Hospital pursues filmless, paperless environment

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It is almost impossible to imagine a modern hospital without a PACS. Initially introduced as a stand-alone application in the medical imaging department, PACS were often linked only to a single unit such as CT or MR. Hospitals gradually began to realize, however, that they could benefit fully from this application only if a link was made to other IT applications. A strong integration between the hospital information system (HIS), radiology information system (RIS), electronic patient record (EPR), and PACS is essential to reach the ultimate goal: a filmless and paperless hospital.

Imelda Hospital, located in the center of Belgium, is a general hospital with 450 inpatient and 50 clinic beds, substantial outpatient activity, and a primary trauma center. The medical imaging department includes various techniques: CR, fluoroscopy, mammography, CT, MR, and ultrasound. Over the past 10 years, we have strived to make each new modality DICOM-compliant, incorporating digital techniques into our imaging step by step, with the ultimate objective of uniting each modality into a single PACS network. The department conducts about 120,000 examinations a year, generating approximately 2.5 to 3 terabytes of data annually.

Successful PACS integration requires not only a technically sound implementation strategy but also a good business plan. It is crucial to consider the expectations and requirements of all those involved in the project. No matter how strong the economic and technical foundations of the PACS integration, success ultimately depends on its acceptance by the end users.

To prepare the request for proposal (RFP), Imelda Hospital entered a joint venture with Gasthuisberg University Hospital in Leuven and St. Jan’s Hospital in Genk, both of which were on the verge of making the transition to completely filmless operation in the late 1990s. To assure the development of a good business plan, including the RFP, economic study, and legal analysis, all the decision-makers had to be involved in the preliminary study: hospital management, economists, radiologists, IT experts, and engineers. Imelda Hospital did not have sufficient know-how on its own, so we combined the expertise of the three hospitals.

Two PACS working groups formed in parallel with this RFP working party. They consisted of a core group of technologists, radiographers, radiologists, and IT experts and an inclusive group with clinicians in all specialties. Both working parties monitored the activities of the RFP group and at the same time prepared for the PACS implementation down to the smallest detail. Such parallel action is of crucial importance. The choice of PACS vendor depends not only on the economic and technological foundations of the system, but also on the ways the solution meets the users’ specific requirements. Their input formed the standard against which the RFP was measured.

INSTALLATION

The core components of Agfa IMPAX image management systems and Quadrat RIS are as follows: the database manager collects, organizes, and manages all user and demographic data in the system. Apart from the database itself, this server is fully redundant, so operation is not interrupted if a glitch occurs. The database is mirrored for failure. Two workflow managers control the data flow to improve accuracy and to enhance overall productivity.

Both servers are simultaneously archive-shared, one for magneto-optical disk and one for digital linear tape. Each image that comes in is immediately archived on both media at once. This tandem approach provides an extra guarantee for the continuity of the data flow. Two DICOM modes are configured for each modality. The technologists normally send all images to the default mode, but if something goes wrong, the modalities can be instructed to send everything to the backup mode. Once the fault has been cleared, everything is copied over, and in the meantime the fault does not cause serious problems.

The archive manager is the archiving tool. It takes all the images on the PACS network and stores them so that users can depend on easy access to them whenever necessary. The PACS broker is clustered and acts as the “interpreter” of the system, forming the point of integration between the RIS and PACS. It provides an orderly, unified view of the RIS to the core
PACS components and automates the workflow, offering an automatic prefetch of prior exams for scheduled patients, on-demand reports, clinical information, schedules, study parameters, and validated demographics.

The four diagnostic display stations are installed in the two central reading rooms. This enables the workstations to be shared by several people and makes maximum use of them. A fifth station, plus a beamer, is used as a conference station in the conference room. Images are distributed to clinicians in different departments (some 100 locations in all) via the Web 1000 solution, so that all clinicians have quick and easy access to the images on their PCs. The Web 1000 is also integrated into the EPR through a URL. The Web 1000 exhibit server receives all the images and studies from the PACS cluster through DICOM and autorouting.

The server has its own RAID (redundant array of inexpensive disks) to store a copy of every study for several months. Clinicians can access the Web server with a standard browser, such as Internet Explorer, Netscape, or even the integrated browser in the EPR. The images are sent to the browser using wavelet compression. The clinicians have several tools integrated in the Web interface to view, manipulate, and measure images. By simply pressing one button, the user has simultaneous access to the report, sent in HTML from the broker.

The HIS assures the unique identification of the patient. Every patient is first entered in the central database of the HIS, which then sends all admission, discharge, and transfer information to the RIS, so that the exact demographics are used to make appointments and work lists, and later to validate the studies and images.

**HIS/RIS/PACS/EPR IMPLEMENTATION**

A patient visit to the medical imaging department begins when that patient makes an appointment or a request is registered; it is complete only when the images and report are available to the requesting physician. Examination orders can be placed using an electronic appointments system either centrally (order communication) or through the RIS. The administrative patient information comes from the HIS. Once the order is listed, the system searches the central image archive for prior relevant examinations. If found, they are placed online by an archive prefetch mechanism.

The patient’s arrival is noted by a change in status on the RIS. The imaging order's procedures are sent together to the DICOM modality work list. The patient's status changes again as soon as the exam starts and is marked "finished" once imaging is complete. The images are sent on to the PACS. The examinations are now ready for reporting by the radiologists on a diagnostic workstation.

Imagers can select examinations on the basis of different criteria, including those marked "new." The RIS tracks the case through dictation, finished text report stage, and approval. The report is then made available to the requesting physician, and cost information is added to the invoicing package. The report is added to the electronic patient file. The images can be viewed using Web technology on a clinical workstation. In normal circumstances, this is a standard PC with a standard screen. The radiologist can make a selection of "keynote images" beforehand, which is particularly useful for CT and MR studies, as they often involve large image volumes. This Web server can be either directly queried or controlled by the electronic patient file. Referring physicians who don't have access to the Web receive the images on a CD-ROM with an autorun DICOM viewer.

Productivity has increased for radiologists, technologists, and clerks as a result of PACS implementation. In addition to this and other familiar advantages such as user-friendliness and environment-friendliness, PACS has a strong influence on profitability. With conventional methods, the technologist lost five minutes per patient carrying out such activities as developing film, filing images, and shunting them back and forth. At 300 patients per day, this adds up to. That time is now devoted to better service and higher quality of healthcare for our patients, which is (Table 1). A high degree of RIS/PACS integration provides radiologists with more information for making a diagnosis. They can call up on their desktop all RIS patient data they consider relevant for their diagnosis. Furthermore, thanks to speech recognition technology, reports no longer have to be keyed in by medical transcriptionists (Table 2).

We have also noticed important reductions in subjective levels of stress and fatigue among department staff because of decreased interruptions by clinicians, improved patient throughput, enhanced scheduling, and the switch from a manual to an electronic archive. The archive allows us to keep all patient images, including prior images, inhouse, and it eliminates the risk that patients will lose their films.

Clinicians did not sign up for training until the day film printing ceased, and as a result they became frequent helpdesk users. Eventually, they realized the advantages of having radiology investigations
available minutes after the completion of a study, with all images accessible from any clinical workstation and examinations viewable simultaneously by different users. Many department heads who originally demanded PACS workstations realized that their needs could be more easily met by the Web-based system on computers they already use for the EPR. Going filmless and paperless involves more than rolling out hardware on a network. Workflow analysis is a key to success, and strong integration is necessary. Once filmlessness is achieved, nobody wants to go back.

Disclosures:

Source URL:

Links: