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Design and Development of a Clinical Decision Support System – Vydya Health

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Abstract: ***The healthcare industry generates enormous amounts of data. Therefore, Information Technology (IT) has increasingly been used to capture and transfer this data as well as facilitate medical decision making. The healthcare industry is growing fast by using IT to computerize various processes such as transactions, inventory keeping, and record maintenance, consequently reducing mundane and repetitive processes. The use of systems-engineering tools has led to innovation in healthcare, including the use of rule-based systems to diagnose diseases. These 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 this study, we have designed and developed a Clinical Decision Support System (CDSS) to help patients get initial advice on possible therapies based on disease selected. This could be used as a disease prevention tool as well.***

Keywords: Clinical Decision Support Systems, Medical Decision Making, Computer Techniques in Medical Informatics

1. Introduction

The importance of making a correct medical diagnosis cannot be overstressed. There are emotional, legal, and financial consequences if a patient is told they are ill when, in fact, they are not. The patient suffers extreme emotional distress; the physician may be legally liable for this distress, and, in this time of managed health care, costs for unnecessary medical procedures are incurred. Of far greater consequence is an improper diagnosis concluding that the patient is disease-free when they are not. If proper treatment is withheld due to this misdiagnosis, the patient will suffer and possibly die. Any technology that can improve the ability to correctly diagnose human illness is a needed advance to humanity's well-being. With the widespread use of electronic data capture and automation of medical records, Clinical Decision Support Systems (CDSS) have become valuable aids in improving the accuracy of medical diagnosis. They have specifically been designed organize and make sense of the vast amounts of medical records and data. CDSS are considered to one of the key features of electronic health records and are most likely create a real transformation in our healthcare system [2].

2. Clinical Decision Support Systems

The world of medicine has advanced in multiple disciplines – from age-old native remedies to modern allopathic remedies. Though the evolution of computer-based decision support systems has helped physicians to quickly and more accurately recommend remedies, current systems suffer from limitations of a limited knowledge base that does not yet encompass remedies from multiple disciplines. This study focuses on the penetration and maturity of Computer-based Decision Support Systems that can suggest remedies from multiple disciplines with a certain level of confidence so that the patient can take informed decisions on the best treatment to pursue.

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

3. Background to the Problem

The healthcare industry has been a pioneer in the application of decision support or expert systems capabilities. Even though the area of medical informatics and decision support has been around for more than four decades, there is no formal definition of a medical decision support system. Wyatt & Spiegelhalter describe a medical decision support system as a computer-based system that uses gathered explicit knowledge to generate patient-specific advice or interpretation [8].

It can therefore be concluded that computer-based decision support systems were developed to provide accurate guideline compliance and to enhance physician performance [5]. Computerized decision support systems can be extremely valuable for treatment or diagnosis support and compliance accuracy when used at the point of care [6]. This feature of computerized medical decision support systems is a key differentiator that makes paper-based decision support models inferior. A well-designed computerized medical decision support system can be used to provide patient-specific support at the desired time and location with the adequate content and pace. When decision support systems are blended into the day-to-day practice workflow, they have

the potential to function as a valuable assistant and also as an educational tool [7].

Computerized decision support systems make decisions based on clinical practice guidelines. These guidelines are the rule-based knowledge that guides decision makers in a medical setting. These guidelines have been developed over the years to reduce variations among medical practices with a common goal to provide cost-effective and high-quality healthcare services [4].

The purpose of this study is to design and develop a Clinical Decision Support System. The foundation for any decision support system is a knowledge base containing the necessary rules and facts, acquired from information and data in the field of interest, which in our case is medicine.

4. Design Approach

The Clinical Decision Support System ("Vydya Health") is designed to be cotemporary and be available from all devices and on every screen size.

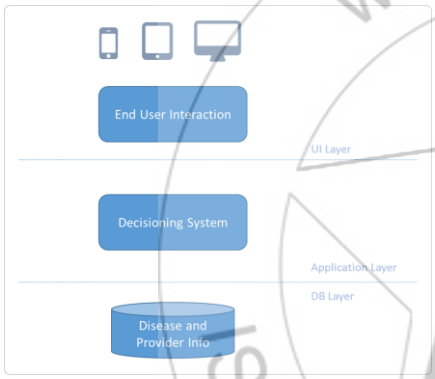

Figure 1: CDSS Technical Architecture

The CDSS system (Vydya Health) is designed using the Model View Architecture with a viewer layer to be mobile friendly. The system is hosted on cloud infrastructure to ensure maximum availability and scalability. It is easily accessible from any connected device such as a mobile phone, tablet and Personal Computer.

In the age of smart devices, the need for systems to be accessible everywhere and all the time is considered and the application is delivered to meet these high-availability and high-accessibility needs.

5. System Implementation

As treatment outcomes prove that no single therapy can provide cures for all types of diseases, the healthcare industry is moving towards integrative healthcare. Considering the chronic nature of diseases, certain types of therapies are able to provide better patient outcomes compared to other therapies. This CDSS system considers the success the rate of certain types of therapies for a particular disease, and recommends therapies that are more suited to that disease. Example usecase is provided in Figure 2 and high-level functional diagram and working screen shots are depicted in figures 3 and 4.

Use Cases:

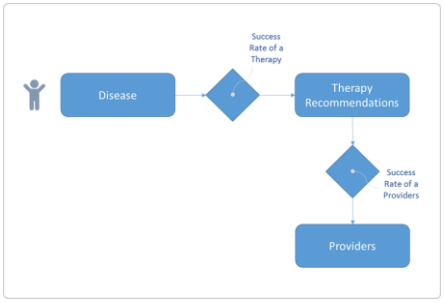

Figure 2: CDSS High Level Functional Diagram

Provider Identification: Patient diagnosis is complete and the patient knows all about the disease.

Input: On the system, the patient selects the disease name.

Output: The system displays list of practitioners who can provide treatment to the selected disease.

Alternative scenario: The system doesn't have any providers matching the selected disease.

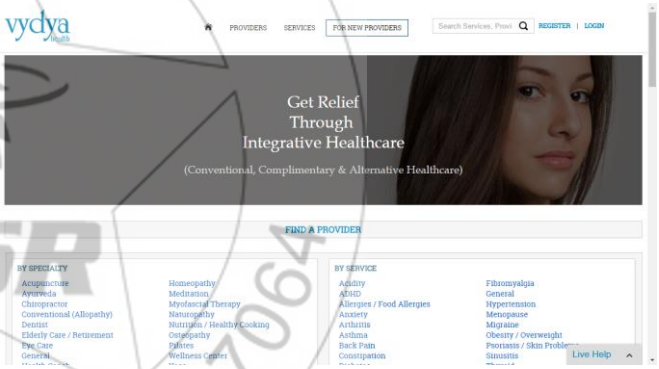

Figure 3: The patient selects the name of the disease that they are looking treatment for

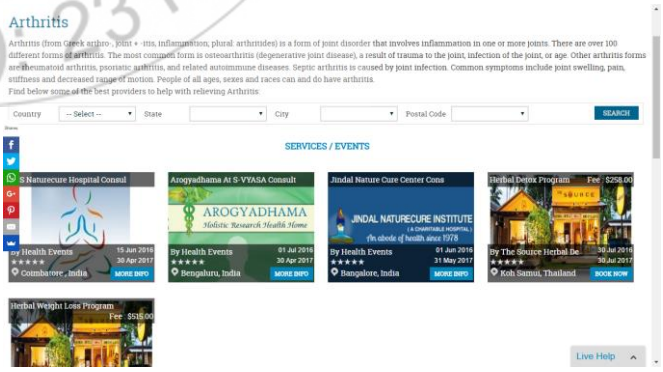

Figure 4: The list of practitioners who can treat the disease will be presented. The patient can select a provider based on the location or level of confidence in a particular therapy.

6. Conclusion and Summary

We have designed and developed a Clinical Decision Support System- Vydya that can help physicians to organize, store, and apply the mammoth amount of medical knowledge. Our system is expected to improve the quality of Healthcare by providing more accurate, effective, and reliable diagnoses and treatments, and by avoiding errors due to physicians' insufficient knowledge. CDSS 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 [1].

The results of this study will contribute knowledge to academic community and medical-practitioners. This study will be beneficial to future research on CDSS and other systems' development to enhance medicine and healthcare in the field of medical informatics. Doctors, medical personals, healthcare professionals and educators will gain from this insightful study and can try to implement and improve the current situation of healthcare system with the CDSS – Vydya Health.

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Author Profile

Raghava Tadavarthi received the B.Sc, M.Sc, and M.Tech degree in Computer Science and Technology from Andhra University in Visakhapatnam. He has worked for Multinational Companies such as Wipro and GE and has more than 25 years of experience in implementing computer based solutions. He is now a Research Scholar at Rayalaseema University.