Reviewing and Modeling Clinical Decision Support System

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Abstract — **Many healthcare providers and clinicians are using various types of systems known as CDSS which assist them to take decision about each case of patient. There is increasing recognition that if CDSS is well planned and put into service, has an immense potential to get better health care quality and possibly even increase effectiveness and decrease healthcare costs. Some existing CDSS are reviewed in this paper. The various types of CDSS available encompass a range of preferences, from general references, through precise detailed guidelines for a given condition. Technological intervention in developing CDSS has to be evaluated while designing, developing and implementing it. The basic CDSS is designed and proposed outline is given. The implementation issues for CDSS have to be considered and for successful execution of CDSS meticulous planning has to be done. Healthcare providers and users of CDSS are required to understand CDSS benefits and limitations, and the inimitable challenges of designing and implementing various types of CDSS to attain the optimal advantage of CDSS.**

Index Terms — **CDSS (Clinical Decision Support System), EHR (Electronic Health Records), QMR, MYCIN, IndiGO, CASNET, ONCOCIN**

I. Introduction

Revolutions in information technology have augmented the quality of output in all the fields. Healthcare is one of such area which uses IT for its better quality service. Information technology can aid by generating case-specific suggestion for clinical decision making. The systems used for this kind of purpose are known to as clinical decision support systems or CDSS [1].
Clinical decision support (CDS) systems provide clinicians, employees, patients, and other persons with knowledge and person-specific data and information, intelligently filtered and presented at appropriate times, to improve health and health care[2]. CDSS is the decision system based on electronic health records. Electronic Health Records, e-prescription systems, computerized medical practitioner order entry, medicine reference system all are reinforced by some type of clinical decision support. CDS can help doctors arrive at right diagnoses, ask the appropriate questions, and perform appropriate tests on the front end of the decision-making process preventing errors of omission as well as stop errors of commission on the rear end, in the period of treatment and procedures. To get better quality of health, electronic CDS is required as suggested by numerous healthcare providers.

II Reviewing Existing Cdss

A few of popular CDSS used by various healthcare providers are reviewed and the functionalities provided by each of them are given as under in brief.

A. QMR:

(Quick Medical Reference) is a investigative decision-support system with a knowledge base of diseases, diagnoses, result findings, disease associations and lab information. With information from the primary medical literature on almost 700 diseases and more than 5,000 symptoms, signs, and labs."[3].

B. MYCIN:

MYCIN was designed and developed in the 1970s to help clinicians choose antibiotics for bacteremia or meningitis [4]. MYCIN was a kind of CDSS designed and developed with the purpose to make a diagnosis and the treatment for certain blood infections. It was later extended to handle other infectious diseases. Clinical knowledge in MYCIN is being revealed as a set of IF-THEN rules. MYCIN was never widely used because of difficulties with maintenance and incorporating the system into a clinician's workflow [5].

C. IndiGO:

Clinical decision support system Archimedes IndiGO, which stands for "individualized guidelines and outcomes," is the commercialization of the Archimedes Model. IndiGO interfaces with electronic health records (EHRs) and disease registries, drawing on those databases to help identify at-risk patient populations and suggest appropriate interventions. In addition, the system can put together patient-specific care plans for better disease management [6].

D. CASNET:

Causal Associational NETworks was being designed and developed in 1960s. It was a universal tool for structuring and building expert system for the identification and treatment of illness and diseases. The most significant and considerable Expert System application based on CASNET was CASNET/Glaucoma. It was build for the purpose of diagnosis and treatment of glaucoma [7].

E. ONCOCIN:

ONCOCIN is a rule-based medical expert system for oncology protocol management developed at Stanford University. Oncocin was designed and developed to assist physicians with the treatment of cancer patients receiving chemotherapy. ONCOCIN medical expert system was one of the first DSS which attempted to model and give decision and judgment and sequencing actions over time, using a customized flowchart language. It extended the skeletal-planning technique to an application area. In this the history of previous events and the period of actions are vital and essential [8].

III. Types Of Clinical Decision Support

CDSSs are available wide-ranging in perspective of utilization, knowledge and data sources, different types of decision support offered, information and knowledge delivery, and workflow impact. Two different subsets of CDSSs were found are: patient-directed systems that provided decision support for precautionary and preventive care or health-related issues and behaviors. Inpatient systems provide clinicians and medical personnel with online decision support and online execution of the recommendations. Most of the CDSSs need additional employment for managing and handling CDSS related data of input and output. CDSSs are heterogeneous and diversified along many dimensions. More care is to be taken in generalizing and simplifying the outcomes of CDSS [9].

Early Clinical decision support systems were derived as a result of expert systems research, with the developers striving to program the computer with rules that would allow it to think like an expert clinician when face up to a patient [10]. These systems might be valuable and functional apart from research also, that it can be used to assist and aid clinicians and medical professional in decision making by taking over some regular responsibilities and tasks, warning clinicians for critical problems, or providing suggestions to clinician [11].

One of the Clinical decision support systems known as knowledge-based CDS include compiled clinical knowledge. Many of the early CDS systems provided expert consultation to the clinician for diagnosis and medication selection. CDS today also encompasses a range of options, from general references, through specific guidelines for a given condition [12].

IV Technological Focus

General features of CDS systems that are designed to provide patient-specific guidance include the information base which can be compiled clinical guidelines, a program for combining that knowledge with patient-specific information, and a way of entering patient data or getting it from the EHR into the CDS system and providing relevant information that can be lists of possible diagnoses, drug interaction alerts, or preventive care reminders back to the clinician.

Clinical Decision Support System can be put into action using a wide variety of implementation strategy and platforms like online Internet-based, local personal computer or a mobile like handheld device. Also, a variety of computing approaches and strategies can be used. These approaches and strategies may base on whether the CDS is built into the local EHR, whether the information and knowledge is accessible from a central repository or whether the whole system is incorporated outside the local site and is accessed, but not incorporated into the local EHR. CDS can make use of any of these core and essential technological computational architectures, way of access to devices. The selection of technology in CDS system depends on the infrastructural facility, financial constraints, supported staff, and the purpose and use of the CDS [13].

V. Proposed Cdss

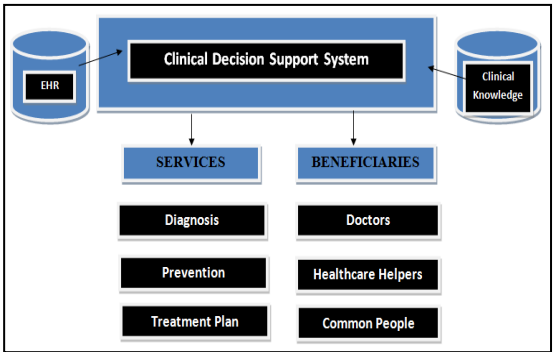

Figure 1. Proposed Clinical Decision Support System

Design of Clinical Decision Support system includes consideration of various functionalities with regard to its facilitation to CDSS users. The services include broad spectrum for their users. The beneficiaries of CDSS depend on the design and functionalities covered by the system.

Here in the proposed design of the CDSS, EHR and Clinical knowledge databases are considered as base knowledge provider. The EHR database includes the records of patients. The EHR database should be according to standard guideline of authorized body. Clinical knowledge includes the authorized medicinal knowledge from various authorized provider. Clinical knowledge can be from medicinal books or authorized online resources like pubmed also. The quality of the database clinical knowledge has wide impact on output of CDSS. So one need to be careful when selecting or generating knowledge databases for CDSS. In the proposed Clinical Decision Support system the services includes Diagnosis, Prevention and Treatment plan. Clinician can diagnose the disease of the patient by using the CDSS databases in better way. Even clinician can use the CDSS for prevention guideline of disease to be given to patient. By using available EHR, pattern of disease can be find out by applying data mining techniques on it. Early prevention of diseases are also possible by detailed study of EHR and forecasting the threats for prevention of those diseases for patients. Treatment can be planned well by using clinical knowledge. EHR can also be used to check proven results for specific treatment plan

for specific disease. While EHR is generated quality of those have be taken care off. Even the structure and completeness of EHR should be considered for better quality output in CDSS. In CDSS if quality of EHR is compromised then, CDSS will not generate quality output.

The CDSS are often used by Doctors and Healthcare helpers. By providing appropriate framework of CDSS it can be directly used by common people also. As in the proposed CDSS beneficiaries are multiple, framework of CDSS has to cover broad spectrum of functionality according to user. Also workflow of local environment has to be considered when designing of system. The restriction and limitation of the working situation has to be considered as well when designing the better CDSS.

VI. Implementation Of Cdss

Planning for CDSS, deciding whether to purchase a ready commercial system or develop it in within the organization is key challenge. Deciding the functional requirements and extent of use of CDSS in local environment has to be decided considerably. Involvement of clinicians has to give there vital inputs while implementation of CDSS for better accomplishment and output. The design and implementation issues are often interrelated in Clinical Decision Support System. If any problem in designing the CDSS is there, it has to be identified and thoroughly evaluated before implementation.

There is a growing literature of best practices for CDS design and implementation [14]. In addition to proficient view, the literature also gives information on characteristics of CDSS implementation.

In designing CDSS sequencing the tasks and deciding workflow is key issue. CDSS designer and those implementing CDS must take into account. Once the sequencing is done and structure has been analyzed the implementation can be done in more systematic way and there are more chances of successful CDSS.

VII. Conclusions

As illustrated above, the research facts demonstrate that CDS systems have enormous potential to improve the quality of care, but attention must be paid to implementation processes, not only for the quality improvement to be realized, but also to avoid negative effects of CDS.

By different types of CDSS different types of services can be designed for the end users. These services of CDSS can be used directly or indirectly by multiple beneficiaries.

By implementation of CDSS healthcare providers can provide safer, more skilled, and more effective health care.

It is vital that healthcare providers be concerned in the development and improvement of such systems. Healthcare providers have to recognize prospect of CDSS and have to promote within their health care environment for the development of systems that carry significant enhancement in health care quality and outcome [15]. Even though it need to be remember that CDSS is not a substitute of clinician, an appropriate use of CDSS will lead clinician to better output and better healthcare quality [16].

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