Clinical applications

Managing echocardiography workflow

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In February 2005, The Regional Heart and Vascular Center at Danbury Hospital went live with Philips Xcelera Echo Lab Management, an echo reporting and management system that it had beta-tested for Philips. The system helped the center implement a new workflow that reduces the time-to-report, enhancing sonographers’ knowledge, satisfying both readers and referring physicians, and enhancing patient care.

Located in Danbury, Connecticut, the Regional Heart and Vascular Center at Danbury Hospital (Figure 1) serves Western Connecticut and Eastern New York. Danbury Hospital’s Echocardiography Laboratory is the first lab in Fairfield County (and one of the first 50 labs in the world) to be accredited by the Intersocietal Commission for the Accreditation of Echocardiography Laboratories. The lab is accredited in all three major areas of echocardiography, i.e. Transthoracic Echo, Transesophageal Echo, and Stress Echocardiography.

At the main campus, plus two outpatient centers, the staff conducts over 9,000 studies each year, including 2,000 stress echos, 6,500 Adult TTEs, 300 pediatric TTEs, 250 adult TEEs, and 500 interoperative TEEs. The staff includes six physicians, seven sonographers, a clinical manager, an RN, and clerical support. In 1999, workflow in the Echocardiography Center was not optimized. Study acquisition (Figure 2) is only one of many steps. In fact, an analysis of the workflow (See Intermezzo, page 35) identified 26 steps to efficiently and effectively running an echo lab.

All of these steps could, in principle, be managed using appropriate software. At that time, however, there was no suitable commercially available software or hardware. Nevertheless, using the MESA test tools from the IHE, the laboratory was able to implement a digital display and storage system. The software was run on a Linux-based system, with
an old server that the hospital had planned to discard.

While the system was a successful stop-gap solution, it lacked both support and the important workflow-enhancers that we needed. So, in 2001, it was decided to investigate commercial solutions. A team comprising the Chief of Cardiology Andrew Keller, Clinical Manager Rick Rigling, the department administrator, and representatives from purchasing and information technology visited echo labs across the country to view full service digital reporting solutions in action.

**Xcelera Echo Lab Management**

Danbury has a long-standing relationship with Philips and had always been pleased with Philips’ service and responsiveness. In 2001, the Xcelera Echo Lab Management system had not yet been launched as a commercial product, but was regarded as work in progress. Nevertheless, it was closer than any commercially available product designed to meet the needs of the laboratory. The fact that Philips also provided the clinical ultrasound systems gave a measure of confidence.

Xcelera Echo Lab Management eases workflow while providing tools to enhance diagnosis – all from a single point of contact: the Xcelera Client Workstation (Figure 3). Seven Xcelera client workstations were obtained: three for sonographers, two for the physicians, one for the clerical support, and one for the OR.

The transition to digital echocardiography went smoothly, and the impact was immediate. The system was easy to learn, supporting Philips’ claim to offer “Sense and Simplicity”. The manufacturers took care to match the way that a sonographer and a physician interact to come to the same report. A sonographer and a physician tend to look at the anatomy of the heart in different ways, but Xcelera accommodates the workflow and thought processes of both users.

According to the manufacturer, Xcelera Echo Lab Management is “customizable, fluid, open and standards-based, and future-safe”. A brief investigation of these claims in practice led to the following conclusions:

**Customizable**

The reporting codes can be customized to make them physician-specific. This is an important aspect, as different physicians have different reporting styles, and it is easier to adapt the system to the physician rather than vice versa.

**Fluid**

The reports are available throughout the health system or online, wherever they are needed. Any secured client of the health system can immediately access the report through an interface to the hospital information system.

**Open and standards-based**

Danbury Hospital’s Echocardiography Laboratory is a large laboratory that also has an active cardiology fellowship program. This means that it is important to have ultrasound
systems from several different vendors in the lab, so that the sonographers can gain experience with equipment from different manufacturers. Because the Xcelera system is open and standards-based it works with all the ultrasound systems in the lab.

**Future-safe**

Particularly in the case of IT, it is important to work with a large vendor, in order to be sure of getting the essential long-term support.

**Faster reporting**

One dramatic improvement that Xcelera brought to Danbury was to eliminate delays in report distribution. In the previous workflow arrangement, the study had to be read by the physician, and then transcribed and proofed to create the final report, which had to be available within 24 business hours. Given the conditions, this turn-around time was regarded as acceptable, but the time saved with Xcelera is remarkable. Once the sonographer finishes the study, it is on the chart in the patient’s room in 5-10 minutes. For outpatients, the referring physician can find the results on the HIS within the same timeframe.

Using Xcelera, the report is completed within five minutes of the interpretation of the study and is electronically signed and disseminated (Figure 4). Before implementation of Xcelera, digital images were stored on a server and viewed with a digital viewer. Reporting was done using different software, and paper copies were sent to the referring physicians. The readers would sit at PCs and dictate diagnoses as they viewed the studies. They had a paper on which they circled codes. The transcriptionist could enter those code numbers, which would then generate phrases. However, these were not automatically transferred to the final report. Instead, the full interpretation had to be dictated, transcribed, proofed, signed, and distributed.

The problems were not confined to the number of steps. The physical location was also challenging. The images had to be viewed on the imaging system, while the reports had to be read at the other side of the room on a different PC.

The transition to Xcelera required changes from the entire staff. There were concerns that the readers might not accept the user interface, and that referring physicians might not like the automated language of the reports. These concerns proved to be unfounded. All the readers were enthusiastic, and the faster report generation resulted in higher referring physician satisfaction. People were calling out of nowhere to say how fantastic it was to get a report shortly after the study. The fact that the reports looked different was not regarded as a problem. The important thing was that the referring physician got the report quickly, often before the patient returned from the exam.

In echo, and particularly in echocardiography, physicians want to know the results quickly so they can make a judgment to start treatment if necessary. In the past, referring physicians were always called immediately if there were markedly abnormal reports. But distributing reports quickly on normal or near-normal studies is also helpful. A report of a mild or moderate abnormality, transmitted to the treating physician in a timely fashion, facilitates treatment of that patient. Timeliness is also valuable with normal reports, because it diffuses patient anxiety. An additional benefit is that Xcelera significantly reduces the amount of paperwork the patient has to carry around.

The faster turn-around time has given Danbury a competitive edge. The hospital’s volume has grown, due at least in part to the enhanced efficiency of the Echocardiography Center and the satisfaction of referring physicians.

**Greater role for sonographers**

With Xcelera, the sonographers’ roles have expanded beyond image acquisition. After acquiring studies, they immediately fill out the report, adding the demographics and preliminary results. The report then goes to the
The ideal would be a paperless environment until the final report is generated.

The number of patient recalls has also decreased. This may be due, at least in part, to the additional understanding of clinical pathology the sonographers have gained from using Xcelera.

Studies are now reviewed on the spot, in the presence of the sonographer, rather than simply passed on to physicians and reviewed later. The goal is to have other sonographers’ reports match the physicians’ reports, in order to increase efficiency. The transcriptionists’ roles have also changed, from rephrasing and adapting reports to focusing on proofreading and distributing.

**The future**
The current Xcelera solution is regarded as the first step in an overall plan to enhance workflow. In the short term, Xcelera will be augmented with multi-modality viewing and web access. The current interface with the HIS will also be modified, so that the demographics in the report can be automatically populated.

A new outpatient center is currently being built, which will contain additional Xcelera workstations. The other satellite clinics will also be equipped with reporting capabilities, rather than housing only the echo systems and sending images to the main campus for reporting.

Beyond these short-term goals, the aim is to create an automated workflow that reduces the cost of the laborious manual entry that is now done on a daily basis. The information should flow automatically from the HIS and order entry system to the ultrasound department and from there to billing and accounts receivable. It should also be possible to audit the sonographers’ and physicians’ time on a quarterly basis.

A further development will be to interface with an image broker such as Philips iSite, so that images can be displayed across the infrastructure of the hospital – and at physicians’ homes.

The last of the 26 steps would be an automated customer satisfaction survey.

**Conclusion**
Xcelera has lived up to the expectations. The next phase is to expand what Xcelera can achieve. It has already been possible to significantly decrease the paper that travels with a patient who has a test done, but the ideal would be to go to a paperless environment until the final report is generated.
Entities that can restructure their laboratory to automate these components will reduce cost and improve efficiency, while maintaining or improving quality and patient satisfaction. Industry entities, which develop open products to automate this workflow, will develop a marketable system with true value to the customer.

**Proposal:**
Partner with industry in a luminary environment to deploy, modify, or develop systems to develop and automate the workflow process.

**Work Site:**
Danbury Hospital

Danbury Hospital is conveniently located between New York and Boston, accessible by rail, air, or bus. The hospital catchment area includes over 350,000 patients in Fairfield and Litchfield counties in Connecticut, and Westchester and Duchess counties in New York State. The echo-cardiography laboratory is modern and has been accredited by ICAEL in all three adult echo-cardiographic disciplines. The patient volume is equally divided between outpatients and inpatients; the volume of the echocardiography laboratory approaches 7000 procedures per year. A geographically separate satellite office (performing 1500 studies annually) is ideal for testing connectivity issues for tele-echocardiology.

The medical director of the laboratory (Dr. Andrew Keller) is a Trustee of the American Society of Echocardiography, a member of the newly formed Digital Echocardiography task force of the American Society of Echocardiography, and is recognized nationally and locally as an expert in echocardiography and data management. Mr. Richard Rigling is the technical director of the echocardiography laboratory; he is a trustee of ICAEL, and an active committee member within the American Society of Echocardiography.

The facilities are large enough to accommodate and test critical test bed applications, yet small and friendly enough to allow for constant feedback with staff and physicians. The site is ideal for beta site deployment and visitation by potential customers. A strong infrastructure exists within HIS, the department of medicine (including the internal medicine training program), and human resources.