Review Article

Knowledge Management and Web Ontologies: The Clinical Diagnostic Process Scenario for Ehealth Delivery Model

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ABSTRACT

There is a general recognition in the health informatics community that research on developing new methods and knowledge-mediated technologies for informed decision making according to individual patient's profile and the individual requirements of healthcare institution is essential. KMs belong to the category of information systems used to manage organizational knowledge. That is, the knowledge management systems are IT-based systems and they are developed to enhance and bring effectiveness in organizational processes of knowledge creation, storage, transformation and application. Several knowledge management components depend on IT as core enabler.

Keywords: Ehealth, Health and medical informatics, Analysis, Management of healthcare, IT & HIS, Knowledge management.

INTRODUCTION

Study proves that web technology is playing important role for the integration of information and knowledge for many years. The recent development in web technologies and rapid use of methodologies and latest technological tools has allowed knowledge representation to integrate information.

Information technology has grown drastically over the last decade due to advancement in networking technologies. Along with the advancement in size, the underlying architecture and the structural complexity has also changed. Health Information Systems is a coalescent system formed by the intersection of information sciences and health care. It is a source of rich information of medical information, which is of primary importance for the doctors, nurses or other health care experts to treat or diagnose a patient. Health Information includes the storage and maintenance of health records and protection (by law) of patient information. The systems developed and implemented are proprietary and hence have a custom architecture. The usage of Electronic Health Records is increasing rapidly leading to a huge amount of digital formats. Comprehending the mixed data is becoming increasingly complex for the physicians, which is leading to slower decision making. The integration of the data is a very tedious

and difficult process. It would require a considerable amount of programming effort to interlink the data due to different interfaces and architectures. Medical data requires a unified approach because of the promising opportunities in the field of Bio Medical research by world health organizations and agencies.

Semantic web technology provides a common framework such that it is easy to access and process information by machines. The heterogeneous nature of the health care data makes it a very suitable candidate for Semantic Web Application. It aims to analyze the data by comparing the similar ontology and then interlink the data as a whole allowing easier querying by the end user in the repository of information. There are already some efforts in this field.

Current web technologies such as Resource Description Framework (RFD) and Web Ontology Language (OWL) has changed the concept of web and made it more intelligent than the old web systems. The current web developments in knowledge management are contributing significantly for the performance of KM like; knowledge integration which is involving human role for the integration of knowledge management while introducing the social networks to increase social activities.

The clinical diagnostic process

"The diagnosis and treatment of human responses to actual or potential health problems" is somewhat defined as the response in which the prescription is made. The following process defines the outcome of the amount of knowledge involved:

Assessment

This is very important and serious step and analyses of answering some questions, e.g. what is the real problem and what is happening, or some time it depend on prediction that what might occur. In this particular step organizing, analyzing and collection some particular data about related patient to place.[1] Data collection done by examine different tests, interviewing the patients, and personal observations, normally we have subjective or objective data. Symptoms about disease that patient explains, e.g. I can't stand up, and then Signs that are normally observe by experts, e.g. swollen tissues,

Diagnosis

Diagnosis is a suggestion or statement that explains some human reaction to reality, or some kind of possible health troubles that necessitate nursing involvement.

Plan

This phase helps to give reliable and incessant care that match the patients unique desires, this is important if achieve patient targets and nursing order, patients targets are connected with patients issues as mentioned in diagnosis, and explain the required output of nursing care and nursing order explain how nurse help patient to attain specific targets.

Implementation

This phase apply the tactics required to implement nursing order. And one of the important job which involve reassessing patient, and also justify weather the care plane is precise, engaging nurses order and maintaining the chart of patient care and situations.

Evaluation

This is a comparison phase in which patients current status is compared with patient goals, and normally it consists of: assess quality of hardcopy of care plane, assess customer progress, and assess status of care plan. Nursing guidelines and

protocols are normally called nursing practice and these protocols help out the care health proper delivery. In general nurses use health care knowledge with the use of their own experiences and now a day's enabling technology is working in these kind issues.[1,2]

Knowledge management aspects

Knowledge Management (KM) in health-care can be regarded as the confluence of formal methodologies and techniques to facilitate the creation, identification, acquisition, development, preservation, dissemination and finally the utilisation of the various facets of a healthcare enterprise's knowledge assets. The health care industry has evolved into an extended enterprise-an enterprise that is powered by sophisticated knowledge and in-formation resources. In today's knowledge-theoretic healthcare enterprises, knowledge is deemed as a 'high value form of information which is central to the enterprise's 'capacity to act'. The field of knowledge management provides the methodological and technological framework to:

- Pro-actively capture both the experiential knowledge intrinsic to what are we doing vis-à-vis healthcare practice, delivery, and the empirical knowledge derived from the out-comes of what have we done; and,
- Operationalise healthcare knowledge to serve as a strategic decision-making resource, vis-à-vis an ensemble of business rules, trend predicting insights, workflow analysis, analytic outcomes and procedural guidelines and so on.

Healthcare enterprises can be regarded as 'data rich' as they generate massive amounts of data, such as electronic medical records, clinical trial data, hospitals records, administrative reports, benchmarking findings and so on. But, in the same breath we can say that healthcare enterprises are 'knowledge poor' because the healthcare data is rarely transformed into a strategic decision-support resource. For that matter, with the emergence of technologies such as KM and Data Mining (DM), there now exist opportunities to facilitate the migration of raw empirical data to the kind of empirical knowledge that can provide a window on the internal dynamics of the healthcare enterprise. We argue that such data-derived knowledge can enable health-care managers and policy-makers to infer 'inherent', yet invaluable, operative principles / values / know-how / strategies pertinent towards the improvement of the operational efficacy of the said healthcare enterprise.[3] We contend that the operational efficacy of a healthcare enterprise can be significantly increased by,

- Procuring diverse facets of empirical knowledge from the seemingly placid healthcare data repositories; and,
- By operationalising the pro-cured empirical knowledge to derive a suite of packaged, value-added Strategic Health-care Decision-Support Ser ices (SHDS) that aim to impact strategic decision-making, planning and management of the healthcare enterprise.[4] The vantage point of the aforementioned SHDS is that they provide strategic insights/ recommendations/predictions/analysis to assist healthcare managers/policy-makers/analysts to device policies or make strategic decisions or predict future consequences by taking into account the actual outcomes/ performance of the health-care enterprise's current operative values which may not necessarily be the same as the espoused operative values.

Present scenario of the eHealthcare delivery model

The healthcare ecosystem is changing. The confluence of several critical factors is necessitating a comprehensive re-evaluation of healthcare systems and the delivery of care. Established healthcare systems in developed countries find the need to address the predicted chronic disease epidemics and the demands of an aging population. In developing systems, healthcare modernization is a priority as we witness a rising prevalence of 'Western' diseases. The explosion of data and associated implications for data management will also need to be tackled. These exacting challenges will also create exciting opportunities to build healthcare systems of the future that are underpinned by enabling technology. This eHealthcare environment will focus on patient-centric systems that reduce complexity, improve efficiency, and provide better patient outcomes.

In developed systems, health information exchanges (HIEs) have been proposed as one model to assist in forming, maintaining, and strengthening physician/ patient relationships for chronic care. The rationale is that HIEs allow physicians to access a complete view of their patients' treatment plans, including factors such as adherence levels. Physicians can then coach patients through the long-term behavioral changes required to maintain their health and keep costs in check. Over the past few years, information systems have become increasingly important in healthcare delivery. The use of computers in a wide range of medical applications and healthcare management is one potential alternative to reducing the overall costs of healthcare delivery. Further, the use of sophisticated decision support systems is envisaged to improve quality of clinical decision making. While hospitals and other health organizations have information systems departments to handle and process the continuous flow of information, from patient to insurance data, and universities (particularly medical schools) are attempting to develop curriculum in healthcare information systems, research in design, implementation and use of information systems in healthcare has been somewhat limited to medical schools and healthcare providers. A literature review of mainstream MIS and Management Science journals clearly indicates that healthcare information systems research has not been accepted entirely into the MIS field. Thus, there is a need to identify and develop a framework.[1]

Medical informatics

Is the field concerned with "the cognitive, information processing, communication tasks of medical practice, education, research, including the information science and technology to support these tasks".

Electronic Patient Record: According to the Medical Records Institute, the electronic patient record is a "computer-stored collection of health information about one person linked by a person identifier." The institute further identifies five distinct levels of computerization for patient information systems:

- Level 1: in this level, health organizations are still depending on paper-based medical records.
- Level 2: Here, the goal is to digitize the medical record and create an electronically available record;
- Level 3: the electronic medical record is the upgraded version of the computerized medical record.
- Level 4: here, the electronic patient record combines several enterprise-based electronic medical records concerning one patient and assembles a record that goes beyond the enterprise-based retention period;

- Level 5: the more comprehensive collection of an individual's health information is the electronic health record.

The development of EMR systems presents a unique opportunity to support and further the nation's health research enterprise. To date, the utility of health information networks has been seen as related primarily to reducing healthcare costs, limiting medical errors, and generally improving the standard of care. While these benefits are important, there is another critical element in the healthcare continuum that could greatly benefit from the development of EMR systems: medical research. Studying large samples of medical records or clinical datasets could be an essential step toward understanding the etiology and progression of disease, treatment methods, its outcomes across varied populations and disease groups.

This leads to the development of a system in which with interpolating clinical ontologies and EMR Environment the new set of references are derived which will be beneficial in understanding the complex behavior of the EMR in distributed database environment.

As emerging technologies, semantic Web and SOA (Service-Oriented Architecture) allow Business Process Management System to automate business processes that can be described as services, which in turn can be used to wrap existing enterprise applications.[4] Business Process Management System provides tools and methodologies to compose Web services that can be executed as business processes and monitored by Business Process Management consoles. Ontologies are a formal declarative knowledge representation model. It provides a foundation upon which machine understandable knowledge can be obtained, and as a result, it makes machine intelligence possible. Healthcare systems can adopt these technologies to make them ubiquitous, adaptive, and intelligent, and then serve patients better.

Knowledge Translation in Health Care uses the Knowledge-to-Action Cycle1 as a guiding framework to define and describe Knowledge Technology (KT), and outline strategies for enhancing KT capacity and facilitating the implementation of KT activities.[5]

For this we need a precise framework of regulations in order to maintain appropriate and structured health care documentation that ensures that the information maintains a sufficient level of quality to be used in treatment, in research and by the actual patient.

People involved in KT research and practice need to identify information from several categories:

- Evidence and evidence summaries (e.g., systematic reviews, clinical practice guidelines, health technology assessments [HTAs]).
- Evidence to develop knowledge syntheses that form the basis of guidelines.
- Successful KT interventions.
- Information describing the theoretical bases (e.g. KT models or frameworks) important for designing and evaluating KT.

While an enterprise architectural approach is appropriate for business and IT alignment it also has potential with respect to the design and implementation of healthcare applications by effective representation of healthcare processes.

With this information and the data available over the internet for the different healthcare delivery model the study project was compiled and the research objective was defined.

The personal server & the application of healthcare knowledge framework

The current wide availability and decent cost of the asynchronous digital subscription line (ADSL) connections provide practical means for transferring the imaging studies to the homes of the consulting specialist doctors. This is an important factor of success of the application. The consultants are also working as private practioners after- hours, enabling them to work at home at the time they prefer, make the work more attractive, reduce the costs, and increase their productivity. (See figure 1.)

The above diagram will give a clear cut idea of n- tier healthcare knowledge framework.

This can be used for EMS, where in all the necessary equipments will be attached to a handheld & they will be interconnected by either WIFI or 3G network to the Data Server at the hospital where the doctor on call can see the actual readings of the patients remotely. Even the Ambulance can be notified by a SMS Gateway for the availability at the patient's disposal. In this way the Healthcare Knowledge Framework was designed in accordance with Clinical Protocol Guidelines & Clinical Practices.

Ontologies & healthcare

The ontology based framework is developed for the counselling on personal health by including personal health records. This framework uses ontology to match personal health data with medical treatments, maintain a data transmission between patients and system. Every dynamic change is observed to trigger alerts.[4] Intelligent service deduction and knowledge inference technology is used to recognize a situation and provide customized healthcare services. The ontology here is tested to share knowledge between the different stake holders in the pipes project for diabetic control. In intensive care unit, medical ontology is used to register health problems. The healthcare system that combines frame based representation, description logic is used to store patient information. This paper proposes an ontology based knowledge framework that provide personalized healthcare by retrieving all necessary knowledge such as patient care, insurance policies, drug prescriptions etc. The developed ontology allows the users and physicians to manage and even create context aware new medical workflows without the intervention of IT people. But the system does not use any semantic rule engines for knowledge retrieval and reasoning.

CONCLUSION

We feel that a good knowledge management system can also help healthcare organizations in improving their policies and can change the organizational cultural environment. By conducting training sessions using KMs healthcare organizations can also increase the practical abilities of their clinical staff and will also is helpful for support staff and supervisors for guiding their staff with much better approach.

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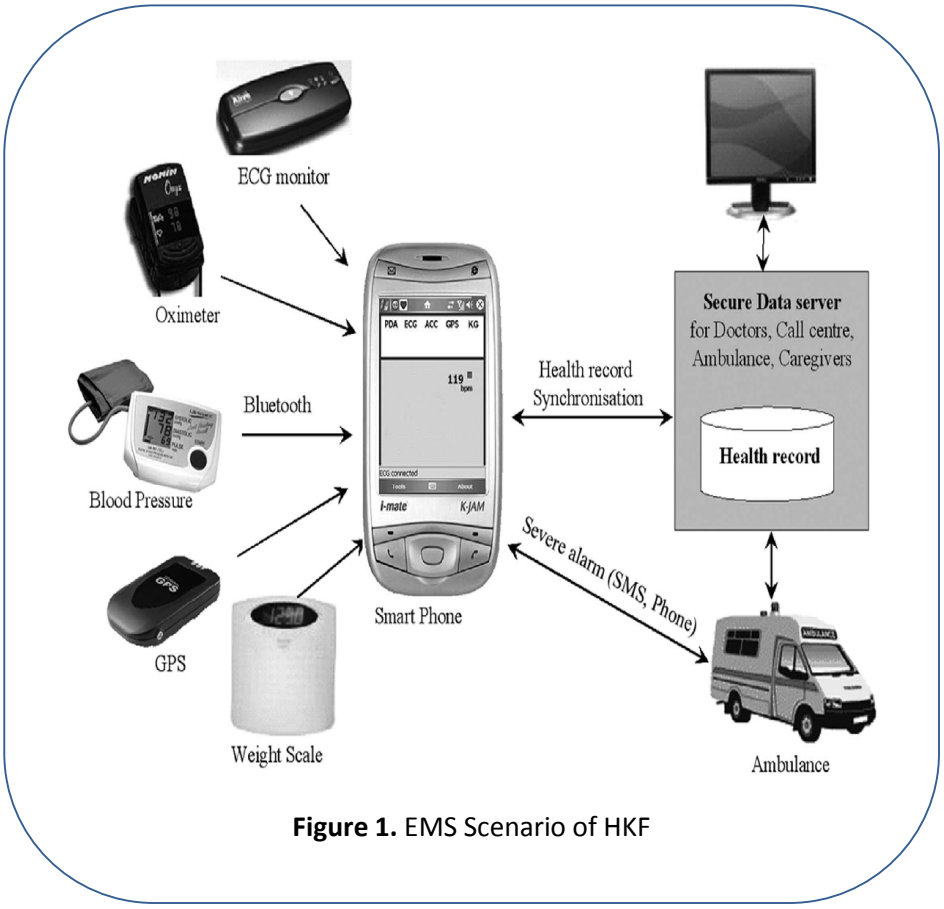

Figure 1. EMS Scenario of HKF