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An Information Modeling Using EHR

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ABSTRACT

With the rising incidence of chronic illness, developed nations with their aging populations now face the management and prevention of non-communicable and chronic diseases such as diabetes, stroke, hypertension and cancer etc. To address this global health crisis, a key element of health strategies must be to increase the effectiveness of Chronic Disease Management (CDM) activities, including chronic disease prevention which results in reduction in overall cost, time and effort in the management of patients with chronic disease. The objective of this paper is to address the problem of building ideal systems that provide support for guideline compliance and process enactment in the context of chronic disease management. It aims to define the practical boundary of applicability of workflow approaches versus decision support system approaches in supporting guideline-based care.

Keywords: CDM (Chronic Disease Management), HIS (Healthcare Information System), EHR (Electronic Health Record), WfMS (Workflow Management System)

1. INTRODUCTION

One of the key flaws in current health care systems that contribute to the high morbidity and mortality rates and escalated health care costs, is the lack of sufficient communication and coordination of services[5]. Care management, advocated for many years as a way of ensuring appropriate and coordinated care, emphasizes the involvement of patients and careers in care planning. Two particular types of information that was most sought were information about available services and resources, and information about particular health conditions.

Health professional communication demonstrates many flaws. In general, these include: unnecessary duplications of information or tasks being performed; delays between communication; lack of essential information being communicated; information inconsistencies; and the lack of support for wider distribution of potentially beneficial information to other health care providers and organizations [6-8]. Such communication problems include misunderstanding between healthcare providers due to use of different terminologies and misinterpretation. For effective care of the patient there must be effective communication between the providers themselves to coordinate the activities involved in the care of the patient. There must be support for distributed activities such as scheduling, referrals and reporting and to support joint decision making within the multidisciplinary team.

2. PROMOTING SUPPORT FOR CDM (CHRONIC DISEASE MANAGEMENT)

The nature of chronic disease care processes, make it challenging to devise Healthcare Information Systems(HISs) that can sustain the continuity and coordination of evidence-based practice for chronic disease as they unfold over a long timescale and require care and services from multiple health care providers. There is a widely held optimism that the use of clinical decision support systems, i.e., systems that provide patient specific advice, can facilitate the practice of evidence-based medicine and thereby substantially improve health care quality [1]. The empirical record shows that many clinical decision support systems do appear to be effective; however, the record of successes in CDM is patchy. Thus, with the rising prevalence of chronic illness, there is a growing pressure to develop systems that engender evidence-based care. The potential for workflow support to coordinate services and improve communication in the context of CDM is intuitively appealing, but is still a challenging accomplishment in practice.

3. MOTIVATION FOR SYSTEM INTEGRATION

Although the potential for workflow support to coordinate services and improve communication in Chronic Disease Management(CDM) has been recognized, there has been little accomplishment in this area, due first and foremost to the fact that it has been proven as a challenging thing to achieve in practice[2].

3.1. The Role of Guideline-based Decision Support

Guideline–based decision support systems are traditionally used within clinical applications such as prescribing and dispensing medications. In order to provide patient-specific recommendations, patient data is often obtained by prompting clinicians to enter the relevant data into the system at the point of care. EHRs provide the information such as- particularly to query about the patient's medical history and other related information that remain significant over time (such as current medications, active problems and diagnosis). In the same time, EHRs will belong in a *shared* central repository from which all clinical information systems such as decision support systems can access patient information both locally and internationally. A single, shared HER better ensures the quality and completeness of patient data, which allows clinicians to make better decisions in conjunction with the use of decision support systems.

In general, guideline-modelling research focuses specifically on modelling the *clinical decision making processes* of typically, a single provider. For successful implementations of chronic disease guidelines and integration of workflow within the primary care setting, the user interface design and decision-support services that a system provides are necessary points for consideration [3]. It is important to differentiate between the process of arriving at clinical decisions, and the process of carrying out the actions that were decided upon. The latter point is particularly important in CDM where healthcare services are very often delivered and coordinated within a multidisciplinary team. However, guideline-based care has to be performed according to some larger business process model that incorporates resource management, institutional policies and procedures, etc, which is what workflow modelling entails.

3.2. The Role of Workflow

A workflow is "The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules".

Workflow modelling researchers look specifically at business processes and increasingly, at how to incorporate flexibility in those models to account for the changes that occur in work practices. Again, this area is not tied to any specific business domain such as healthcare. The potential for workflow technology to coordinate services and improve communication within healthcare processes is recognized as intuitively appealing, the implementation of which is highly challenging and is rarely accomplished in practice.

The workflow models used by workflow management systems (WfMSs) can further augment guideline representations. This can assist the coordination between providers and across consultations or 'sessions' for instance, by incorporating into the model explicit notions about workflow activities being enacted by multi-provider roles, automated invocation of decision support tools or applications, scheduling and prioritization. Such workflow models in conjunction with their use in WfMSs provides added value and a more practicable solution to guideline-based decision support for CDM in particular at the point of care since the 'workflow' in this context is typically broader and covers multiple provider roles and inter-organizational care processes[4].

3.3. The Role of the Electronic Health Record (EHR)

The EHR is specific to the domain of healthcare, and EHR instances are each on its own a representation of a patient/case. EHR standards aim to develop standards that enable all the data related to the health of a patient to be modeled and implemented within an IT system that manages it. These standards aim to find the balance between being specific enough to their domain, as well as being generic and flexible enough to account for future knowledge. While EHR research is much about data, it is also increasingly, about the sharing of the data.

HL7(Health Level Seven) is an international body that has predominantly supported this latter facet via messaging. In particular, it has a USAM (Unified Service Action Model) that specifies relationship between clinical 'act' and things/entities. However, this information lies within a messaging framework, and must have support for capturing the context and state of progression of care, and relevant message In a persistent manner.

3.4. Leveraging the EHR for Integration with Decision Support and Workflow

Traditional paper-based health record only stored information regarding the patient's condition, and medical care of the patient- the "workflow" was left up to the humans to make sure activities were performed accordingly, and moreover, to ensure the timely low of information between participants in the workflow. The necessity of EHRs and its potential to be shared across domains and international boundaries are increasing rapidly. The EHR is a central component of any HIS.

A good case can be made for the use of EHRs in chronic disease management. A case study that looked into the effect of using electronic data exchange in a diabetes coordinated care environment found that communication between health care providers increased, they had better access to data, and there was a small improvement in patient's health over a short period of

time[9]. The Phase Three architecture aims to address the problems such as – a key feature being clinical scenarios with sets of available actions associated with each scenario. Despite the innovations, however, the recent evaluation using the scenario-based decision support in general practice shows no effect on management of chronic conditions, most likely due to the significant barriers to its usability[10].

It must be recognized that from the perspective to where the EHR fits in a clinical information system, there is the need to support for other components within that system: guideline-based decision support and workflow. The notion of information persistence is of particular importance for chronic disease management where information about the care of the patient remain significant over a long period of time, requiring the coordination of services from multiple healthcare disciplines, which are often geographically dispersed. In general, while we acknowledge the validity of each research perspective (i.e., guideline-based decision support, workflow and EHR), we also acknowledge the need for an integrated approach if future clinical information systems are to meet the requirements of chronic disease management. Our approach presented in this paper explores specifically how the EHR can be leveraged to integrate with workflow and decision support applications.

4. ELECTRONIC HEALTH RECORD (EHR)

The Electronic Health Record (EHR) is a secure, real-time, point-of-care, patient centric information resource for clinicians. The EHR aids clinicians' decision-making by providing access to patient health record information where and when they need it and by incorporating evidence-based decision support. The EHR automates and streamlines the clinicians' workflow, closing loops in communication and response that delays or gaps in care. The EHR also supports the collection of data for uses other than direct clinical care, such as billing, quality management, outcomes reporting, resource planning and public health disease surveillance and reporting.

There are also various synonyms used, such as patient record, electronic patient record (EPR), and computer-based patient record (CPR).

A *Patient record* is the repository of information about a single patient.

A *computer based patient record* is an electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision support systems, links to medical knowledge and other aids.

The EHR has the following properties:

- *Durability:* Each unit of information committed to the EHR remains persistent.
- *Atomicity:* Each unit of information committed and accessed has a minimal unit of integrity and security.
- *Consistency:* The EHR remains in a consistent state with each committal of information.
- *Isolation:* No conflict occurs when simultaneous users commit information.
- *Indelibility:* Committal to the EHR is indelible for medico-legal and process improvement purposes.
- *Modification:* Users are able to modify the contents of the EHR.
- *Traceability:* The EHR carries with it a sufficient audit trail during committal for the purposes of clinical and legal tracking.

Types of EHR: Institute of Medicine (IOM), United States (cited in) defines the following types of EHRs:

Primary Patient Record: It is used by health professionals while providing patient care services.

Secondary Patient Record: It is derived from the primary record and contains selected data elements to aid non-clinical users, in supporting, evaluating or advancing patient care.

Consolidated Health Record (CHR): The CHR can be called the medical record, the patient record, and the computer based patient record. The CHR usually contains two divisions which are:

Medical Record: An official record documenting the diagnosis, treatment or care of a patient.

Administrative record: An official record pertaining to the administrative aspects of the care of a patient.

Shared EHR: The EHR can also be viewed in terms of a shared EHR and a local EHR, where the former is used as a secondary source of information thereby improving communication between a group of disparate clinics, and the latter is used as a primary source of information within a local clinic and typically belong to a single provider clinic. The sharing of EHR information can take place at three different levels:

1. Between different clinical disciplines or other users, all of whom may be using the same application, requiring different or ad hoc organization of EHRs.
2. Between different applications at a single EHR node, i.e. at a particular location where the EHR is stored and maintained.

3. Across different EHR nodes, i.e. across different EHR locations and/or different EHR systems.

Integrated Care EHR (ICEHR): It is a repository of information regarding the health of a subject of care in computer process able form, stored and transmitted securely and accessible by a multiple authorized users. It has a commonly agreed logical information model which is independent of EHR systems. Its primary purpose is the support of containing, efficient and quality integrated health care and it contains information which is retrospective, concurrent and prospective.

Virtual EHR: It is an EHR that is constructed dynamically and in real-time" through a process of federation of two or more EHR nodes". The virtual EHR is essentially a logical view from the extraction of EHR data across multiple EHR sources, which are largely consisting of legacy systems.

5. CLINICAL DECISION SUPPORT

It primarily concerned with the construction of AI programs that perform diagnosis and make therapy recommendations. Unlike medical applications based on other programming methods, such as purely statistical and probabilistic methods, medical AI programs are based on symbolic model of disease entities and their relationship to patient factors and clinical manifestations.

There are various definitions of what constitutes an electronic decision support system. These are:

Access to knowledge stored electronically to aid patients, carers and service providers in making decisions on health care. The taskforce definition is restricted to clinical decision support systems, principally used by health care providers. The taskforce acknowledges that it is important for consumers to also have access to high quality information that is evidence-based in electronic decision support systems developed for consumers.

Electronic decision support systems have three main components: knowledge, rules, and software. Knowledge stored electronically includes published clinical practical guidelines, commercial databases, and custom-designed knowledge bases based on expert opinion. Knowledge is translated into active rules used within the electronic decision support system. The software applies the knowledge, rules and local patient and clinical data and presents the electronic decision support functionality on the clinician desktop.

Electronic decision support systems vary in complexity. The more complex systems match characteristics of individual patients with a computerized knowledge base and generate patient-specific and situation-specific recommendations. The systems are usually embedded in other computer applications, such as those used for prescribing and dispensing medicines, electronic health records and other information systems used in health settings. Ideally, the patient information used in the systems would come from existing electronic sources, such as electronic health records.

The benefits of clinical decision support include improved patient safety, quality of care and efficiency in health care delivery.

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