A Medical Decision Support System (DSS) for Ubiquitous Healthcare Diagnosis System

Regin Joy Conejar ¹ and Haeng-Kon Kim* ¹

¹School of Information Technology, Catholic University of Daegu, Korea
regin@cu.ac.kr, *hangkon@cu.ac.kr

Abstract

Decision support is a crucial function for decision makers in many industries. Typically, decision support systems help decision-makers to gather and interpret information and build a foundation for decision-making. Medical Decision Support Systems (DSS) play an increasingly important role in medical practice. By assisting physicians with making clinical decisions, DSS are expected to improve the quality of medical care. In this paper we propose DSS for ubiquitous healthcare system with the use of decision support system. The decision support system is also capable of making decisions based on the diagnosis of estimated health situation in a comprehensive set of recommendations for the ethical development and application of DSS.

Keywords: MDSS, Ubiquitous Healthcare, Decision Support System

1. Introduction

The healthcare industry generates massive amount of data. Information Technology (IT) is, therefore, used extensively to capture and transfer information [1]. Healthcare industry is growing fast by using IT to automate its many processes like transaction, inventory keeping and maintaining records, thus eliminating mundane and repetitive processes. [2] Healthcare is the management, prevention and the treatment of illness and the main aim is to provide clean and effective services that lead to the preservation of mental and physical well-being of humans and animals.

Medical decision-support systems (MDSS) are computer systems designed to assist physicians or other healthcare professionals in making clinical decisions. MDSS can help physicians to organize, store, and apply the exploding amount of medical knowledge. They are expected to improve the quality of care by providing more accurate, effective, and reliable diagnoses and treatments, and by avoiding errors due to physicians' insufficient knowledge. In addition, MDSS can decrease healthcare costs by providing a more specific and faster diagnosis, by processing drug prescriptions more efficiently, and by reducing the need for specialist consultations [3]. The medical diagnosis of an illness can be done in many ways; from the patient’s description, physical examination and/or laboratory tests.

Most MDSS cover only a narrow field of medical knowledge and exhibit a significant decline of their performance if they are used at or beyond the border of their intended scope. The impact of MDSS on the quality of care should be monitored continuously by rigorous outcome studies. In addition, MDSS should provide a method to capture those cases, by which the user overrides the system's advice. The diagnostic advice of MDSS will always be
limited because the system can process only a small portion of the patient data available to the physician.

Various problems such as inadequate coordination and communication among providers, misaligned incentives, and poor information management have a negative impact on the health of patients which can drive up spending on health care unnecessarily. Many of these problems stem from fragmentation, lack of integration and a focus on particular services rather than the holistic needs of patients, which characterize care in our health system today. Making the needed improvements will require nothing less than a transformation in how patient care is delivered.

Transforming health care delivery so as to better meet the needs of patients will require changes to strengthen delivery of care for patients who already have good access to services, as well as changes to improve care for patients who find it harder to get the care they need. In both cases policymakers and health care experts are eying new and emerging models of health care delivery as potentially better positioned to meet the challenges of growing complexity in health care and the expectations of actively engaged patients.

2. Related Works

2.3. Innovation in Healthcare

Innovation in healthcare continues to be a driving force in the quest to balance cost containment and health care quality. Healthcare innovation can be defined as the introduction of a new concept, idea, service, process, or product aimed at improving treatment, diagnosis, education, outreach, prevention and research, and with the long term goals of improving quality, safety, outcomes, efficiency and costs [4].

The conceptual framework for innovation in healthcare is as shown in Figure 1. The healthcare organizations serve six distinct purposes – treatment, diagnosis, prevention, education, research and outreach. In serving these purposes, healthcare organizations must manage quality, costs, safety, efficiency and outcomes. At the very core of healthcare innovation are the needs of patients and the healthcare providers who deliver care. Healthcare innovation focuses mainly on three areas– a) how the patient is seen, b) how the patient is heard, and c) how the patient’s needs are met.
2.2. Healthcare Engineering

The use of systems-engineering tools leads to innovation in health care. These engineering-information technology based tools have been used in a wide variety of applications to achieve major improvements in the quality, efficiency, safety or customer-centeredness of processes, products, and services in various manufacturing and services’ industries. However, the healthcare sector as a whole has been very slow to embrace them, even though they have been shown to yield valuable returns to the growing number of health care organizations (Fone et al., [25]).

Healthcare Engineering tools could be used to measure, characterize, and optimize performance at higher levels of the health care system (e.g., individual health care organizations, regional care systems, the public health system, etc.). There are wide varieties of healthcare engineering tools, some of these are discussed below:

2.2.1. Healthcare Decision Support System

Healthcare Decision support systems are gaining an increased popularity in various domains of health care. They are especially valuable in situations in which the amount of available information is prohibitive for the intuition of an unaided human decision maker and in which precision and optimality are of importance. Healthcare Decision support systems can aid human cognitive deficiencies by integrating various sources of health information, providing intelligent access to relevant medical knowledge, and aiding the process of structuring health decisions. They can also support choice among well-defined alternatives and build on formal approaches, such as the methods of operations research, statistics, and decision theory. They can also employ artificial intelligence methods to address heuristically problems that are intractable by formal techniques. A healthcare decision support system provides an important, relevant checkpoint based upon the previous diagnostic information. Information delivered can include general clinical knowledge and guidance, intelligently
filtered and presented at appropriate time. There are four components of a Healthcare decision support system:

1. The knowledge base which consists of compiled information that can be in the form of rule base or case base.
2. The second part is the model base that contains the formulas for combining the rules or associations in the knowledge base with actual patient data.
3. Third component is a User interface, which is a way of getting the patient data into the system and getting the output of the system to the user who will make the actual decision.
4. Fourth is the data base system. The data may be originally entered by the clinician, or may have come from laboratory, pharmacy, or other systems. Output to the clinician may come in the form of a recommendation or alert at the time of order entry, or, if the alert was triggered after the initial order was entered, systems of email and wireless notification can be employed.

2.2.2. Data Mining

Healthcare databases are well known for the complexity and diversity of data contained within. Healthcare industry today generates large amounts of complex data about patients, hospitals resources, disease diagnosis, electronic patient records, medical devices etc. The large amount of data is a key resource to be processed and analyzed for knowledge extraction that enables support for cost-savings and decision making. Data mining brings a set of tools and techniques that can be applied to this processed data to discover hidden patterns that provide healthcare professionals an additional source of knowledge for making decisions. These patterns can be utilized for clinical diagnosis.

2.3. DSS in Healthcare: An Overview

Decision making in healthcare is primarily done in two areas. The first area (lower level) involves patient management, diagnosis and treatment, record keeping, finance and inventory management. The other area involves higher level decision making that gives the hospital a competitive edge. The shareholders that play an important role in lower level decision making constitute of doctors and nurses. One such DSS that encompasses all functions from patient management to inventory management was designed by UK General Practice and is named PRODIGY (Prescribing Rationally with Decision support In General Practice Study). It provides access to clinical knowledgebase on the best evidence available about conditions and symptoms managed by primary healthcare professionals. Aimed at nurses, pharmacists, and patients, it provides full text guidance, quick reference guides, patient’s information leaflets, information on drugs, and self help contacts.

DSS helps in diagnosis by providing a dictionary of health problems to the clinicians or by displaying background information about specific patients. It also provides assistance with diagnosing a patient’s condition, guide to proper drug usage, reminders to administer preventive services to give patients at specific time. One of the products in this domain is Isabel, a web-based system that has been interfaced with electronic patient/medical record. It has two component systems: Isabel Diagnosis Reminder System (IDRS) and Isabel Knowledge Mobilizing System (IKMS). IDRS gives the doctors and physicians a likely list of diagnoses for given set of clinical features that are based on symptoms, signs and result of tests. IKMS has a dictionary of 10,000 diagnostic categories which help the doctors and physicians to do concepts search instead of keyword search in the in-built knowledge silos present in the system.
2.3. Expert System

Expert systems have applications in many domains. They are mostly suited in situations where the expert is not readily available. In order to develop an expert system the knowledge has to be extracted from domain expert. This knowledge is then converted into a computer program. Knowledge Engineer performs the task of extracting the knowledge from the domain expert. Rule based expert systems are the most commonly known type of knowledge based systems. Figure 2 shows different modules for a rule-based expert system.

![Figure 2. Expert System Components](image)

Expert systems have been developed and applied to many fields. Knowledge is a theoretical or practical understanding of a subject or a domain. In other words, Knowledge is the sum of what is currently known. Diagnosis system is a system which can diagnose diseases through checking out the symptoms. A knowledge based online diagnosis system is developed for diagnosis of diseases based on the knowledge given by doctors in the system. All health care professionals including doctors medical students, pharmacists can keep their knowledge up-to-date regarding as its knowledge base external database is updated on regular basis.

3. DSS Design

The given Figure 3 explains the concept of Adoptive Medical Diagnosis System (ADMS). A diagnosis system usually starts with the patient complaints and the doctor learn more about the patient situation interactively throughout an interview. In this system, patient comes to doctor with his disease. Now, doctor is interviewing the patients regarding their diseases and tries to find possible disease. When doctor find the possible disease then write the prescription for that disease and give to the patient for treatment.
4. Proposed System

A Medical Diagnosis System is developed with the purpose of assisting the Physician in diagnosing several diseases. It retrieves data from previous records to improve the accuracy of current diagnosis, indicates and analyses laboratory exams and lists all the possible diseases that the patient may have. The main objective of this system is to produce relevant data and information for consultations, and with the results obtained at this stage, produce possible diagnoses.
Figure 4. Decision Support System

5. Conclusion

Many developing countries are facing the shortage of medical experts in medical field. Due to shortage of medical expert they are getting a huge queue of patients in hospitals. Especially in rural areas we have young medical expert or don’t have medical expert. This Medical Decision Support System can be substitute by using Decision Support System. This is very useful to diagnose patient diseases and prescribe the good prescription to the patients as a human medical expert. Also this system can be applied anytime, anyplace, any hospital to provides medical prescription for general diseases. DSS certainly have the potential to help clinicians master the exploding amount of medical knowledge and thereby improve the quality of care.

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