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December 2007

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### Recommended Citation

Wickramasinghe, Nilmini; Bali, Rajeev; Lehaney, Brian; Marshall, Ian; and Naguib, Raouf, "Knowledge Management: The Hidden Power Behind Network-Centric Healthcare" (2007). *AMCIS 2007 Proceedings*. 313.  
<http://aisel.aisnet.org/amcis2007/313>

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# KNOWLEDGE MANAGEMENT: THE HIDDEN POWER BEHIND NETWORK-CENTRIC HEALTHCARE

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## Abstract

*The adoption and diffusion of e-health and the application of information and communication technologies (ICTs) in healthcare is being heralded as the panacea with both European and US governments making e-health a priority on their agendas. In this context, a model of network centric healthcare operations has been proffered as the best way to maximize the benefits of ICT use in healthcare as well as to facilitate the rapid sharing of information and effective knowledge building required for the development of coherent objectives and their subsequent attainment in order that the full benefits of e-health can be realized. Integral to the success and sustainability of such a model is the need to embrace the tools and techniques of Knowledge Management (KM). In this paper, we discuss the critical role of KM in such a context.*

**Keywords:** healthcare, healthcare management, healthcare operations, global healthcare, e-health, network centric healthcare, healthcare technology, ICT, knowledge management

## Introduction

During his State of the Union Address in January 2004, President Bush affirmed the intention of the Government to emphasize the role of technology in administration and delivery of healthcare in the United States (Bush, 2004). Similar sentiments have been voiced by the European leaders (The Oslo Declaration on Health, 2003; Global Medical Forum Foundation, 2005), and the World Health Organization (A Health Telematics Policy, 1997; e-health in the Eastern Mediterranean, 2005). Both European and US Governments are focusing their initiatives primarily in terms of medical information technology, in particular computerized patient records or electronic health records (Brailer and Terasawa, 2003).

It has been contended (von Lubitz and Wickramasinghe, 2005; von Lubitz and Wickramasinghe, 2006a-d; von Lubitz et al, 2006) that it is not possible to maximize the full potential of these e-health initiatives and, more generally, the application of ICT in healthcare operations unless we take a network-centric perspective. They have argued that currently the vast majority of technology applications in healthcare are platform-centric with the few notable exceptions being the use of Community Healthcare Information Networks (CHINs), Local Area Networks (LAN) or Wide Area Network (WAN)-based electronic patient records or billing/reimbursement systems; such systems connect several units within the same administrative entity - such as an Health Maintenance Organization (HMO) or a hospital system - is steadily increasing (Overhage et al, 2002; Caarlile and Sefton, 1998, Overhage, 2004; Kulkarni and Nathanson, 2005). These networks are still distinctive and disconnected entities and their operations are, essentially, platform-centric.

Platform-centricity of healthcare ICT operations leads to fragmentation and broad incompatibility of individual efforts and thus does not enable the seamless sharing of data and information critical for effecting superior healthcare operations (Valdes et al., 2003). Presently, the existing networks and e-health initiatives in healthcare represent distinctive and disconnected entities whose operation is, essentially, platform-centric, i.e. concentrates on a single system (platform) without any regard for the operational interaction among different systems (von Lubitz and Wickramasinghe, 2005; von Lubitz and Wickramasinghe, 2006a-d; von Lubitz et al., 2006). For these reasons, despite providing very significant advantages to the local users (Overhage et al., 2002; Caarlile and Sefton, 1998, Overhage, 2004; Kulkarni and Nathanson, 2005; Wickramasinghe and Mills; 2002; Wickramasinghe and Ginzberg, 2001), the overall impact of the electronic information systems on either national or international healthcare operations continues to be relatively limited (Valdes et al., 2003; von Lubitz and Wickramasinghe, 2006b) and, in addition, contributes to the escalating healthcare expenditure (Wickramasinghe and Schaffer, 2006).

## Network- centric healthcare operations

The networkcentric approach stands in direct apposition to platform-centricity (von Lubitz and Wickramasinghe, 2006a-d; von Lubitz et al., 2006; Alberts et al., 2000; Cebrowski and Garstka, 1998). The doctrine of “network-centric healthcare” calls for the development of interconnected information grids that, together, constitute a powerful and well-structured network that facilitates information sharing among all participants within the operational continuum space (Cebrowski and Garstka, 1998; Stein, 1998).

Consequent to improved information sharing is the enhancement of its quality and integrity which, in turn, escalates the level of situational awareness that is the foundation for efficient, real-time collaboration among the involved entities, their self-synchronization, and operational sustainability which leads to a dramatic increase in mission effectiveness (Cebrowski and Garstka, 1998).

As described by von Lubitz and Wickramasinghe (2006a-d) in the context of network-centricity, healthcare operations must be conducted within the intersecting territory of three mutually interconnected and functionally related domains (Garstka, 2000) as described in Table 1.

**Table 1: The Three Domains in Network-centric Healthcare**

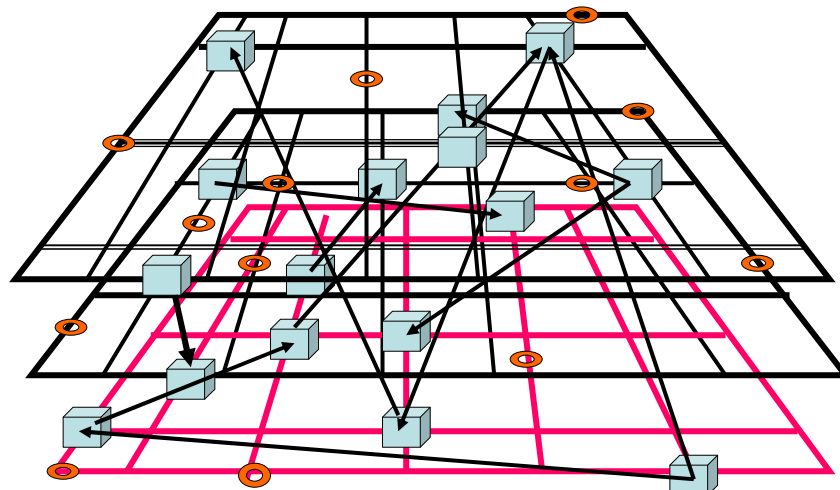
<b>Domain</b>	<b>Description</b>
<i>Physical</i>	Encompasses the structure of the entire environment healthcare operations intend to influence directly or indirectly, e.g., elimination of disease, fiscal operations, political environment, patient and personnel education, etc.
<i>Information</i>	Contains all elements required for generation, storage, manipulation, dissemination/sharing of information, and its transformation and dissemination/sharing as knowledge in all its forms. It is here that all aspects of command and control are communicated and all sensory inputs gathered.
<i>Cognitive</i>	Relates to all human factors that affect operations, such as education, training, experience, political inclinations, personal engagement (motivation), "open-mindedness," or even intuition of individuals involved in the relevant activities.

The essential and enabling technology element of NCHO is the Worldwide Healthcare Information Grid (WHIG) that allows full and unhindered sharing of information among individual domains, their constituents, and among constituents across the domains (von Lubitz and Wickramasinghe, 2006 a-d, Figure 1).

In order to perform such a function, the WHIG must consist of an interconnected matrix of ICT systems and capabilities (including communication platforms, data collection, storage, manipulation/dissemination, and sharing), associated processes (such as information and knowledge storage and retrieval, management and their dissemination/sharing), people (e.g., healthcare providers/investigators, administrators, economists, politicians, lawyers, ICT personnel), and agencies (governmental and Non-governmental organizations) at local/national/international level). Hence the network enables and supports the generation, diffusion, flow, use and re-use of relevant data, pertinent information and germane knowledge throughout the web of healthcare players (Figure 2).

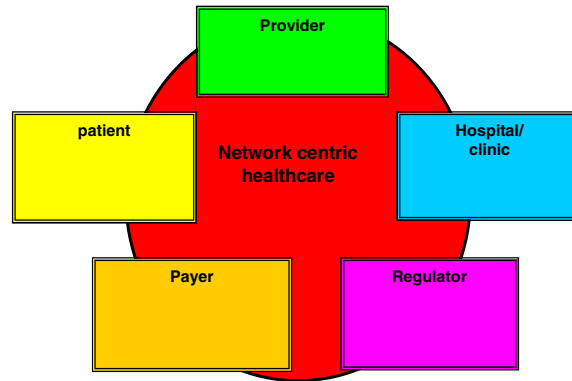
#### **Networkcentric information/knowledge grid system**

(Adapted from von Lubitz and Wickramasinghe, 2006b)



**Figure 1: Schematic of WHIG**

The interconnected grids represent the complex network structure required to support NCHCO. The ellipses located throughout the network represent entry points while the cubes represent nodes where intelligence capabilities further refine and process the data and information that resides in the network.



**Figure 2: Web of Healthcare players**

Healthcare has been shaped by each nation's own set of cultures, traditions, payment mechanisms, and patient expectations. Given the common problem facing healthcare globally, i.e., exponentially increasing costs, no matter which particular health system one examines, the future of the healthcare industry will be shaped by commonalities based on this key unifying problem and the common solution; namely, the embracing of new technologies to stem escalating costs and improve quality healthcare delivery.

Currently, the key future trends that will perhaps significantly impact healthcare include: (i) empowered consumers, (ii) e-health adaptability; and (iii) a shift to focus on healthcare prevention. Key implications of these future trends include (i) health insurance changes, (ii) workforce changes as well as changes in the roles of stakeholders within the health system, (iii) organizational changes and standardization, and (iv) the need for healthcare delivery organizations and administrators to make difficult choices regarding practice management (Wickramasinghe, 2000). In order to be well positioned to meet and manage these challenges within the US and elsewhere in the world, healthcare organizations are turning to KM techniques and technologies (Bali et al, 2005; Baskaran et al, 2006; Quinn et al, 2005). Thus, as the role of KM in healthcare increases in importance, it becomes crucial to understand the process of adoption and implementation of KM systems.

## **Knowledge Management (KM) for Healthcare**

Knowledge is a critical resource in any organization and is also crucial in the provision of healthcare. Access to the latest medical research knowledge is often the difference between life and death, between accurate or erroneous diagnosis, and between early intervention or a prolonged and costly hospital stay. KM deals with the process of creating value from an organization's intangible assets (Wickramasinghe and Mills, 2001; Edwards et al., 2005). It is an amalgamation of concepts borrowed from the artificial intelligence/knowledge based systems, software engineering, BPR (business process re-engineering), human resources management, and organizational behavior (Purvis et al. 2001). KM deals with conceptualization, review, consolidation, and action phases of creating, securing, storing, combing, coordinating, and retrieving knowledge. In essence, then, knowledge management is a process by which organizations collect, preserve, and utilize what their employees and members know about their jobs and about activities and procedures in their organization (Xu and Quaddus, 2005).

KM is a still relatively new phenomenon and a somewhat nebulous topic that needs to be explored. However, organizations in all industries, both large and small, are racing to integrate this new management tool into their infrastructure. KM caters to the critical issues of organizational adaptation, survival, and competence in the face of increasingly discontinuous environmental change (Rubenstein and Geisler, 2003). Essentially, it embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings.

The KM system is extremely helpful in internal and external sectors of an organization. Internally, KM is designed to enhance the maintenance and organization of the data bases. Externally, it aims to make a better impact on the customer and external partners. The healthcare sector is characterized by its diversity and the distributiveness of its component organizations. There is a continuous process of generation of knowledge within each of these components (such as providers, patients, suppliers, payers, and regulators), as well as an immense volume of knowledge created at the interfaces among these organizations (Jadad et al., 2000; Pavia, 2001).

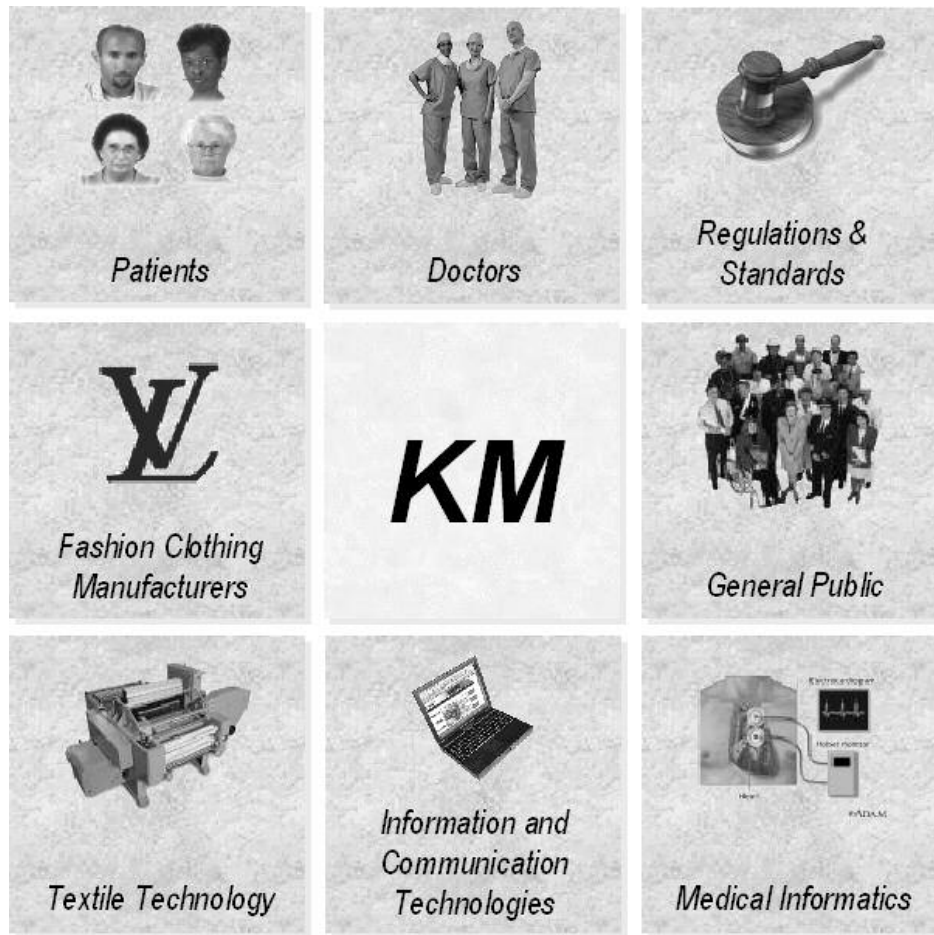
Healthcare provider organizations are special type of organizations in that they are for the most part motivated by topics such as quality and service, but without the profit drivers that animate private industry. At the same time they are highly professional institutions, populated by people with specialized knowledge that needs to be constantly updated, shared, and leveraged (van Beveren, 2003). This phenomenon creates even more pressure on healthcare providers and others in the sector to manage the knowledge that flows through the sector.

The role of KM in healthcare organizations would be important in both clinical and administrative practices. Clinical care would be much more effective with increased sharing of medical knowledge and “evidence-based” experience within and among healthcare delivery organizations (Nykanen and Karimaa, 2006). Administrative practices in healthcare organizations will benefit from the systemic interfaces of knowledge about technology, costs, “best-practices,” efficiencies, and the value of cooperation. Such effects of knowledge creation and sharing would make it easier and more effective to manage the healthcare organization. Finally, the role of KM is especially crucial in the interface between the clinical and administrative functions. By and large these two categories of activities are separated by differentiations such as professional specializations, role in the organization, and goals and standards of practice. Hence, there is a tendency to avoid sharing knowledge and exchanging experience-based lessons so as not to upset the existing balance of power of the organization.

## **Personalized Healthcare: Worked Example**

As KM deals with the tacit and contextual aspects of information, it allows an organization to know what is important for it in particular circumstances, in the process maximizing the value of that information and creating competitive advantages and wealth. A KM solution would allow healthcare institutions to give clinical data context, so as to allow knowledge derivation for more effective clinical diagnoses. KM can enable the healthcare sector to successfully overcome the information and knowledge explosion, made possible by adopting a KM framework that is specially customized in light of their ICT implementation level.

Personalized healthcare (which includes such items as smart wearable and implantable systems) has come about mainly because of the public’s desire to become more active in their healthcare decisions and well-being. Healthcare providers are exploring new ways of delivering care that is tailored to each person’s unique needs. In order for personalized healthcare to become a reality, we need to consider several necessary components. These include inputs from healthcare professionals, regulations and standards, perspectives from the general public and views from fashion clothing manufacturers. These seemingly disparate inputs can be conceptualized in Figure 3.



**Fig 3: The “carpet tile” approach**

This schematic, which we have termed the “carpet tile” approach, sees eight essential concepts (“tiles”), each one of which revolves a central concept of KM. In this conceptualization, we view KM as being both the central tenet as well as the “glue” which holds personalized healthcare together. This schematic can be used as the “foundation” layer for the WHIG schematic presented earlier in this paper.

A critical success factor would include the development of a logical design which supported the ubiquitous transfer of pertinent information and germane knowledge to aid the decision maker. Without such a knowledge architecture in place, the automation of any (and all) information would very rapidly create information overload and result in chaos. In this example, we would advocate following a systems-based approach and would develop a gestalt perspective to ensure that the whole was indeed greater than the sum of the parts.

Gödel’s theorem tells us that, in order to find a solution within a system, one must look outside the system. We contend that KM provides the solution to the current and prospective challenges for personalized healthcare as it provides the tools, techniques and strategies to facilitate the necessary paradigm shift for making our healthcare system truly functional in the twenty first century.

## Conclusion

This paper has presented the efficacy of KM within a network-centric model for contemporary healthcare organizations. We have identified such factors as technology, organizational, human and economic and facilitators both external and internal to the organization that must be considered when trying to implement an appropriate KM solution in healthcare. After describing the WHIG model, we presented a simple KM framework dubbed the "carpet tile" schematic which conceptualized a future state of modern healthcare. Taken together, these models serve to underscore the importance of taking a holistic approach to addressing the challenges currently faced by healthcare.

While medical science has made revolutionary changes, in contrast healthcare has made incremental changes at best. The disparity between these two is one of the major reasons why today's healthcare industry is faced with its current challenges. We believe that by embracing the tools and techniques of KM it will be possible for healthcare to make evolutionary changes and thereby meet patients' great expectations as well as create effective and efficient operations which will serve to stem the current trend of escalating costs.

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