Effects of a Large-Scale Deployment of Soft-Copy Devices for Picture Archiving and Communication Systems Viewing

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A study was developed to investigate several aspects of deployment of stand-alone computers and a web-based server for displaying digital images. The costs associated with installation, upgrades, training, and maintenance of both systems were documented, as well as patterns of usage and preferences of physicians for the two types of systems. A clinical archive was created to store relevant images with a web-based front end. Users were classified according to their imaging requirements and were given access to images from either the diagnostic archive (full study sets) or the clinical archive. The range of functionality of the web-based system was significantly lower than that of the stand-alone system; however, the costs associated with the administration of the stand-alone systems were far higher than those associated with a web server. A clinical archive was created to store relevant images with a web-based front end. This study illustrates the different approaches to distribution of images to clinicians with the costs of administration of each system.

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AS THE DEPARTMENT of Radiology at the University of Florida rapidly approached the point where all studies were digital and film was no longer needed, access to studies by clinicians became a top priority. The technical, economic, cultural, and political implications of removing film from the hospital and clinics and ultimately from the enterprise were considered before deployment. Since the interactions of physicians with images were not well understood, a study was developed to investigate several aspects of deployment and physician access.¹⁻⁴

One consideration of the deployment was the cost associated with installation, upgrades, training, and maintenance of the systems. Two systems were tried: a stand-alone workstation on which images could be stored and viewed, and a web-based server. The costs associated with managing

stand-alone workstation software versus the web server software were documented.

STAND-ALONE WORKSTATIONS VERSUS WEB-BASED IMAGE ACCESS

Stand-alone workstations usually offer more advanced image manipulation and viewing tools, and rapid access to images stored on the local disk. The price, however, includes the cost of the computer and software, installation time, administrative time, and network routing overhead. Web-based image access solutions can reduce some of the capital costs, but may limit access to partial studies at reduced resolution. Security concerns associated with web-based solutions may lead to additional costs associated with confirming approved connections and users. Tasks associated with administration of image distribution over a wide area were identified (Table 1). The times associated with host table management, user-ID administration, and routing configuration are based on the average time to add a system to the picture archiving and communication system (PACS). Although the installation of the web-based server is greater than that of the stand-alone system, there is only one web-based server that is accessed by a standard browser. When a system is added to PACS, the archives and routing computers must be informed of new routing rules and host tables must be updated to include the new computers. These times are comparable for both types of systems, but routing need not be changed to add a user to the web-based access since all images continue to route to the web server. User-IDs and passwords for the web-based solution are added to one computer; if users need to access multiple stand-alone systems, a mechanism must be in place to allow authentication of the users at each workstation. If this cannot be accomplished through a domain service, the passwords must be added to each workstation. Upgrades to the systems take about the same amount of time, but in the case of the web server, the upgrade need only take place on one system.

At the University of Florida, more than 24 diagnostic workstations have been installed for soft-copy interpretation and close to 30 workstations installed for clinician use in areas such as

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Table 1. Times Associated With Workstation Administration

Tasks	Estimated Time	
	Web-Based	Stand-Alone
Installation	4 hours	2 hours
Host table management	1 hour	1 hour
User IDs & passwords	1 hour	1 hour
Archive routing configuration	1 hour	1 hour
Upgrades	1 hour	1 hour

intensive care units, emergency departments, clinics, and conference rooms. In many of these cases, automatic routing moves images to the appropriate workstation. A web server contains relevant images selected by radiologists for clinical review. The web-based software allows simple image manipulation tasks such as window/level, zoom, and magnify, but does not give the clinician the high-level navigation tools available on the workstations.

CLINICAL ARCHIVE

To prevent performance degradation for archive retrieval from requests outside the radiology department, a clinical archive was built to hold relevant images as a supplement to the diagnostic archive with the full image set.⁵ The images stored on the clinical archive use a combination of "clinical compression," where the radiologists select only the images in the study that are deemed relevant, and "computer compression," which is associated with limiting the image resolution to improve performance over a network. A small test set of clinicians was given access to both the clinical archive using the web-based application and the diagnostic archive holding the complete study using the stand-alone workstations.

Clinicians were classified as "power users," those clinicians requiring the larger data set for

surgery and treatment planning; "immediate care users," those clinicians needing the images for urgent patient care in an intensive care or trauma setting; and "casual users," those clinicians who rely mostly on the radiologists interpretation but want to see the relevant images, perhaps for patient education. Different rules were set up for each type of user. Power users have full access to the diagnostic archive, as well as to the reduced image set in the clinical archive with the web server front end. Immediate care users have images automatically routed to the stand-alone workstation in the patient care area. Casual users are given a combination of pre-routed images when the need can be anticipated and to the web-based system. To give access to clinicians while encouraging them to consult with radiologists, several "consultation rooms" were built with clinician workstations next to radiology reading rooms. Clinicians can hold rounds and view images on their own without disrupting the diagnostic interpretation sessions, yet radiologists were nearby and available for consultations.

RESULTS

Preliminary data suggest that although the system administration time required to manage the stand-alone workstations far exceeds that of the web server, there are several places where the stand-alone workstation is a better solution. Analysis of the other factors being measured is ongoing. As trends in physician behavior and access emerge, equipment is adjusted to meet the needs of all the users in the hospital and clinics. It is anticipated that as web-based tools evolve, in time there will be little or no difference in the software used for diagnostic interpretation and clinical use.

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