

Decision support methods in healthcare



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Introduction

Currently, healthcare practitioners are working hard to ensure that the safety of patients is guaranteed. They are also working toward averting expensive lawsuits that result from medical malpractices. Additionally, medical practitioners have devised mechanisms for the bar-coding of medicines, patients, and nurses to ensure that patients receive safe medicines and quality healthcare services (Tan, & Sheps, 1998). Some healthcare systems are using decision support methods and relational database design to make effective decisions concerning patients care. In this paper, I will discuss the decision support systems and relational database design of Partners HealthCare System, Inc.

Partners HealthCare System, Inc. uses complex medical intelligence systems to enable doctors and nurses make efficient decisions as pertains to patient care. Electronic Medical Administration Record (EMAR) is one of the database management systems that the healthcare system uses to make decisions and carry out its activities. Partners HealthCare System is a network that consists of various healthcare facilities. The network has medical centers, community hospitals, specialty healthcare services, and several basic healthcare specialists (Lighter, & Fair, 2000).

Partners HealthCare System, Inc. employs Oracle and SQL for the warehousing of its data. It also uses it for data mining and OLAP applications. Additionally, the organization makes wide use of CACHE, an Intersystem Corp based in MA, for various clinical purposes. The HealthCare System separates their mission to offer important healthcare for patients from other

applications. Moreover, the System selected CACHE because of its highly availability, and high demands of effective patient care.

CACHE forms a significant part of Partners relational database design and web application setting. It is particularly relevant to Partner's mission in clinical applications because of the technology's use of algorithms and schemas that store data effectively. The performance of the database is enhanced by the sparse matrix storage method. The organization manages the application of CACHE over the web and this helps the Partners to have an advanced and substantial processing of transactions. CACHE has a distributed protocol, which effectively lessens network traffic (Shortliffe, & Cimino, 2006). Consequently, there is increased processing of transactions. Additionally, it is easy to scale up the technology to serve several users without compromising its performance.

CACHE technological innovation is a significant tool for the development of applications for patient care because it handles data in a more flexible way than other conventional relational database structures. The clinical department of Partners HealthCare System has complicated forms of data. Consequently, a lot of data cannot be classified effectively into two-dimensional systems. The advantage of CACHE is that it can consider data in two or more than two dimensional structure when necessary (Harrington, 2002).

Partners HealthCare System Inc. has developed a modern wireless EMAR as an artificial intelligence for patient care. This development has particularly replaced all paper works carried out by nurses in recording medicine

dispensation to patients. Moreover, EMAR technology uses advanced decision support systems and features that promote client safety. Through the technology, the medications in storage facilities, such as the pharmacy dispensing equipment, is bar-coded to enable nurses to scan the ID to verify that correct medications are supplied to the right clients. Additionally, the practitioner can scan his or her ID badge to create a completed inventory track of the medication course.

Highest verification of medication procedures, as indicated by one of Partners' nurses, takes place in the pharmacy. When the medical practitioner feeds information into the system concerning the prescription, the medication order is examined before it is made available for the nurse to deal with. Some artificial intelligences employed in the prescription are based on probability of medication reactions, likely patient reactions to the medications, and likelihood of overprescribing drugs to patients in relation to previous prescriptions.

EMAR technology constitutes of several electronic reminders that help nurses in their daily medication prescriptions thereby enabling them to solve problems arising during patient care processes. For instance, the technology provides cues that remind nurses concerning such issues like prescription overdue, or recording of patient's pain level to decide whether the administration of a particular medication is effective or not. However, nurses take into consideration that EMAR checking does not replace their role in evaluating situations to make decisions (Shortliffe, & Cimino, 2006). The checks enable nurses to have confidence that the safety of patients is guaranteed.

EMAR is compressed in wireless computers and laptops with readers of barcodes, and this allows nurses to move closely to the patients with their computer system. By bringing the scanner to the patients' bedside, risks and errors are eliminated. For instance, if a medical practitioner enters a wrong medication order after a drug prescription at the pharmacy, the nurse will receive an alerting message on his or her laptop screen, as he or she scans the patient prior to drug administration. Artificial intelligence innovation for decision support is employed by various medical practitioners to make the decision support systems more useful.

CACHE technology serves an important role in enhancing workflow among healthcare systems and benefits contributors. Through CACHE applications, insurance organizations are connected with healthcare systems to deliver services to patients. CACHE applications promote the workflow between third-party companies and Partners HealthCare System. For instance, relational database design of a real-time query between the healthcare organization and insurance firms aids in determining eligibility for benefits. This affects the organization's capacity to collect finances for a medical situation while improving the workflow (Wager, Lee, & Glaser, 2005).

Applications have been developed to connect Partners' system of order entry of medications to database of pharmaceutical organizations to ascertain whether particular medications are covered by particular payers. The incorporation of this element into the drug prescription process has resulted in improved workflow in drug prescription, and it ensures that Partners HealthCare System, Inc. is compensated for the medications prescribed.

Partners HealthCare indicates that CACHE applications have benefits associated with their usage. This technological innovation employs open standards. Consequently, it enables interoperation among several platforms. Therefore, CACHE is crucial in the implementation of web services to link several systems. CACHE is also cheap because Partners achieve their mission for patient care from the product hardware without necessarily investing large amounts of funds in other technologies. Moreover, CACHE applications do not require complex management as compared to SQL and Oracle developments. CACHE is more accessible and easy to maintain whereby medical practitioners use computers directly in healthcare settings (Shortliffe, & Cimino, 2006).

The figure below represents an entity-relationship model used in Decision Support Methods in Healthcare and Relational Database

Adopted from: <http://www.andrew.cmu.edu/user/rpadman/Data%20management%20technologies-%20day%202%20slides.ppt>

Health and Human Services (HHS) department indicates that there is need for the advancement in the database systems of healthcare services to create a nationwide database that uses electronic medical recording to trail an individual's dealings with the healthcare system from birth till death. As a means of staying relevant to the HHS requirement, Partners HealthCare System has implemented an electronic health information management (e-HIM). This requires the healthcare organization to guarantee the accessibility of information to promote advanced healthcare provision and essential health matters required to make decisions for use in various environments

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and organizations. Nevertheless, these objectives will only be realized when there is efficient, accurate, reliable, and secure storage of information in efficiently designed automated databases (Wager, Lee, & Glaser, 2005).

Relational database is the most common kind of database employed in healthcare systems. It tracks patient care including various forms of treatment, results from the treatments, and significant indicators of states of patients such as pulse rate, level of blood pressure, and blood glucose. Moreover, relational database interlinks with several information structures in healthcare service systems such as Partners. For example, a relational database in the section of cardiac care is linked directly with the registration system of the healthcare facility. Once a patient is registered, information concerning him or her is relayed to the database through health level seven procedures (Shortliffe, & Cimino, 2006). This allows cardiac care practitioners to focus on offering the best care to the patient because they do not need to register the patient again.

Relational database reduces the need for paperwork in recording and transfer of information. It also improves efficiency in healthcare systems while acting as an accounting tool. For instance, patients suffering from diabetes, who exhibit fairly similar signs and symptoms such as overweight and high levels of blood glucose, can be closely examined to ascertain the manner in which various medications, like Glucovance, help in managing their symptoms. Moreover, relational database is essential as it determines patients at risk, for instance, individuals with aneurysms in family history. When these patients are recognized they undergo screening to avoid suffering from certain ailments (Wager, Lee, & Glaser, 2005).

Decision trees are used in Partners HealthCare System and other healthcare facilities to help in solving of clinical and healthcare problems. With the increase in the difficulty of clinical problems, there is an exponential increase in the probabilities and uncertainties, and this means that sophisticated solutions, rather than the simple ones, are required. Consequently, in these scenarios, decision trees become more suitable because they take into consideration weighted probabilities and anticipated outcomes (Harrington, 2002).

Decision trees help in clinical situations because they present precisely and instructively the procedures with which the medical practitioner provides care to a patient as indicated by clinical and laboratory diagnostic results. The extensive procedures are routinely attained at basing on previous use of algorithms and decision trees in solving clinical problems. Medical practitioners use such procedures cautiously when practicing clinical medicine. When using decision trees, the physicians recognize that clinical decision models are different from mathematical representations. When protocols are employed to give directions, they prevent undesired or costly clinical processes (Tan, & Sheps, 1998).

Protocols are normally used to evaluate benefits of using a particular prescription or a new type of drugs. Accurate protocols allow for the collection of information from various healthcare facilities because patients are put under a stringently defined management process. Moreover, if the protocols are accurately defined and monitored, wise conclusions are reached at when drugs are used effectively.

Protocols and other decision making techniques have various advantages. They enable clinical practitioners to efficiently learn on how to solve clinical problems. They enable medical practitioners to formulate some questions that enable them to define clinical problems at hand. They present precise scientific and systematic procedures for solving clinical problems. Moreover, they are efficient as regards to time, effort required, and cost. Decision trees and protocols form the foundation upon which significant knowledge of particular clinical problems is evaluated. Additionally, these decision making tools help medical practitioners to consult each other concerning particular clinical problems, and they form suitable means to evaluate clinical activities.

Decision trees and protocols are also beneficial to patients because they increase the probability that the patient will receive high quality care, maximum effective results from medications, and more effective medical aid. Moreover, decision trees enable the avoidance of unnecessary prescriptions and medicines thereby assuring the client that only the necessary treatment is achieved. Furthermore, these tools ensure cost-effective and standardized treatment. Below is an example of a decision tree for appendicitis (Wager, Lee, & Glaser, 2005)

Perforated

Operate inflamed

Decide now Perforated

Not operate inflamed

Perforated

Patient worse

Inflamed

Perforated

Wait seven hours

Patient same Inflamed

Expert systems and decision making techniques entails the clinical decision support systems CDSSs, which are computer programs devised to offer expert support to healthcare practitioners in the making of clinical decisions. These expert systems employ integrated clinical information to enable doctors to evaluate data concerning patients thereby making relevant decisions as concerns to the diagnosis of diseases, their prevention and medication. Expert systems are available in various healthcare departments including pharmacy, dentistry, and medicine (Lighter, & Fair, 2000).

Many CDSSs constitute of four fundamental components. These are inference engine (IE), knowledge base (KB), working memory, and the explanation module. The inference engine is the major part of the system, and it uses the information stored in the system together with the information about the patient to make decisions concerning particular situations. Moreover, the IE manages the kind of activity that the system can initiate. For instance, it establishes the alert and reminder procedures in an alerting mechanism. Moreover, it determines the conclusions or decisions

that can be displayed on the screen of the diagnostic system. The KB represents the information used by the IE. For instance, in a case of caries, the KB will present information concerning the risks for fresh lesions and their levels. Knowledge bases are created either by a domain expert or by a computerized procedure. The creation of knowledge by an engineer involves the assistance of a clinical domain specialist who edits and manages the KB. On the other hand, in a computerized process, information is obtained from external sources that include journal articles, books, and database using a particular computer application (Harrington, 2002).

Information collected concerning a patient is stored in the database or modified into a message. This forms the working memory. Patients' information ranges from demographic features such as gender and date of birth, drugs in use, allergies, and previous medical problems, among other data. All CDSSs do not contain the explanation module. The explanation module serves the purpose of creating validations for the decisions made by the IE when using the information in KB against patient information within the working memory.

CDSSs work in a synchronized manner in that they communicate directly with the medical practitioner who waits for the information from the system. An example of this application is one which examines interactions between drugs or likely allergies experienced by patients in response to particular prescribed medicine. When working in a synchronous approach, CDSSs carry out their rationalizations in an independent manner without the aid of any user (Gillies, 2002). For instance, the production of a reminder for a checkup or hygiene takes place independently.

Clinical Decision Support Systems are categorized as either open or closed loop structures. In open-loop system, the CDSS makes decisions but it does not initiate an action on its own. Examples of open-loop systems are applications that produce alerts or reminders. The eventual decision concerning the activity to be performed is determined by the medical practitioner. On the other hand, in closed-loop systems, the system initiates the action without involving a medical practitioner.

Other significant types of CDSSs include consultation systems, clinical guidelines, and event monitors. A consultation system entails situations where a medical practitioner enters information concerning a patient into the system. Information entered may include patient demographic characteristics, medical history, and physical diagnosis, among others. The system then lists the problems related with the situation and provides possible solutions. An event monitor, on the other hand, constitutes of software that collects all data copies accessible in electronic design within the healthcare facility and employs its knowledge base to relay alerts and reminders to medical practitioners when necessary (Lighter, & Fair, 2000).

Clinical instructions are integrated in the CDSSs, and they are invented by clinical experts and distributed by professional or state organizations. In this case, the clinical guidelines serve as official statements to recommend the most appropriate practices as pertains to particular clinical problems.

Researchers in clinical field have invented standardized representations of information to promote the sharing of the guidelines. An example of standardized representation of information is the Guideline Interchange Format (GLIF) or Arden Syntax. Arden Syntax refers to an American National

Standards Institutes (ANSI) standard used to represent quantifiable clinical information (Wager, Lee, & Glaser, 2005).

Arden Syntax presents decision rules known as medical logic model (MLM). Moreover, every MLM has adequate reasoning to enable it make a clinical decision. On the other hand, the Guideline Interchange Format (GLIF) constitutes of a format interpretable by the computer to enable representation of clinical practice directions invented by InterMed collaboration, which is a project carried out jointly at Stanford, McGraw, Harvard, and Columbia University laboratories (Gillies, 2002). This application serves as a language that can be used for general purposes to develop and implement clinical decision support systems, which are applied in various clinical spheres. Besides supplying recommendations for patient care, the application can be used to ensure quality and medical knowledge. Therefore, decision support systems help healthcare professionals to make relevant decisions when dealing with patient care to ensure maximum quality and safety for the patients.