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Medical Knowledge Management in Healthcare Industry

B. Stroetmann, and A. Aisenbrey

***Abstract*—**The Siemens Healthcare Sector is one of the world's largest suppliers to the healthcare industry and a trendsetter in medical imaging and therapy, laboratory diagnostics, medical information technology, and hearing aids.

Siemens offers its customers products and solutions for the entire range of patient care from a single source – from prevention and early detection to diagnosis, and on to treatment and aftercare. By optimizing clinical workflows for the most common diseases, Siemens also makes healthcare faster, better, and more cost effective.

The optimization of clinical workflows requires a multidisciplinary focus and a collaborative approach of e.g. medical advisors, researchers and scientists as well as healthcare economists.

This new form of collaboration brings together experts with deep technical experience, physicians with specialized medical knowledge as well as people with comprehensive knowledge about health economics.

As Charles Darwin is often quoted as saying, "It is neither the strongest of the species that survive, nor the most intelligent, but the one most responsive to change," We believe that those who can successfully manage this change will emerge as winners, with valuable competitive advantage.

Current medical information and knowledge are some of the core assets in the healthcare industry. The main issue is to connect knowledge holders and knowledge recipients from various disciplines efficiently in order to spread and distribute knowledge.

***Keywords*—**Business Excellence, Clinical Knowledge, Knowledge Management, Knowledge Services, Learning Organizations, Trust.

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I. Introduction

In healthcare, having the right information at the right time can become a very difficult challenge due to the sheer amount of ever-expanding knowledge.

Clinicians, administrators, industry managers, and research scientists are facing a growing body of knowledge that they have to routinely access, absorb, and utilize [1]. The volume of medical knowledge doubles itself every 17 years. New areas of research, such as bionanotechnology and genetics, are growing at a tremendous pace [2]. There is also the issue of the various formats in which information exists as well as the diverse disparate medical information sources. Taking these aspects into account, it is not surprising that knowledge management is attracting so much attention.

The healthcare industry is currently trying to become a knowledge-based community that connects hospitals, clinics, pharmacies, physicians, and customers for sharing knowledge, reducing administrative costs, and improving the quality of care [3]. The success of healthcare depends critically on the collection, analysis, and exchange of clinical, billing, and utilization information or knowledge within and across organizational boundaries [4].

The aim of this paper is to suggest the systematic knowledge management approach of Siemens Healthcare to facilitate access to reliable, relevant medical information with adequate depth.

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II. The Importance of Knowledge

The nature of knowledge has been a matter of intense discussion since the beginning of philosophy [5]. Successful organizations, according to Dorothy Leonard and Walter Swap in their new book, *Deep Smarts: How to Cultivate and Transfer Enduring Business Wisdom*, rely on people who possess knowledge that provides a distinctive competitive advantage [6]. The wealth of existing expertise, ideas, and latent insights that lie scattered across or deeply within organizations should be used to improve business performance, initiate new product developments, or improve the quality of decisions through peer advice.

Efficient and short knowledge-sharing processes are a core feature in functioning Knowledge Management (KM) projects.

According to the study by Davenport & Prusake [7], most KM projects have one of three aims: (1) to make knowledge visible and show the role of knowledge in an organization, mainly through maps, handbooks, and hypertext tools; (2) to develop a knowledge-intensive culture by encouraging and aggregating behaviours such as knowledge sharing and proactively seeking and offering knowledge; (3) to build a knowledge infrastructure: a web of connections among people given space, time, tools, and encouragement to interact.

To address this issue, we need to focus on how to: (1) represent knowledge and standardize data and process models, (2) automate business processes and human workflows, and (3) drive these processes across application and organization boundaries [8].

The whole point of KM is to make sure that the knowledge present in an organization is applied productively for the benefit of that organization.

III. Transformation in Healthcare

The medical field in recent years has been facing increasing pressure for lower costs and increased quality of healthcare.

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These two pressures are forcing dramatic changes throughout the industry. They affect not only the way how work is organized but also the workplace culture.

For Siemens Healthcare increasing quality means for example: early detection of predispositions and more efficient prevention, faster and more specific diagnosis, targeted and more effective therapy, better adapted to the individual status of the disease high-quality care. Cost pressure dictates enhanced healthcare efficiency through innovative medical imaging and laboratory diagnostics as well as through the use of powerful IT.

Also the next decade is expected to bring a great number of medical advances that not only will vastly improve patient care but also change how that care is delivered. Further escalating healthcare costs, demographic changes, increasing medical demand, increase in chronic diseases on the one hand and technological advances and the potential of truly personalized medicine on the other will transform how we approach health care. Interviews with various experts show that many of the medical advances of the next decade will accelerate the trend toward personalized medicine. The result will be more effective treatment and better patient outcomes, they say [9]. Everyone involved in healthcare industry is called up to develop sustainable solutions to provide patients with optimum care. The transformation requires even closer collaboration and action from every stakeholder.

Thus, healthcare provides need to start looking across episodes of care into the integration of care. This means having a team-approach to medicine that is enabled by having the right testing, diagnostic and therapeutic modalities as well as having information technology

Healthcare suppliers need to support healthcare providers in their efforts to deliver high quality, efficient, and environmentally friendly care. Medical engineering is probably the industry where developers and users collaborate the most. Employees often work in multidisciplinary teams; the individuals have complementary skills and expertise, but not necessarily a medical background. Nevertheless, they have to understand customers' needs and expectations extremely well. At Siemens Healthcare, customer focus is not a vague slogan. Understanding the customers' world is key and becomes increasingly important as it enables the company to tailor its efforts to their needs. The main three pillars of Siemens Healthcare strategy are:

- Understand the patient's disease
- Understand the patient's biology
- Analyse to prevent and predict

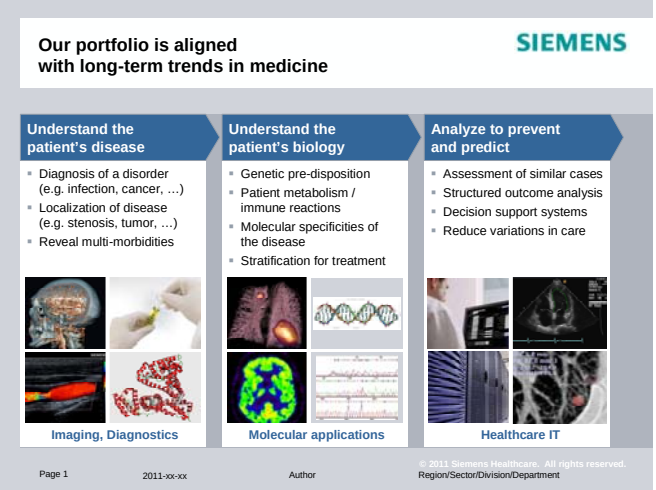


Fig. 1 Siemens Healthcare portfolio is aligned with long- term trends in medicine

Given the context's complexity, medical knowledge plays an important role in this.

IV. Importance of Actively Managed Medical Knowledge

Just as we manage our organisation's other key assets, important knowledge need to be actively managed. The required expertise of most employees is related to economics, business or technical issues, hence medical knowledge has to be actively managed.

Siemens Healthcare takes an active approach to Medical KM by executing a series of strategies to improve how knowledge is managed – including a branding strategy focused on mobilising awareness and support of the KM initiative. The organization places value on the tacit knowledge that individuals have and combines it with explicit knowledge (e.g. scientific journals, clinical workflows, guidelines) thus improving communication, collaboration and information transfer.

The co-ordination of the KM activities is performed by a dedicated team of KM "workers" that actively manage the operational KM process. They aim at improving knowledge creation and sharing processes in the organisation. Also,the team co-ordinates the basic processes of the knowledge life-cycle which comprise the Identification of Knowledge Need; Creation; Sharing; Collection and Storage and Update.

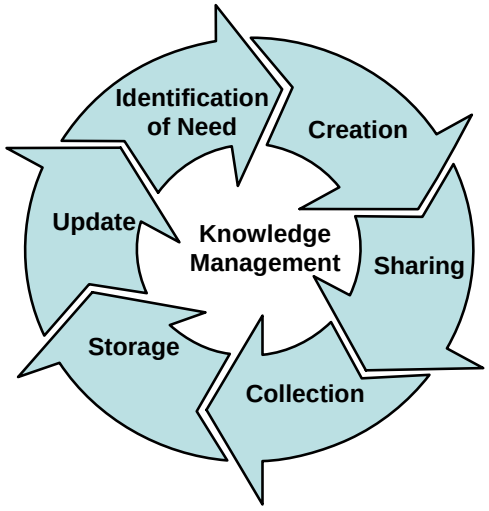


Fig. 2 The Knowledge life- cycle model

First of all, the organization had to identify its medical knowledge needs.

These were determined by profound analysis of the current and future healthcare market, demographic developments as well as screening of most life-threatening but preventable diseases like coronary artery diseases, stroke and/or lung cancer in connection to Siemens Healthcare's mission fighting the most threatening diseases. In addition, the identification and interviewing of medical experts inside and outside the firm that have a broad view in the above mentioned disease areas were key drivers in the identification of disease trends. Once the trends had been identified and researched, the findings were compared with staff skills and experiences, thus medical knowledge needs could be identified.

If the needed medical knowledge is not available, the "creation process" is initiated. The company focuses on a human-centric view of knowledge creation to enable the constructive and subjective nature of such a process. In this regards the utilization of diverse knowledge sources, drawing upon different organizational functions and professional disciplines is an essential success factor. Medical Knowledge is provided by dedicated Clinical Competence Centers; they provide the necessary breath of medical knowledge combined with extensive clinical expertise.

The "new" information together with the existing information are "collected and stored" in a web-based database named "Clinical Knowledge Base". Any input to the Knowledge base is evaluated and commented by the medical experts and thus adapted to the need of the organization. This meta-information serves to give an overview of the finding of a publication, the author, etc and to allow a better keyword search.

Siemens Healthcare's approach in successful medical knowledge "sharing" is the implementation of push-pull strategies within the organization. KM Services offered are combination of pull (self-service) and push services (facilitated transfer) specially designed to meet the needs of the organization.

For example: the information is pulled from operational, technical and clinical areas and pushed in the shortest time possible to the staff of the organization and decision makers.

The KM program offers three services. First, pull services (self-service) – contribute & retrieve knowledge as and when one's need it. Second, push services (facilitated transfer of knowledge) driven by the need of the organization. And, third, individual expert advice where peers and experts join hands to discuss and share knowledge.

As the "Clinical Knowledge Base" serves as the central platform for medical knowledge, the company places the utmost importance to keep the stored information updated and current. Basically and essentially the medical knowledge is updated whenever new medical findings become available. Every single document has a time stamp which reminds the responsible physician of the respective Clinical Competence Center to review the document and approve or reject it for the Knowledge Base.

V. Clinical Competence Centers – The Central Source of Medical Knowledge

The foundation of Clinical Competence Centers (CCC) within Siemens Healthcare three years ago was performed to provide direct access and assistance e.g. to technical engineers, scientists, sales representatives and managers that not necessarily have a medical background. Today's Clinical Competence Centers focus on Cardiology, Oncology and Neurosciences because Cardiovascular Disease (CVD), Cancer, and Stroke are the leading causes of death globally and present a huge economic burden in healthcare systems worldwide.

The members of the Clinical Competence Centres have profound expertise in the diagnosis and treatment of a specific disease or group of diseases. Their activities cover counselling and guidance of more technically-minded colleagues, as well as high-quality education and training sessions. They orchestrate cross-functional teams that jointly develop new products for a dedicated disease area thus providing a forum for the exchange of information and discussion of new ideas.

With others, these physicians also regularly monitor scientific medical literature to identify new trends, write for select publications and international medical journals. They disseminate important findings in regular intervals within the organization for example via electronic media like "the Journal Watch"

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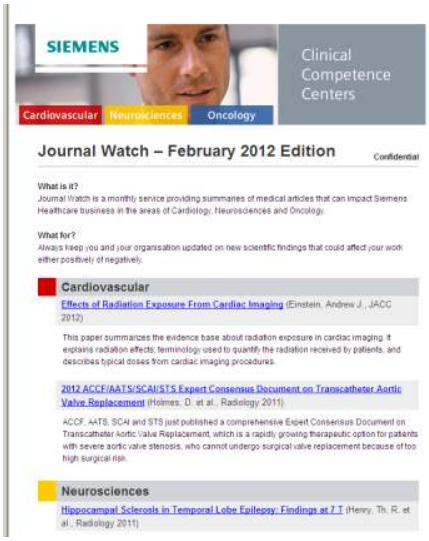


Fig. 3 Journal watch

Furthermore, the members of the Clinical Competence Centers build and maintain networks of key opinion leaders in their specialties to identify future disease trends in any early stage. They are involved in intensive international scientific cooperation and closely linked to expert centres and patient organisations. This acquired information is used to support the overall portfolio strategy of Siemens Healthcare.

As healthcare is a constant changing process, the physicians of the CCCs are also practicing in hospitals to keep up with medical progress and advances in their specialties.

VI. Clinical Knowledge-Base – the Online Platform for Disease Specific Information

Best-practice information, white papers, and select literature as well as experts' comments and relevant metadata, e.g., ICD10 codes, are stored in the Clinical Knowledge Base. The Clinical Knowledge Base is a specialized database that aims to ensure that Siemens Healthcare will have access to high-quality medical knowledge in a comprehensive, useful, and accurate way.

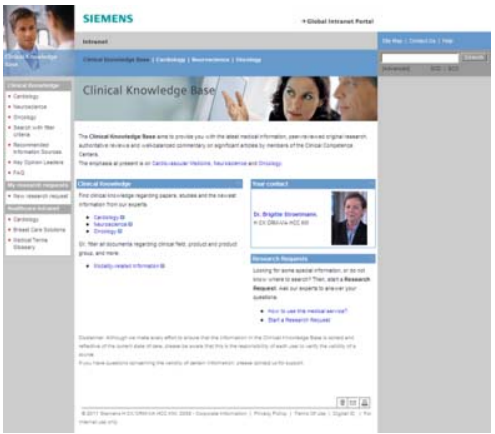


Fig. 4 Clinical Knowledge Base

With the primary focus on cardiology, oncology, and neurosciences, it allows online access to scientific medical information, review articles, and graphical presentations of disease workflows provided by the members of the Clinical Competence Centers. The unique feature of the papers presented in the Clinical Knowledge Base? Every single paper is reviewed and commented on with respect to its relevance for the Siemens Healthcare business. While it is relatively easy for clinical experts to identify relevant medical publications, it is rather complex to perform a scientific as well as business-related interpretation of each paper.

Transferring medical and clinical workflow knowledge is clearly another important focus of Siemens Clinical Knowledge Management. One example to support disease-specific sales activities is medical workflows that have been visualized with VISIO software for main diseases like stroke, prostate, and breast cancer as well as (AMI). The whole knowledge of workflows, the deep understanding of medical technology along with profound IT expertise is combined so that each single process step is described by the optimal Siemens solution as well as its medical benefits.

This close connection with ongoing business activities is considered key to successful knowledge management.

The Clinical Knowledge Base is available to everyone and can be accessed freely from any level. There is a special application built on the Microsoft SharePoint® collaboration platform for capturing, organizing, and sharing knowledge throughout the organization. It also uses workflows to drive the user through the collaboration process. The content of the Clinical Knowledge Base is consistently updated, which includes not only filling in new information but also cleaning out outdated information as well.

A. Ask the Expert Function

The Clinical Knowledge Base enables its users to post urgent requests via a simple web-based interface. Unlike emails, which must be directed to a specific recipient, the Clinical Knowledge Base guides the inquiry to the medical experts best suited to answer it. The selected expert receives an email notification with a direct hyperlink to the question. The expert answers the question in a main text field and can add attachments as desired. Via a simple "send to requester" button, the answer is sent to the questioner. He also has the opportunity to comment, e.g., on the quality of the provided answer, via the feedback button. The system is so easy to use that even newcomers quickly have medical information at their fingertips.

All requests are stored on a central database that can be searched by the members of the Clinical Knowledge Management group and the Clinical Competence Centers.

B. Support of Multiple Perspectives

In order to support different users and different tasks, a Knowledge Management System should provide various perspectives on the knowledge it stores. Managing complexity requires offering different levels of detail [10].

The Clinical Knowledge Base is designed to provide

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multiple perspectives on the same medical content for diverse user groups from different backgrounds. The diverse user groups include managers, sales representatives, and marketing people as well as research scientists organized in groups and departments in the different business units of Siemens Healthcare.

For example, a sales representative prepares a customer visit and wants to know about the latest publication on the special modality product as well as the business impact of that publication.

In another case, it may be important to get access to the customer's latest publication in a dedicated clinical field.

The Clinical Knowledge Base provides filter options that allow searching the Knowledge Base for products & product groups, document type, and regional coverage in selected disease areas.

Another user group could be a research scientist in a business unit. His research may be basic, such as investigating the underlying basis of health and disease, or it may be more applied, like conducting clinical research, investigating methods of prevention, diagnosis, and treatment of human disorders or he might sign appropriate cell and animal models, or use human volunteers to study the clinical effects of various factors. The research scientist might want to know best practices in the management of stroke patients. Via advanced search functions in the clinical knowledge base, best-practice workflows from hospitals in various European countries, performance metrics, and points of excellence are easily accessible.

C. Support of Awareness [11]

In order to foster organizational learning, a KMS should support the dissemination of knowledge. Whenever its content gets updated, users that are interested in the corresponding topics should be notified. For this purpose, a user can subscribe to certain types of knowledge or more general content.

VII. Medical Education & Web-based Trainings

Medical education plays a vital role in the healthcare industry. Continuous learning and a drive for excellence are necessary in order to achieve best solutions for patient care. The experts from the Clinical Competence Centres held regular education course and also created clinical web-based trainings, for example, Sales Executive Trainings on Cardiology, Electrophysiology, Neurosciences, and Oncology. Among others, the curriculum includes the most important diseases or clinical questions, the clinical key drivers for imaging and therapy, clinical application, and workflow topics.

With web-based access via the Clinical Knowledge Base, training can be easily paced and scheduled into the day-to-day workflow. Upon successful completion of a course, the participants receive their own certification as proof of learning.

In addition to these web-based trainings, employees also have the ability to visit class-room trainings that are organized in clinical settings. The participants have the unique opportunity to see live procedures, e.g., from the EP lab or operating theatre.

VIII. Active Employees

KM as a whole is a complex process, which requires more than an optimal information and communication infrastructure. "Too often, companies implement state-of-the-art technology and then discover that culture and behavior are slow to change, which impacts their consistency with the organization's broader business strategy and culture. The success of KM initiatives depends equally on the active involvement of everyone throughout the organization as well as on their consistency with the organization's broader business strategy and culture." [12]

Today, KM is absolutely indispensable for the company. For many years, Siemens has followed a KMS with clear objectives and approaches and with a strong commitment from the top management.

Since 2001, Siemens has been among the best finalists in MAKE, the European Most Admired Knowledge Enterprises ranking, which is conducted annually by the UK-based consulting firm Teleos. In 2010, the organization received the first-place ranking for the third time (2003, 2004, 2010).

The Clinical Knowledge Base of Siemens Healthcare is a constructive example of the company's successful KM.

The organizational benefit of the Siemens Healthcare Clinical Knowledge Management concept is the improved operational efficiency of finding relevant information when needed and a higher confidence in the quality and relevance of that information.

Siemens employees avoid performing the same tasks twice by making more effective use of the knowledge available to them in databases, archives, and documents. That helps them cut costs and save time.

The Clinical Knowledge Base of Siemens Healthcare is a constructive example of the company's successful KM.

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