UCSF moves PACS from research tool to clinical practice with Agfa's help

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University encountered barriers to expanding home-grown PACS network

The University of California, San Francisco was one of the early adopters of PACS technology, developing a home-grown PACS network that went online in 1993, before many institutions were even beginning to think about the technology. Since then, UCSF clinicians have discovered that PACS can help hospitals operate more efficiently than conventional means of image storage and distribution.

UCSF has also discovered the limitations of a home-grown solution for PACS, however. The hospital's successful experience with PACS prompted it to pursue the expansion of its network, but this would have required an investment in resources and staff time that the radiology department wasn't sure it wanted to make. Rather than reinvent the wheel, UCSF found a commercial vendor—Agfa—to help it take its PACS network to the next level.

UCSF and Agfa began working together in April to update and expand UCSF's PACS network with Agfa technology. While the agreement includes the purchase of $2.5 million in Agfa equipment, it's more than just a straight PACS sale: The two sides have agreed to partner on the development of new PACS technologies that could eventually become commercial products. UCSF expects to be about 75% filmless by mid-1998, compared with 25% currently.

A home-grown solution

UCSF began its involvement in PACS in 1992, when it hired Dr. Ronald Arenson to chair its department of radiology. Arenson came to UCSF from the Hospital of the University of Pennsylvania, another PACS pioneer, and was intrigued by the potential of digital image management to improve healthcare. Arenson won a commitment from the university hospital and its radiology department to build a filmless department, and hired a team of PACS experts from the University of California, Los Angeles to build a network that represented the next generation from what had been developed at UCLA. The team was headed by Bernie Huang and was set up as UCSF's Laboratory for Radiological Informatics (LRI).

Huang's team developed a PACS network that in many ways was state of the art at the time. Due to UCSF's financial resources and support for the project, the LRI team was able to install a fiber-optic network for high-speed ATM transmission of images and other patient data. This decision was later to prove crucial: It enabled the network to operate at a high level of performance and ensured that future expansion would be less difficult.

From the beginning, the UCSF team believed that work-flow management was the most critical factor in the success of PACS. They placed a major emphasis on developing a system that could automatically route images to the appropriate location, such as sending head trauma studies to the hospital's neuroradiology section. Indeed, effective work-flow management has been the core of much of Arenson's PACS philosophy.

Most of UCSF's work on its home-grown PACS focused on in-house image distribution. Links were established to send images from locations such as the emergency room and intensive-care unit to the radiology department, and computed radiography readers were installed at a number of locations and for portable studies.

UCSF clinicians quickly found that PACS dramatically changed the way they practiced medicine. With CR, for example, the number of retakes required dropped to near zero, and the broad dynamic range
of CR is useful in enabling radiologists to manipulate images, according to Katherine Andriole, PACS clinical coordinator at UCSF. CR's impact on the emergency room has also been dramatic. "We're able to get information to our emergency-department physician immediately once the image is taken," she said. "In the past, we had to locate the radiologist, have them read the imaging study, and get it back. Now, the patient is still on the table when the radiologist is viewing that image and consulting with the referring doctor."

In fact, the rapidity with which PACS enables radiologists to turn around studies has made emergency-room physicians much more demanding. The radiology department has instituted a policy mandating that ER images be read within 15 minutes, but sometimes even that isn't fast enough, according to Dr. David Avrin, co-director of clinical PACS. "There is a lot of pressure on radiologists to do contemporaneous readings with technology like this," Avrin said.

The next step

Despite the advances, UCSF's radiology department after three years found it had reached a crucial step in its implementation of PACS. The department wanted to distribute the technology further throughout the hospital, but the demands of expanding the system were too great if the university did it on its own. For one thing, the LRI had discovered that, because the network was developed in-house, much of its engineering resources were being spent maintaining the network that had already been put in place, rather than in implementing new technology. In addition, PACS technology had changed dramatically in the few years since UCSF installed its own system. The price of computer hardware had fallen, which reduced the cost of components such as archiving media. Perhaps most significant, however, was the development of the DICOM 3.0 standard, which had not yet been ratified when UCSF installed its network in 1993.

In 1996, UCSF went looking for a vendor to help it expand, and settled on Agfa because the university believed that the Ridgefield Park, NJ, company best shared its vision of work-flow management as the core of a PACS network. The two sides at the end of 1996 cemented an agreement to work together, and Agfa began installing its equipment in April. In phase one of the installation, Agfa put in the infrastructure that enables the company to graft its technology onto the university's network, including interfaces between the hospital's RIS, existing PACS network, and legacy archive, which will continue to operate online. Agfa also installed new archives for short-term and long-term storage of new imaging studies. Phase two of the installation will involve adding workstations to enable additional locations at UCSF to gain access to the network.

UCSF will also add links to external sites. Within San Francisco, UCSF has links over a Sonet Ring ATM network to the VA Medical Center, San Francisco General Hospital, and Mt. Zion Medical Center, although Mt. Zion is the only facility that is sending images to UCSF on a regular basis. UCSF is also a luminary reading site in the TeleQuest network. A link via the international overread services company Second Opinion enables the university to read images sent from sites as far afield as the U.K., India, and Israel.

Future collaboration

In addition to supplying equipment, Agfa and UCSF have agreed to collaborate on a variety of PACS projects. Due to their experience developing a home-grown system, the LRI researchers have unique insight into how PACS technology affects clinical practice. The co-development projects include the following:

0. The addition of a teaching database developed by UCSF to Agfa's PACS line, which will enable radiologists to compare cases under review with those in the database;
0. Further development of work-flow management techniques in PACS;
0. The development of algorithms for wavelet compression that may serve as a de facto standard in the absence of an official DICOM 3.0 standard for wavelet compression (see story, page 4); and
0. The development of image distribution software for referring physicians based on World Wide Web browser technology.

Of the three, the last project may be the most important in diffusing PACS technology from the radiology department to the entire healthcare enterprise. Web browser technology will enable radiology departments to get images to referring physicians without printing film and without installing dedicated workstations. "Right now the biggest limiting factor (to wider PACS adoption) is not internal with radiology, it's
external," Arenson said. "That is why we are working on Web solutions for outside radiology. We need dedicated workstations for high-volume places like the ICUs and ERs, but for referring physicians' offices, we hope we can depend on Web technology to provide images to them."

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**Number of beds:** 632
**PACS vendor:**
Agfa and internally developed PACS
**Year PACS installed:**
1992, expanded in 1997
**Cost of installation:**
$2.5 million (Agfa PACS only; does not include cost of in-house network)
**Percent filmless:** 25% currently, 75% by end of 1997
**Number of workstations:** 15
**Teleradiology links:**
UCSF/Mt. Zion Medical Center, San Francisco; TeleQuest for U.S. sites; Second Opinion for Europe and Middle East

**Disclosures:**

**Source URL:**

**Links:**