

Survey: Integration of bio-medical equipments with OSCAR EMR system

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Abstract

The use of Electronic Medical Record Systems for managing Clinical Data is on the rise in India. With many hospitals and medical institutions ready to adopt one or the other EMR application for their data management, a major drawback in their system resides in the fact that apart from medical history and other clinical data entered by the clinicians, evidence-data like CAT scans, X-rays, PET-scans, Lab Results, etc. cannot be stored in these systems. OSCAR EMR is a robust open-source clinical data management system that allows users to upload evidence-data in the form of PDF, JPG, PNG file formats. With the option to upload and store such data in various file-formats, it is still difficult to convert the data output from various medical equipments into computer readable formats, transfer it to a computer system and then upload it to OSCAR EMR system. With this problem in mind, we will be investigating the options to integrate the following medical equipments directly with OSCAR EMR such as X-Ray machine, MRI machines, CAT scans, PET scans, Ultrasound.

We will work upon creating interfaces (using hardware or software as needed) to output the data from these equipments into DICOM format and create easy to manage networks that will enable these DICOM data to be sent to the OSCAR system directly along with the patient ID.

Key Words: OSCAR EMR, CAT scans, X-rays, PET-scans, Lab Results, etc

I. INTRODUCTION

As medical care gets more and more complex and new information is already overwhelming physician's capacity to treat patients with the latest information, physicians need new technologies to help them cope. There is great need for a digital record to allow capture of patient data that can then be processed and mined for insights into better treatment for patients. The electronic medical record (EMR) is the tool that promises to provide the platform from which new functionality and new services can be provided for patients [1].

Physicians are expected to document encounters they have with patients to ensure crucial information for decision-making is recorded and actions taken are also recorded. Documentation is also required as an archival record of what happened in cases of dispute. To a great extent, physicians resent the task of documentation, as it detracts from their primary task: taking care of patients. Physicians also resent the duplication of effort required with documentation, as every medication that is written on a prescription pad, every lab test ordered, every x-ray ordered has to be re-written in the chart to maintain a good record. Communication between practitioners is

difficult as in many cases the information collected is fragmented, frequently redundant and voluminous. Finally, physicians are constantly inundated with new information and have no tools to help them incorporate new techniques and treatments into their day-to-day activities, other than using their memories or having to lug around large textbooks.

Weed's innovation was to generate a record that would allow a third party to independently verify the diagnosis. In 1972, the Regenstein Institute developed the first medical records system. Although the concept was widely hailed as a major advance in medical practice, physicians did not flock to the technology.² In 1991, the Institute of Medicine, a highly respected think tank in the US recommended that by the year 2000, every physician should be using computers in their practice to improve patient care and made policy recommendations on how to achieve that goal.³ However, in spite of pockets of use of EMR since the 1970's, mostly in government hospitals and a few visionary health institutions, EMR use has not taken off. It is estimated that EMR use is about 20% in the hospital sector in the US (less in Canada) and about 5% in clinics (probably about the same in Canada). In Canada,

many large clinics have already implemented these technologies. However, the vast majority of physicians work in 1-3 physician practices, where the costs of implementing technology are prohibitive [2].

Description of the technology: Clearly, the EMR (used by physicians in their offices) and the EHR (used by health systems to transmit and manage health care data) are complementary technologies. One without the other doesn't provide much benefit. The modules required by an EMR include: scheduling, patient registration, documenting patient encounters, writing prescriptions, managing documents, requisitioning and receiving lab and diagnostic imaging reports, managing interoffice communications, clinical decision support and billing. The modules required by an EHR are: Authentication of patients and providers, laboratory results reporting, drug claims adjudication, diagnostic imaging reporting, hospital discharge summaries, secure messaging and clinical decision support..

LITERATURE SURVEY

For this proposed project, IEEE papers were studied as part of literature survey. Till this point the report has given basic information on the Integration of Bio-Medical Equipments with OSCAR EMR System phenomenon, variety of observed using open source OSCAR technology and EMR technology. OSCAR EMR is a robust open-source clinical data management system that allows users to upload evidence-data in the form of PDF, JPG, PNG file formats. With the option to upload and store such data in various file-formats, it is still difficult to convert the data output from various medical equipments into computer readable formats, transfer it to a computer system and then upload it to OSCAR EMR System. Electronic Medical Records may include access to Personal Health Records (PHR) which makes individual notes from an EMR readily visible and accessible for consumers. The Digital Imaging and Communications in Medicine (DICOM) Standard describes the means of formatting and exchanging medical images and image related information to facilitate the connectivity of medical devices and systems. The Health Level Seven (HL7) is a standard for the interchange of data within the healthcare industry.

The poor design is impacting EMR usability where physicians are faced with information overload. This is causing physicians to accept and validate erroneous data that may inadvertently produce unintended clinical consequences. The subject research describes the shortcomings of the EMR system leading to low adoption, and then proposes a new approach of using the Design

Structure Matrix (DSM) method for improving EMR system usability through the analysis of system functionality. Here is the literature survey of the method as follows. X-ray, computed tomography (CT), and MRI, and their common use in clinical practice, the number of medical images is increasing every day. These medical images provide essential anatomical and functional information about different body parts for detection, diagnosis, treatment planning, and monitoring, as well as medical research and education.

In paper [1] depicts that aims at addressing new challenges in standard-based interoperability provision among legacy healthcare information systems, while adhering to international and national standards for data and service representations. We introduce a framework to employ healthcare standards and clinical terminology systems to achieve semantic interoperability between distributed Electronic Medical Record (EMR) systems. A real world case study for integration of a Clinical Decision Support System (CDSS) with the EMR of a specialist will be presented.

In paper [2] depicts that EMR adoption rates are as low as 10% nation-wide, due in part to poor design of the system user interface. The poor design is impacting EMR usability where physicians are faced with information overload. This is causing physicians to accept and validate erroneous data that may inadvertently produce unintended clinical consequences. The subject research describes the shortcomings of the EMR system leading to low adoption, and then proposes a new approach of using the Design Structure Matrix (DSM) method for improving EMR system usability through the analysis of system functionality. A clustering algorithm is used to evaluate the interactions between system elements, and results are analyzed to decide if further design improvements can be made. The preliminary research results suggest that the application of DSM may allow improvements to the EMR functional design and enable improved physician acceptance of such systems.

In paper [3] HCC requires more than merely designing an artificial agent to supplement a human agent. The dynamic interactions in a distributed system composed of human and artificial agents—and the context in which the system is situated—are indispensable factors. While we have successfully applied our methodology in designing a prototype of a human centered intelligent flight-surgeon console at NASA Johnson Space Center, this article presents a methodology for designing human-

centered computing systems using electronic medical records (EMR) systems.

In paper [4] depicts that Clinical decision support systems (CDSS) can significantly increase the quality of care while decreasing cost and effort. They are difficult to develop and most existing systems are proprietary, tightly integrated with specific electronic medical record (EMR) systems, and expensive to own. EGADSS is an open-source CDSS that has been developed as a standalone, standards-based, re-usable component to make decision-support available for any EMR. In order to realize this vision, the EGADSS team has had to develop an open interface for medical data exchange, which maximizes interoperability, simplicity and standard conformance.

This paper reports on a solution to this challenge based on the HL7 Clinical Document Architecture (CDA) and the electronic medical summary standard. CDA-based medical summaries are used to encapsulate virtual medical records about patients that serve the DSS component as temporary databases. We show how these temporary databases can be queried from within Arden syntax-based guidelines in a standard query language. Moreover, we show how the CDA can be used to communicate CDSS alerts and recommendations back to the EMR.

1. PROBLEM STATEMENT

With this problem in mind, we will be investigating the options to integrate the following medical equipments directly with OSCAR EMR:

1. X-Ray machine
2. MRI machines
3. CAT scans
4. PET scans
5. Ultrasound

We will work upon creating interfaces (using hardware or software as needed) to output the data from these equipments into DICOM format and create easy to

manage networks that will enable these DICOM data to be sent to the OSCAR system directly along with the patient ID.

2. OBJECTIVE

The following are the objectives of the proposed work:

- To integrate bio-medical equipments commonly used at hospitals in India with the EMR application: OSCAR McMaster EMR.
- To validate interoperability of the bio-medical equipments with OSCAR.
- To standardize outputs from various bio-medical equipments into DICOM format to enable integration with any software application system.
- To investigate the feasibility of HL7 based data transfer from these equipments to software systems.

3. METHODOLOGY:

Clinical decision support systems (CDSS) can significantly increase the quality of care while decreasing cost and effort. They are difficult to develop and most existing systems are proprietary, tightly integrated with specific electronic medical record (EMR) systems, and expensive to own. EGADSS is an open-source CDSS that has been developed as a standalone, standards-based, re-usable component to make decision-support available for any EMR.

An Electronic Health Record (EHR) is a systematic collection of electronic health information about an individual patient or population. It is a record in digital format that is theoretically capable of being shared across different health care settings. In some cases this sharing can occur by way of network-connected, enterprise-wide information systems and other information networks or exchanges. EHRs may include a range of data, including demographics, medical history, medication and allergies, immunization status, laboratory test results, radiology images, vital signs, personal statistics like age and weight, and billing information.

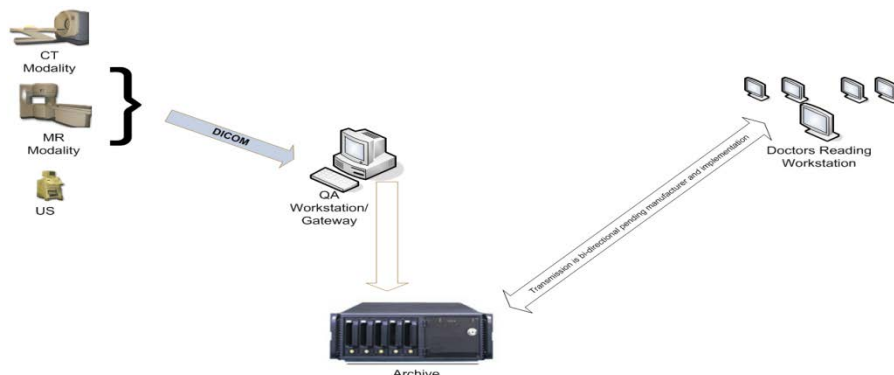


Figure 1: Picture archiving and communication system (PACS) work flow diagram.

Fig.1 shows medical imaging technology which provides economical storage of and convenient access to, images from multiple modalities (source machine types). Electronic images and reports are transmitted digitally via PACS; this eliminates the need to manually file, retrieve, or transport film jackets. The universal format for PACS image storage and transfer is DICOM (Digital Imaging and Communications in Medicine). Non-image data, such as scanned documents, may be incorporated using consumer industry standard formats like PDF (Portable Document Format), once encapsulated in DICOM. A PACS consists of four major components: The imaging modalities such as X-ray plain film (PF), computed tomography (CT) and magnetic resonance imaging (MRI), a secured network for the transmission of patient information, workstations for interpreting and reviewing

images, and archives for the storage and retrieval of images and reports. Combined with available and emerging web technology, PACS has the ability to deliver timely and efficient access to images, interpretations, and related data. PACS breaks down the physical and time barriers associated with traditional film-based image retrieval, distribution, and display.

OSCAR is primarily written in Java Server Pages (JSP) and served via the Apache Tomcat servlet container. The backend storage is a MySQL database, and the interface layer between Java and MySQL is Hibernate. Most installations are performed on a Linux server. OSCAR is installed on a different machine than the one it is used on, in a server-client configuration.

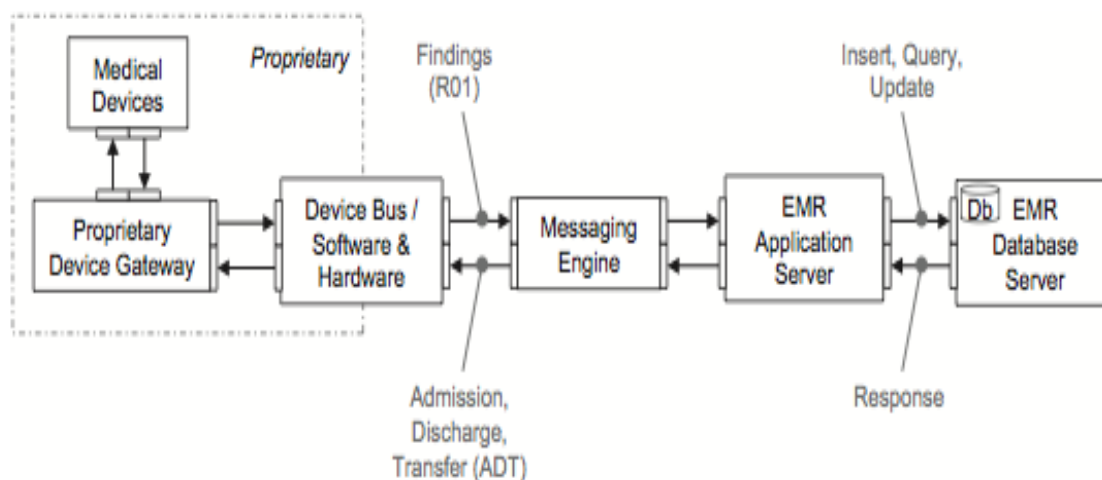


Figure 2: Example of gateway-based device interfacing

Fig.2 shows the communication mechanism typical of MDGs (Medical Device Gateway), in which proprietary medical device networks communicate outbound results to an EMR using a standard interface such as HL7 and can receive inbound identifying information from the EMR. One immediate benefit of this communication approach is that the communication mechanism within the system incorporating the devices and the Gateway can be manufacturer-defined and prescribed. On the outbound side of the Gateway, a more universal interface can be supported through what is identified as a Device Bus Software & Hardware interface mechanism. The outbound side of this interface can be a standard such as HL7. Many device Gateways already communicate using an HL7 standard, obviating the need for this intermediary interface. However, should the gateway interface use a proprietary format, then the intermediary can be used to

translate data into a more standard format for communicating with a messaging or interface engine. The messaging engine provides the capability to tailor the HL7 message from the device Gateway to a format required by a specific instance of EMR. The outbound traffic of this interface is representative of the results (HL7 R01) findings transaction. These gateway interfaces also support inbound admission, transfer, and discharge messaging so that patient demographic identifying data may be posted back to the devices through the device Gateway. This is very important from the perspective of positively identifying the findings from a particular patient.

4. RESOURCE REQUIREMENT

6.1 Software

- JAVA

- SQL SERVER
- 6.2 Hardware
- PC/Laptop
 - X-Ray machine
 - MRI machines
 - CAT scans
 - PET scans
 - Ultrasound
 - Connecting wires etc.

6.3 Input Images



Figure 3: X-Ray image

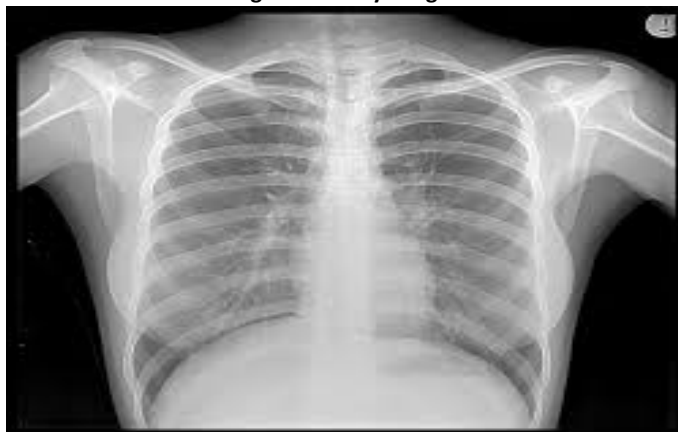


Figure 4: X-Ray Image



Figure 5: X-Ray Image

5. CONCLUSION:

The hardware and software for all OSCAR EMR systems is easily available, but they vary considerably in proprietary components, installation requirements and customizability. This study aims to address the needs of clinicians like us from resource-limited settings who are exploring options for adopting an outpatient point-of-care EMR but have unreliable internet access and limited financial and human resources. Our emphasis is on EMR availability, cost, simplicity of installation and maintenance, clinical functionality, and reporting for monitoring and quality improvement. We attempted to take into account clinical setting and patient problems, cost of needed hardware and proprietary software components, technical skill needed for installation and maintenance, scalability, clinical functionalities and ease of reporting.

Given the importance of the EMRs for the future of medical care, we feel it is imperative that an international body directly test these products to determine their clinical functionalities and limitations. Unfortunately, the long-term goal of having primary care data available for local, national and global use in making public health and quality care comparisons is nowhere in sight. Ultimately, a new Millennium Development Goal should include the creation of a universal open-source health informatics platform that will allow the collection, management and delivery of clinical and population data that will guide decision processes at the local, regional and global levels. Until this goal is achieved, care will continue to consume unnecessary resources because of fragmentation, medical errors and poor data utilization. While there are and will be challenges, there is general enthusiasm and excitement for the Implementation of OSCAR EMRs across the Integration of Bio-Medical Equipment.

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