Towards an Electronic Patient Record for Cardiology: The Issue of Integrity of Patient Data

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Abstract

In the Cardiology department, many different sources of clinical information are used in the daily routine. Integration of these (digital) sources into an electronic patient record is a logical step. One of the issues regarding the integration of data is the integrity of patient data: there shouldn't be any mis-registration of patient related data such as patient ID, patient name.

To achieve integrity of patient data, we have now created a method to automatically transfer patient related data from one system to the other, mostly by using industry standards for communication of these data.

With the integrity of these data secured, we can now proceed with the integration of the data into one system.

1. Introduction

In the Cardiology Department of the Radboud University Nijmegen Medical Center, many different sources of information are used in the daily routine. With the digitalization of many of these sources, integration of these sources of information in an electronic patient record is a logical step.

A number of digital information sources from other departments have already been integrated into one referral system by the Radboud University Medical Center Nijmegen's central ICT department by using an in-house developed framework (XpertMed, based on .NET technology). It now contains patient demographics; Radiology images, Lab results and letters to referring professionals. Other data to be included will be medication, admission data, images, pathology results and treatment information. The Cardiology department will also contribute to the XpertMed framework, for example with digital ECG data, the Cardiology-PACS, catheterization reports, and echocardiography reports.

In collaboration with other departments in Nijmegen and other Cardiology departments in the Netherlands, we are now addressing a number of issues regarding the integration of the cardiology-specific data. The integrity of data is one of the key issues that have to be solved when combining these information sources: it must be certain that the data provided from a certain patient, is indeed from that patient. Manual entry of patient data, causing most integrity problems, should therefore be avoided.

2. Methods

The method of choice to achieve patient data integrity is to obtain available data automatically from the hospital information system (HIS). Each system that uses patient demographic data should therefore be linked to the HIS.

Industry standards, such as DICOM[1], HL7[2], Soap/XML[3] should be used where possible to achieve this goal.

In our hospital, patient demographic data, outpatient clinic appointments, and admissions are made available using the SOAP/XML protocol. This protocol is used throughout in all centrally provided systems of our hospital and is part of the hospital's policy to use web enabling and integration (WEI) techniques to create an electronic patient record system. For the method of data storage, the HL7 V3 standard is used. A simple unsolicited HL7 ADT system is also available to obtain patient demographical data. It provides an HL7 message with patient information every time a patient is entered in the hospital information system, a modification in data is made or when a patient is admitted or released from the hospital. No ADT queries can be made to our central ICT system.

Patient demographic data can be provided to most image producing systems, such as angiography systems and echocardiography systems, by using Dicom Work lists. Thus, the correct patient data is available at the beginning of the study and will be available throughout

the process of image creation, storage and reporting. Dicom Worklist providers can be readily purchased from various vendors. There are also a few Dicom toolkits available free of charge. One of these systems is the Dicom toolkit provided by Offis[4]. In includes image send and receive software, Dicom parsers, Dicom-to-bitmap converters and a Dicom Worklist system.

3. Implementation

In Figure 1, the flow of patient related data as proposed for our Cardiology department is depicted. For communication between each of the systems, the protocol that is used is indicated.

We created an interface between the HIS (patient scheduling information) and the ultrasound imaging modalities using two computer services. The first service, built in Microsoft Visual Studio .Net 2003, queries the hospital information system using the Soap/XML protocol to obtain patient appointments and related demographics. These data are stored in Dicom format on a computer server. The second computer service is the (open source) Dicom Worklist package provided by OFFIS (part of the Dicom toolkit dcmtk 3.5.4). This service listens to Dicom Worklist requests from the echo-systems and responds by sending the patient data relevant to that system.

For the cathlab, an HL7-ADT link was used to transfer patient demographics to the system. From the cathlab DMS (GE Centricity Xi2) a variety of methods is used to transfer these data into the various subsystems: a serial interface to communicate with our Siemens Hicor X-ray systems, a file based method for the electrophysiology system and a Dicom Worklist for the General Electric Maclab haemodynamic system.

In most of our clinical databases, such as the cathlab waiting list system, the complication registration, research databases and echo reporting system, a procedure using the Soap/XML protocol is built in to retrieve patient demographical data.

Information is made available to the electronic patient record system by means of Soap/XML messages or by using Web API's.

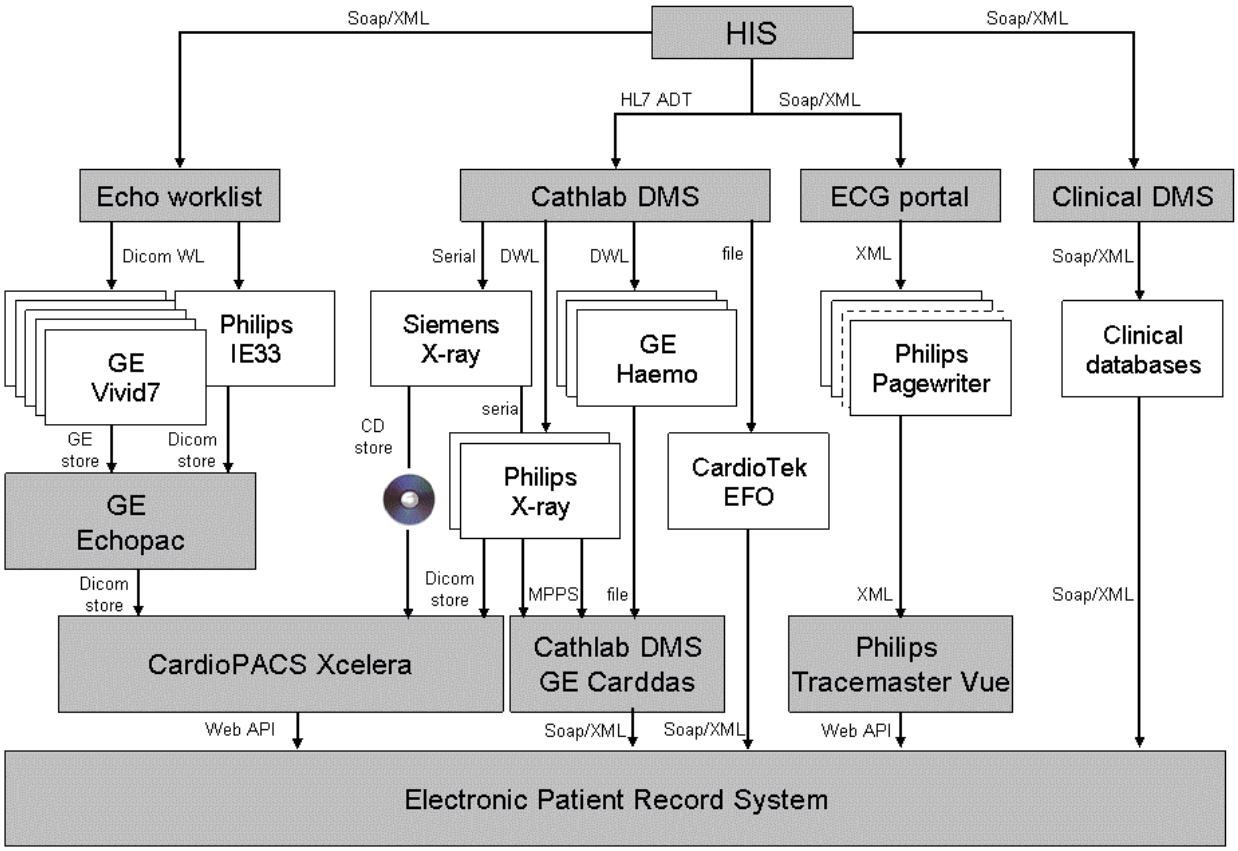

Figure 1. Flow of patient related data as proposed for our Cardiology department. For communication between each of the systems, the protocol that is used is indicated.

4. Results

For the echocardiography systems and the cathlab systems, manual entry of patient information has almost been banned. Only in case of emergency procedures, manual entry of patient data is sometimes needed. In the cathlab for example, a patient that needs to be treated quickly may not yet have been entered in the hospital information system. In case of echo, it is sometimes unavoidable that the echo system is not connected to the network at the time of image acquisition. In these cases, the patient data is checked manually after reconnection to the network

In both the echo lab and the cath lab, the technicians are very content with the solution because the introduction of the system to provide patient demographical data has resulted in more accurate data and less typing.

After successful introduction of the system in the adult echo lab, system was also introduced in the pediatric echo lab. The echocardiography systems in use at the children's hospital are connected to the same GE Echopac system as our systems.

In the clinical databases, extensive use of the Soap/XML protocol is made to transfer patient demographics and other data. Again, less typing is required in these databases. Furthermore, changes in patient demographical data as present in the hospital information system are easily transferred to the clinical databases, thus keeping these data up to date throughout the department.

5. Discussion and conclusions

By using industry standards like DICOM, as well as the Soap/XML protocol, we have been able to provide most systems in the Cardiology department with adequate patient demographical data.

This has resulted in more accurate patient data in our systems and has improved the efficiency in the cath lab, echo lab and other parts of our department.

Cases remain where manual entry of patient data is unavoidable, such as at an emergency procedure in the cathlab. In this case, apart from patients that are new to the hospital and have not yet been entered in the system, there is also a possibility that the patient has been registered into the HIS some time before the procedure and that the patient has not yet been admitted to the hospital. In that case, no HL7 ADT message of that patient is sent to the cathlab system, and hence, the patient is not present in the cath lab system. A solution to this problem would be to use an HL7 query to query the hospital information system, however, HL7 queries cannot be made to our HIS. An alternative may be that next to the HL7 message stream, a second stream to the cath lab system is made, querying several databases for possible cathlab patients, obtaining accurate patient demographical data from the HIS using the Soap/XML protocol, and entering these data into the cath lab system. Of course, care has to be taken to avoid double entries of a patient in the cathlab system.

A solution to the case where an echo system is not connected to the network to retrieve the Dicom Worklist is to use wireless communication. Since the echo systems are also used to image patients in the coronary care unit, care has to be taken not to use very powerful wireless devices, such as Wireless LAN (ISO 802.1). Probably Bluetooth communication can be used, although the range and the connection speed of that communication protocol inferior to Wireless LAN. It would require that a Bluetooth access point is placed in every room where an echo can possibly be made. A similar issues is currently addressed in the recently acquired Digital ECG system (Philips Tracemaster) and ECG systems connected to the ECG management system.

The present work is strongly related to other efforts around the world to obtain integration and communication of data. For example the IHE organization[5] is successfully working on interoperability between different vendors in the field of radiology and (recently) Cardiology. We have clearly benefited from these efforts, as all of our imaging systems now have the possibility to effortlessly communicate with Dicom Worklists and PACS systems. However, local implementations of data communication, as presented in this paper, will always remain necessary.

After having provided each system in the Cardiology department with accurate patient demographical data, the next step is to provide the electronic patient record system with relevant data. We are currently waiting for the Web API's to be provided by Philips for the CardioPACS and ECG management system, which will allow us to integrate the image and ECG data in the EPR system. Most other systems in our department will use the Soap/XML protocol to send PDF files with i.e. procedure results to the electronic patient record system.

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