Designing and Developing Electronic Health System Using XML & RDM

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An examination of many hospitals that recently implemented in King Saudi Arabia (KSA) a little electronic health record (EHR) system finds that clinical and administrative leaders built EHR adoption into their strategic plans to integrate inpatient and outpatient care and provide a continuum of coordinated services. Using Relational Database Management (RDM) and eXtendable Marker Language (XML) Systems, successful implementation depended on: strong leadership, full involvement of clinical staff in design and implementation, mandatory staff training, and strict adherence to timeline and budget. The EHR systems facilitate patient safety and quality improvement through: use of checklists, alerts, and predictive tools; embedded clinical guidelines that promote standardized, evidence-based practices; electronic prescribing and test-ordering that reduces errors and redundancy; and discrete data fields that foster use of performance dashboards and compliance reports.

Keywords: HER, XML, RDM, KSA

INTRODUCTION

Saudi Arabia with an area of 2.15 million km\(^2\) and a population of about 30 Million, with a number of 256 hospitals. The kingdom of Saudi Arabia (KSA) is have 49,000 beds in government hospital and 14,000 in the private hospitals.

A-Terms used in the field include electronic medical record (EMR), electronic patient record (EPR), electronic health record (EHR), computer-based patient record (CPR) etc. These terms can be used interchangeably or generically but some specific differences have been identified. For example, an Electronic Patient Record has been defined as encapsulating a record of care provided by a single site, in contrast to an Electronic Health Record which provides a longitudinal record of a patient’s care carried out across different institutions and sectors. But such differentiations are not consistently observed. Geographical Information System (GIS) was used to locate the administrative areas, the places of hospitals.

A. Review of the Health Record in KSA & Health Care Planning in Saudi Arabia

Health care planning system in Saudi Arabia has different agencies that play important roles in providing health care to residents. These agencies are The Ministry of Health, The National Guard, The Ministry of Defense and Aviation, and The Ministry of Interior [3]. In addition to these agencies there are specialist hospitals in Saudi Arabia that provide health care to specialist health cases. These
agencies provide health care services on the basis of exclusive free health care to all citizens. In addition, the private sector in Saudi Arabia plays an increasingly significant role in the Kingdom and coordinates with the referral network and the regulatory requirements of health sector as a whole [4]. The Ministry of health in Saudi Arabia has seen that the primary objective of both the public and private health sector is to improve the health conditions of all citizens through the provision of comprehensive preventive and curative health services throughout the Kingdom, with particular emphasis on equitable and efficient primary health care (ibid). In order to achieve this objective.

B-Benefits of EMRs

1. Replace paper-based medical records which can be incomplete, fragmented (different parts in different locations), hard to read and (sometimes) hard to find.
2. Provide a single, shareable, up to date, accurate, rapidly retrievable source of information, potentially available anywhere at any time. Require less space and administrative resources.
3. Potential for automating, structuring and streamlining clinical workflow.
4. Provide integrated support for a wide range of discrete care activities including decision support, monitoring, electronic prescribing, electronic referrals radiology, laboratory ordering and results display.
5. Maintain a data and information trail that can be readily analyzed for medical audit, research and quality assurance, epidemiological monitoring, disease surveillance...

II-Design the electronics forms for data entry

A-The design of electronics forms based on the existing manual forms

About 80% of the public hospitals operated by municipal entities across the nation today are said to be running deficits and do find themselves in severe situations as they must deal with cutback in medical costs, doctor shortages and other problems. Fujinomiya City General Hospital, recipient of “Minister of Internal Affairs and Communications’ Commendation for Excellence in Municipal Hospital Services (2006)” and “Minister of Health, Labor and Welfare’s Commendation for Meritorious Services in Emergency Care (2007),” is one the model hospitals which continue in the black while admirably playing their rolls as regional core hospitals.

C-improved Patient Safety

Hospitals report that EHRs have been “life savers” by preventing drug interactions, allergy conflicts, and human error in ordering, filling, and administering drugs through functions that compare physicians’ orders against standards and verify a patient is receiving the right medication or treatment. The Sentara health system calculated that it avoided 117,400 potential medication errors due to medication bar-coding. Gunderson reports in a published study that after implementing its EHR, medication errors per 1,000 hospital days decreased from 17.9 to 15.4. The percentage of medication events (injury caused by a drug) that were medication errors decreased from 66.5 percent to 55.2 percent. [2]
D-Building Connections: Making Electronic Health Records Work

Healthcare organizations of all sizes face many of the same demands and challenges when making the transition to electronic health records. To realize the long-term and widespread benefits in this transition requires network connections (Table 1). The true value comes through networked access through a range of devices across the continuum of care.

III. Methodological Considerations in EHRSS Development

A-Fun ctionally Using XML

B-XML Instance Representation of the whole EHR system code

<Area> Health Area </Area> [1]
<Hospital> Hospital </Hospital> [1]
<Primary Information> Primary Information </Primary Information> [1]
<Patient-Record> Patient-Record </Patient-Record> [1]
<Outpatient Form> Outpatient Form </Outpatient Form> [1]
<Doctor-OrderSheet-Form> Doctor-OrderSheet-Form </Doctor-OrderSheet-Form> [1]
<Progress Notes Form> Progress Notes Form </Progress Notes Form> [1]
<Admission and Discharge Form> Admission and Discharge Form </Admission and Discharge Form> [1]
<Materal Information Form> Material Information Form </Materal Information Form> [1]
<Cause Of Death Form> Cause Of Death Form </Cause Of Death Form> [1]
>In Case of Accedent Form> In Case of Accedent Form </In Case of Accedent Form> [1]
<X-Ray-Request Form> X-Ray-Request Form </X-Ray-Request Form> [1]
<Hematology Requesion Form> Hematology Requesion Form </Hematology Requesion Form> [1]

C-XML Instance Representation of the Patient Record EHR system code

<Patient_Number> Integer </Patient_Number> [1]
<File_Number> Integer </File_Number> [1]
<Date_of_Open_File> Date </Date_of_Open_File> [1]
<Date_of_Birth> Date </Date_of_Birth> [1]
<Place_of_Birth> Integer </Place_of_Birth> [1]
<Religion> text </Religion> [1]
<Social> text </Social> [1]
<Patient_Number> Integer </Patient_Number> [1]
(Job> text </Job> [1]

IV-Creation of Rational Data base system and Tables

A-Relations between tables was established and generated figure (3) ,forms was build of the patient data entry ,consists of :
1- Hospital manpower basic information
2- Patients basic information
3- Outpatient transaction record
4- The clinical system
5- Martial information
6- In case of accident
7- Death causes
8- Doctor orders
9- X-ray
10- operation

B-Outpatient FORM data entry:

Consists of master form and detail form , the master form consists of :-
patient number, patient name , age, sex, nationality ,the consultants and the unit or the department ,The detail of the system consist of :-
1-Date, time, reason for visit , type of visiting t, weight, blood pressure, the hurt pulse
2-History, physical examination and investigation
3-The treatment given to the patient, the problems and the diagnoses
4-Primary treatment
5-Refred for consultation to and next appointment

C-In case of accident data entry master detail

The master form consists of in case of accident was linked with the patient basic inform at like :-
Figure 1: shows the map of Saudi Arabia Subareas

Figure (1)-XML Instance Representation of the whole EHR system diagram
Figure (2)-XML the data entry forms include the system components

Figure (2)-XML Instance Representation of the Patient Record system diagram
Figure (3): the Patient Record system data entry screen for the Outpatient Data entry Screen

Figure (4): The relations between tables of the system
The patient number, patient name, Age, nationality, sex type, department and the consultant doctor using the patient number as the primary key, the incase of accident Type of Injury, location of accident, the date of accident, Attend physician Dr., Unit head dr. A report was designed for printing the accident in many types, time of the accident, the attend physician figure (6). The purpose of the form is to record the data of patients in the case of accident information.
Figure (7)  Cause of death data entry screen paper form

Figure (8)  Cause of Death data entry master detail form
Figure (9) Doctor orders *Data entry form*

Figure (10) *Clinical chemistry requisition form*

The figure (10) shows the selection of the report and entering the number of the patient.
The figure (10) shows All patients report system

The figure (10) shows Outpatient appointment report
The figure (11) shows Doctor order report system.

**D-Cause of death data entry screen**

Cause of death form: Consists of master form and of patient basic data
The master form consists of: patient number, patient name, age, sex, nationality, the consultants and the unit or the department

**The cause of death contains:**

1. Direct cause, antecedent cause A: 
2. Antecedent cause B
3. The date and the signature of the doctor
4. Attend physician Dr., Unit head dr. The purpose of the form is to record the data of patients and the information in case of death.

**F-Doctor Order data entry screen**

Consists of master form and of patient basic data, patient number, patient name, age, sex, nationality, the consultants and the unit or the department.
The detail of the doctor order for consists of
1- the patient number
2- the date , the time when the doctor visit the patient
3-, the doctor orders
4- department and the nurse name
5-The physician name

H-Clinical chemistry requisition form

Consists of master form and of patient basic data , patient number , patient name , age, sex, nationality ,the consultants and the unit or the department.
The detail of the clinical chemistry include the information's of :-
1-Specimen Detail , 2-Lab sample number ,3-Processing priority
4-recived by ,5-Orher test ,6-Clinical history ,7-Reason for ordering the tests

V-Report system screen

The system consists of the following reports
1-patient report
2-outpatient report
3-Doctor order report
4-Patient progress report
5-In case of accident report
6-Materal Report
7-Cause of death report
1-Pation report :

A-Patient reports
Two types of report was designed for the patients , report for one Patient , report for all patient and special report of patients by categories line sex type, nationality

2-Outpatien report
1- Doctor order report system

CONCLUSION
This research provides recommended actions to support the development of an objective EHR usability evidence base and formative policies to systematically improve the usability of EHR systems. In a companion document, 

Electronic Health Record Usability: Evaluation and Use Case Framework, the evolving role of EHRs and the need for a practical, common evaluation framework is discussed. Information design principles tailored to EHR considerations along with initial approaches to heuristic usability evaluation and representative use cases are also provided. These two companion documents on EHR usability are intended to foster discussion on the importance of usability and guide federally funded research activities as well as inform policy development in this area. Through collaborative efforts between physicians, researchers, and vendors these recommendations and frameworks can be further refined to promote the necessary industry focus on EHR design and its significance to consistently delivering desired improvements in care quality and efficiency.

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