

Volume 1 / Issue 3 Autumn 2006 - Features

Process Approach to Cardiac Ultrasound PACS and Reporting

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The conflict between economic viability and the desire to provide medical quality sets the scene for the introduction of a completely digital image-based echo-cardiography reporting system in the 1900-bed University Hospitals Leuven. The goal of this project was to increase efficiency so that state-of-the-art medical quality could be delivered daily bearing the economic constraints in mind.

Cardiac ultrasound imaging, in which the beating heart is visualised, has evolved quickly from being an experimental tool to an examination activity that is performed routinely on many patients. Ongoing improvements to this technique result in more options for measurements and quantitative analysis. But, while such analysis can dramatically improve the quality of the examination, it requires additional expertise and time of operators and cardiologists, which is usually not reflected in reimbursement.

Incremental Development

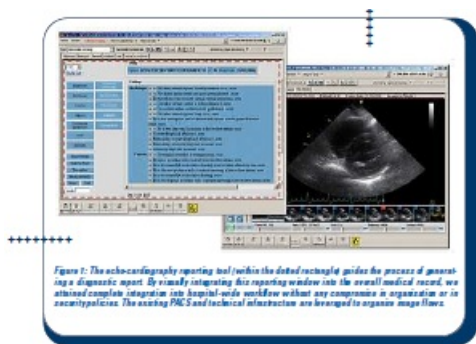
The first element in our approach is to re-engineer the process within Cardiology. We experiment with converting the reporting system from a simple text processor to a tool that guides operators and cardiologists. The second element is to integrate reporting into the hospital-wide Electronic Medical Record (EMR) to streamline the overall process. We opposed the traditional concept of the cardiology reporting system as a separate island with its own internal organisation. Instead, we radically delegated all organisation and workflow to the overall system by visually integrating the reporting module into our existing clinical workstation. The third element is consolidation of technology by integrating image handling into the existing hospital-wide PACS.

Using the Electronic Reporting Tool to Transform the Diagnostic Process

Typical cardiology reporting systems provide a structured layout that summarises measurements (performed on the images within the reporting tool or transmitted from the ultrasound machine), calculations, automatically derived interpretations, and free text for the conclusion. The reporting tool increases the efficiency of formulating the report, but not of the process of arriving at conclusions.

Our approach, in contrast, aims at exploiting the reporting tool as a guide for the execution and interpretation of the examination. Firstly, the structure of the report is tailored to the clinical request, rather than to the technicalities of the examination. This increases efficiency for the referring physician, who will ultimately have to translate findings in the report into therapeutic actions. Secondly, the system provides a structure that reflects which acquisitions and analyses must be performed. This ensures that time is spent mainly on the most relevant actions while overall quality improves by incorporating diagnostic guidelines from scientific evidence. Thirdly, we integrate previous knowledge into the system to improve the medical quality of the report without having to increase our effort in doing so. Patient measurements could be compared to normal values that are adapted to age, weight, gender and previous diagnosis (by means of the reference database generated from the specific patient population). Alternatively, the system could automatically show previous data for the same patient to indicate trends.

This re-engineering effort takes the view that new technology should be exploited to optimise medical quality within economic constraints rather than the opposite. At a technical level, it requires the ability to adapt the commercial reporting system.



Integration into Hospital-Wide Workflow by Visual Integration as a Slave Component

Cardiology reporting is part of a hospital-wide process. Solution providers ensure that their reporting systems can be fed information from other parts of the process and can send results to the EMR. However, they still see the reporting system as the principal system in the department that provides all organisation and workflow. We believe that this “self-absorbed” approach – although aimed at improving workflow – actually counters hospital-wide workflow and organisation.

Our cardiologists do more than merely interact with the reporting system. They use the hospital-wide EMR to consult medical information from different departments. As part of their workflow, they not only approve a medical report, but also the billing of the complete examination, including administered medication – which the reporting sub-system is incapable of doing. Cooperation between physicians from different departments not only requires technical functions in the EMR but also global policies, and confidence in the measures for access control and authentication.

The traditional solution is to have the reporting sub-system provide more of these overall functions. This requires massive amounts of data transfer from the EMR to the reporting system, often just to have that system present the data to the user. Duplication of functions in the different systems is not only a waste of implementation effort, but often interferes with overall policies and security.

In our approach, the reporting system is visually integrated as a slave module in the user interface to the EMR (Figure 1). Information that does not strictly belong in the report will not be included in the reporting system but will be available in the EMR part of the user interface – as it has always been. All actions related to workflow are performed in the EMR, using concepts, policies and security that are in no way compromised by the reporting system. For example, signing off a report (or modifying its status in any other way) is done using buttons in the “outer” part of the user interface. During this action, the EMR pulls the report from the reporting window and manages that copy internally, in the same way as it would have pulled a traditional text out of a window that it had provided. Despite these advantages, little implementation effort was required: virtually no data needs to be exchanged, no excess functionality has to be duplicated in the reporting subsystem, and the processes in the EMR do not require any adaptation.

The success of this approach depends on the open-mindedness of the provider of the reporting system, and his understanding that this solution is not replacing but complementing the existing workflow. This has become a critical element in the selection of our commercial partners.

Integration into Overall Technical Infrastructure and Hospital PACS

This type of reporting system usually comes bundled with a dedicated, cardiology specific image management system. Bundling makes setting up the system easier for the provider. By contrast, we re-use the hospital PACS for long-term image storage and image distribution. This PACS, in turn, shares the 170 terabyte central disk storage system of the hospital with any other system that requires storage.

The advantages of this technology consolidation include economies of scale, concentration of know-how, hospital-wide flexibility in allocating resources, sharing of central solutions for tasks such as backup, and immediate availability of functionality such as image access over the Internet. It may cause concern that all image transfers use the existing PACS infrastructure, but it also enables the user to utilise the existing tools and procedures for correcting errors, and to share experiences in other image intensive departments such as radiology.

This kind of overall optimisation requires a perspective over various medical departments. A global vision by hospital management is more important than introducing any amount of technology.

Published on : Sun, 19 Nov 2006