Dying Patient 1996.
Mintzberg, H., "Mintzberg on Management", The Free Press, New York, 1989.
New South Wales Health Council, "Report of the NSW Health Council A Better Health System for New South Wales", 03/2000, New South Wales Department of Health 2000.
New South Wales Health Department, "A Framework for Managing the Quality of Health Services in New South Wales", State Health Publication No: (HPA) 990024, 1999,.
Pierce, S., "Allowing and assisting patients to die: the perspectives of oncology practitioners", Journal of Advanced Nursing, (30:3) 1999, pp. 616-622.
Rose, K., "A qualitative analysis of the information needs of informal carers of terminally ill cancer patients", Journal of Clinical Nursing, (8:1), 1999, pp. 81-88.
Rose, K., "How informal carers cope with terminal cancer", Nursing Standard, (11:30) 1997, pp. 39-42.
Rose, K., "Palliative care: the nurse's role", Nursing Standard, (10:11) 1995, pp. 38-44.
Sharma, S.K., and Wickramasinghe, N., "A Framework for Building A Learning Organization in the 21st Century", working paper 2002.
Srikantaiah, T.K. "Knowledge Management for Information Professional", ASIS Monograph Series, Information Today, Inc. 2000.
Thorne, K. and Smith, M. "Competitive advantage in world class organizations", Management Accounting (78:3) 2000, pp. 22-26.
Wickramasinghe, N and Mills, G., "Integrating e-commerce and knowledge management - What does the Kaiser experience really tell us?", International Journal of Accounting Information Systems, (3:2) 2001, pp. 83-98.
Wickramasinghe, N. "Practising What We Preach: Are Knowledge Management Systems in Practice Really Knowledge Management Systems?", Business Process Management Journal, Forthcoming.
Wickramasinghe, N., and Fadlalla, A., "Knowledge Management and Data Mining: Strategic Imperatives for Healthcare", working paper, 2003.
Wolper, L., "Healthcare Administration", Aspen Publication, Maryland, 1995.