Implementation of a Cardiology Information System in the Academic Medical Center Amsterdam

CI Buddelmeijer, BG Goldhoorn, AW Huisman, PL de Haan, RJ de Winter

Academic Medical Center Amsterdam, The Netherlands

Abstract

We are implementing the Cardiology Information System (CIS) "Apollo" in the department of Cardiology. We have purchased the Apollo32 system from LUMEDX; formerly Seattle Systems Inc. which have build-in features for extensive local customization. Stand-alone systems build on information requirements of the cardiologist and built on widely divergent platforms will be more and more adopted by integration in the Apollo system. The first parts of the Apollo system Demographics (18000 patients) and Catheterization module (10300 events) are operational since the summer 2000 followed by the Stress ECG (3400 events) and Pediatric Echo (5770 events) module (200). The module CCU (3650 events) and Echo (8300 events total of the Resting, Stress and Transesophageal echo) module are since 1 April2002 operational and will be the unofficial the point of no return. We start to implement the Apollo module: EHH (Chest Pain Clinic) on 1 Oct 2003 followed next year by the module CHF, Electrophysiology, Pacemaker, Holter etc. A number of 36.000 letters/reports are stored on the Apollo servers. Doctors, assistants, nurses, residents and the administration personal (about 125 in total) were using now daily Apollo for different use. They worked on standard workstations (about 50 in total) run with Windows2000NL and MS-Office97 suite connected on the internal AMC network. We plan to increase the number of working places to 60. Our two servers (Access97 and SQL6.5) are located at the computer room of our central automation department. The uptime of the Apollo system is in principle 24 four hours a day, seven days a week. Our experience with the availability is very satisfying. The waiting time for retrieval of an existing letter/report is sometimes too long now. We plan to upgrade (hard - and software) the running servers and workstation. Integration of the Apollo signed letters/reports, a part of our "AMC Electronisch Patiënten Dossier so-called Poliplus", will be published in the EPD at the end of this year. The implementation of interfaces, standards such as HL7 and DICOM, with installed and new coming cardiological equipment delivered by different suppliers are in practice not so easy.

1. Objectives

At present we have an outdated HIS together with a host of stand-alone applications geared at either patient care or clinical research, with varying degrees of IT sophistication. The cardiological subspecialisms have developed their own methods and their own terminology. The main objective of Apollo is to integrate medical data from the different cardiological subspecialisms and to present it according to a configurable user profile.

2. Policy

After assessing the existing state of affairs, an IT policy for the department of Cardiology was formulated. It was decided that the clinical information of the cardiological subspecialisms should be integrated in a single Cardiology Information System. It was also decided that an existing CIS should be purchased rather than developing one on our own.

Existing stand-alone applications are basically left alone until the functionality of Apollo is considered by the users to be good enough to replace the old system. Alternatively, methods and techniques of the old system may be incorporated in Apollo, resulting in a local "blend" of Apollo and the existing IT practices.

In the AMC, patient information is available using web browsers (Netscape, Internet Explorer etc.), using Java CORBA and ActiveX. The Poliplus system, formerly called Zouga-2 [1], integrates information from stand-alone applications with (incompatible) databases and presents that information on the workstation on the desk of the clinicians.

The Apollo32 database will be one of them.

The departmental information systems remain the responsibility of the clinical departments (e.g. Apollo for the Dept of Cardiology). Most of these medical databases, based on a large variety of tools/products such as dBase, MSAccess, FilemakerPro, SQLserver, etc. can be accessed using a hospital-managed network.

3. Choices and realization

The chosen application has to run on standard PC's and work stations, using a familiar OS and a familiar office suite. Here we have opted for Microsoft software.

Since it was obvious that we would have to customize the application to reflect clinical practice in our department, we required that the application could be customized and translated in a simple way. We had not only the problem of translating screens and reports into Dutch, but there were also many practical aspects, such as Zip codes, the Dutch Medical referring system with its special role for the General Practitioner and its special requirements for billing.

In the past many Cardiology examinations depended on analogues stand-alone equipment. Now such equipment often supports its own PC with specific functional application software. For replacement of obsolete equipment/hardware we have to make explicit demands regarding connectivity and the possibility of integration in a CIS.

In 1997 only two (Summit and Apollo) Cardiology Information Systems (CISses) fulfilled our requirements. Nowadays there are more possibilities such as Crannburn Software / Tomcat clinical system etc.

We opted for Apollo32, the system of LUMEDX Corporation (www.lumedx.com), formerly Seattle Systems Inc.

The Apollo CIS consists of a few central modules to be completed with optional modules that may reflect specific subjects the implementing Cardiology Department is involved in (e.g. Pacemaker, Holter). AMC has purchased a fairly complete system, consisting of most of the central modules (Demographics, Hospital admission, Medications) and a number of specific Cardiology modules such as Catheterization, Echo and CCU.

Apollo32 runs under Windows9x and NT4 (updated to Windows2000NL or XP-ProfessionalNL.). A new release of the Apollo32 version 3.0 has become operational in the winter of 2001. The application can be run as a stand-alone application or as part of a network, preferably a Microsoft network environment. The file server (which handles forms, reports and the application) and the database SQL 6.5 server (updated to SQL 7.0 or SQL2000) are located in a secure environment. We plan to install about 50 workstations with NT4 (updated to Windows2000NL) and MSOffice97 professional NL (updated to Office2000Prof.NL) connected to the two servers using a TCP/IP or an IPX protocol on the hospital network.

3.1. Customization

When customizing a clinical database, one seeks as much uniformity as possible for different Cardiological sub-units (e.g. wards, CCU, Cathlab). We assigned a clinical overviewer for each subunit, and formalized the contacts between the IT specialist and the clinical overviewer in a very strict way. We developed a protocol for IT specialists to interact with clinical supervisors. The protocol makes sure that both parties know exactly the tasks they are committing themselves to. Our initial experiences with this method encourage us to formalize this protocol and apply it in all phases of the customization.

The protocol specifies how the functionality of the subunit should be charted and how the necessary data elements, either existing ones or new ones should be formulated. It also specifies the way existing screens should be adapted or extended. The resulting iterative prototyping process is repeated until the user disposes of a functional tool for doing his job in a pleasant and professional way. Requirements and suggestions for change in specific Apollo modules of the clinical supervisors were listed and were scheduled for implementation.

3.2. Connectivity

For connecting specific cardiological equipment (ECG, Echo, Cath. data, CCU etc) standard interfaces, such as HL7 and DICOM3, should be available. Especially a connection to the HIS system (in our case ZIS), supplied by iSoft Group/TOREX/HISCOM) is a prerequisite. When we purchased Apollo, an HL7-connection was not yet available for our HIS.

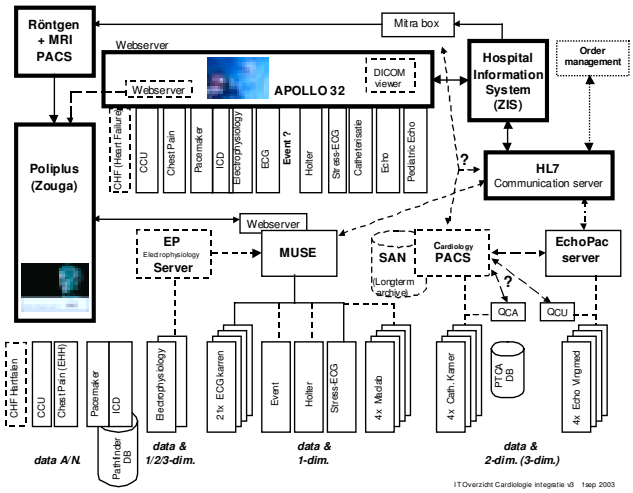

Figure 1. IT overview integration (v3 1 Sept. 2003)

Therefore a customized connection between Apollo and our HIS has been developed by Seattle Systems. This we use for updating Apollo with the most recent demographic data of the patient and his General Practitioner (address data) from the HIS. This connection works well, at least under NT4.0. Still, it would be better if we would have had the possibility of creating a connection using a standard HL7 protocol.

3.3. Performance measurements

To measure response times of the application in a practical situation we use the build-in Apollo Utility

Performance monitor system. It gives response times of the Database Server (Read Only Mode), Database Server (Edit Mode), File Server (Avg. time to read) and several CPU (as Array test, Form Load and Load Controls).

4. Results

We tested both the heavily modified Cathlab module and the CCU module at the end of the year 1999 till the beginning of the year 2001. At this time the Demographics module (18000 patients) and the Catheterization module (10300 events)

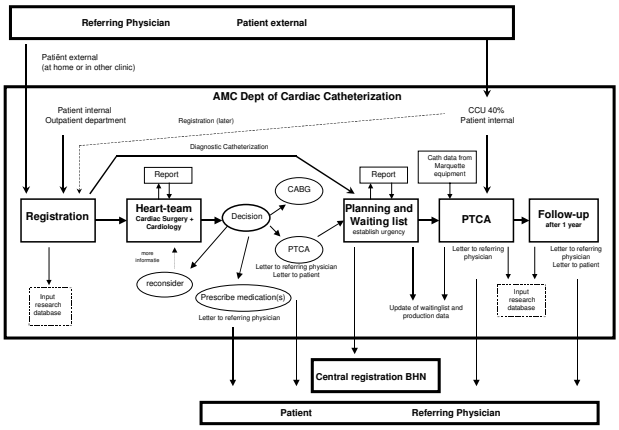

Figure 2. sample process schema

Are operational since the summer of 2000 and were followed by the Stress ECG module (3400 events) and Pediatric Echo module (5770 events) during the year 2001. The CCU module (3650 events) and Echo module (8300 events total of the Resting, Stress and Transesophageal echo) are operational as of April 2002. A number of 36.000 letters/reports are stored on the Apollo servers. The EHH (Apollo Chest Pain Clinic) module will start at 1 Oct 2003 followed next year by the Electrophysiology, Pacemaker and Holter module. Doctors, nurses, residents and the administrative personal (about 125 in total working on 50 workstations) now use Apollo daily for various purposes.

5. Discussion

It was clear from the beginning that an application designed for American Cardiology Departments could not meet European (or AMC) standards in all respects. In a few cases we could only repair this situation by completely redesigning the module involved, which created quite a few problems.

Apollo has been designed for small and for large hospitals. It can work with a single module (as stand-alone using MSAccess only), but also as a fully integrated system (Both MSAccess-based and SQLserver-based). One can worry whether this one system structure has been a good choice in all cases. The subspecialisms of the Department of Cardiology in AMC hospital are so large that they all depend heavily on parts of the medical data in the central modules (Medications, Physical Examination, and History). However, in AMC, items like the Laboratory tests are recorded centrally in our HIS, so they are not automatically entered in Apollo and they have to be consulted using different software.

Therefore the specific Apollo function modules must be able to operate as independent subunits within the Department of Cardiology.

6. Conclusions

It was clear from the beginning that an application designed for American Cardiology Departments could not meet European (or AMC) standards in all respects. In a few cases we could only repair this situation by complete redesign of a module.

For customization of modules in Europe it would be a major advantage if the modules were more generic and easier to modify (they are difficult to change).

Service in Europe (Implementation/ project management and consulting services) of the LUMEDX Apollo systems of should be of a higher level than is the case now.

Nomenclature and structure of the system should be left to local, national developers rather than being the responsibility of LUMEDX.

In the USA Apollo32 is commonly used as an application for ACC -and STS Registries. It can also be used for central registration according to upcoming new European rules.

At the same time, relying on Microsoft products for building the application is a reasonable guarantee for continuity and integration of the software. The disadvantages of relying on Microsoft components (complexity and bugs) are outweighed by its advantages (uniformity and accessible know-how). Suppliers of Cardiological database systems will be confronted in the future with strict requirements with regard to adaptability, standardization and connectivity (e.g. HL7 and DICOM) by the AMC.

Integration of Cardiological data is at present far from obvious. Suppliers of Cardiological Information Systems will be confronted in the future with strict requirements with regard to adaptability, standardization and connectivity by the AMC. The implementation of interfaces, standard such as HL7 and Dicom3, with installed and new coming cardiological equipment delivered by different suppliers (GE Medical Systems and Philips Medical Systems) is in practice not so easy.

References

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Address for correspondence.

Name. C.I. (Chris) Buddelmeijer
Academic Medical Center (AMC)
Dept. of Cardiology room: B2-255
Mail: PO boxes 22660 (National), 22700 (International),
Postlocation B2-125, 1100 DD AMSTERDAM,
THE NETHERLANDS
business e-mail: c.i.buddelmeijer@amc.uva.nl
Internet: http://www.amc.nl