Branching Out With Filmless Radiology

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Texas Children's Hospital, a 456 bed pediatric hospital located in the Texas Medical Center, has been constructing a large-scale picture archiving and communications system (PACS), including ultrasound (US), computed tomography (CT), magnetic resonance (MR), and computed radiography (CR). Until recently, filmless radiology operations have been confined to the imaging department, the outpatient treatment center, and the emergency center. As filmless services expand to other clinical services, the PACS staff must engage each service in a dialog to determine the appropriate level of support required. The number and type of image examinations, the use of multiple modalities and comparison examinations, and the relationship between viewing and direct patient care activities have a bearing on the number and type of display stations provided. Some of the information about customer services is contained in documentation already maintained by the imaging department. For example, by a custom report from the radiology information system (RIS), we were able to determine the number and type of examinations ordered by each referring physician for the previous 6 months. By compiling these by clinical service, we were able to determine our biggest customers by examination type and volume. Another custom report was used to determine who was requesting old examinations from the film library. More information about imaging usage was gathered by means of a questionnaire. Some customers view images only where patients are also seen, while some services view images independently from the patient. Some services use their conference rooms for critical image viewing such as treatment planning. Additional information was gained from geographical surveys of where films are currently produced, delivered by the film library, and viewed. In some areas, available space dictates the type and configuration of display station that can be used. Active participation in the decision process by the clinical service is a key element to successful filmless operations.

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A FILMLESS RADIOLOGY department provides the hospital with many benefits over a conventional department. Beyond the obvious savings of film and chemistry supplies, the electronic

image can be viewed at multiple locations at the same time. Electronic images means no more contention for films, no more double-loading cassettes, no more searching through thick, disordered film jackets for a specific examination, and no more lost films. If a film is ever needed for referral of the patient, a click of a button is all that is required to print the image.

The workstation is the picture archiving and communications system (PACS) surrogate for film. To adequately replace film in a healthcare facility, you must determine the appropriate types, number, and locations of workstations. Many factors have bearing on this determination.

MATCHING WORKSTATIONS WITH CLINICAL SERVICES

The clinical function that a workstation must support varies widely within the hospital. Some workstations, especially within radiology, are used for primary diagnosis, while others are used only for clinical review of images where findings are already contained in a report. Some workstations must support "action-based" imaging, where immediate therapeutic actions are based on the appearance of an image. Some workstations are used only to display reference images, some are used for teaching and presentations at clinical conferences, while others are used for consultations between radiologists and referring physicians. Some images need to be viewed in close proximity to the patient: workstations are needed that support bedside viewing.

Selection of workstations is a balancing act between performance that supports the clinical function and cost. Workstations can be divided into four distinct categories. Diagnostic review stations are the highest performance, highest cost workstations that support the primary diagnostic function of the radiologist. Diagnostic review stations may also be deployed outside the radiology department to support clinical services that have special requirements for the highest level of image manipulation tools. Clinical review stations are less expensive, but still powerful workstations that are deployed to centralized locations in high volume, imaging

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intensive clinical services that routinely depend on multiple imaging modalities or serve numerous patients. Dedicated personal computer (PC)-based viewers are even less expensive than clinical review stations. For essentially the cost of personal computer, PC-based viewers can proliferate access to clinical images throughout the healthcare enterprise. In a dedicated configuration, there is no concern for software compatibility with other enterprise software, high speed network interface cards and lines can be allocated to these specific platforms, and they can be upgraded with additional memory and high performance video cards and monitors. Localizing image viewing also enables autorouting of relevant images, and localizes monitor quality control efforts. Because PC-based viewers can execute a Digital Imaging and Communications in Medicine (DICOM) query, they can be used to verify examination count and demographics. In some services, space is at a premium, while in others, centralized image viewing is not acceptable. In these cases, web-based viewing software is available that runs concurrently with standard hospital software on a standard hospital PC. Web-based software is not as mature as PC-based viewers, so the image manipulation tool-set and radiology information system (RIS) integration is not as well developed. Web-based viewers are the least expensive and appropriate for less demanding image viewing, low-volume clinical services, and bedside viewing applications.

UNDERSTANDING YOUR IMAGING SERVICES

The better you know your hospital's conventional imaging services, the better you can tailor the distribution of workstations. Who is ordering imaging studies? What kind of studies are they ordering? How many examinations do they order? Where do they view the images? Where do we perform the examinations? Who orders films pulled from the film library? Where do films go from the film library? The answers to these questions require a global perspective of imaging services to make sure that every clinical service is supported.

The RIS provides some of the information about customer services. Through a custom report from the RIS, we were able to determine the number and type of examinations ordered by each referring physician for the previous 6 months. Compiling

these by clinical service, we were able to determine our biggest customers by examination type and volume. Another custom report revealed who was requesting old examinations from the film library.

More information about imaging usage was gathered by means of a questionnaire. Some customers view images only where patients are also seen, while some services view images independently from the patient. Some services use their conference rooms for critical image viewing such as treatment planning.

Additional information was gained from geographic surveys of where films are currently produced, delivered by the film library, and viewed. In some areas, available space dictates the type and configuration of display station that can be used. First-hand observation provides the location of lightboxes where images are currently viewed and the location of existing hospital computers that may serve as viewing platforms, and indicates the extent of existing network support. Initially, surveys were made from blueprints, but later visits established face-to-face contact with supervisors in the units. Active participation in the decision process by the clinical service is a key element to successful filmless operations.

WORKSTATION DEPLOYMENTS

Diagnostic review stations were deployed to Reading Areas within Radiology including the Main Radiography/Fluorography area, Ultrasound, Neuroradiology, and the Central Reading Area, where body computed tomography (CT) and magnetic resonance (MR) examinations are viewed along with ordinary examinations. This area is also used for consultations with referring physicians. Another diagnostic review station is located in a reading area in the outpatient treatment center.

Clinical review stations were allocated to services with large volumes and multiple modalities where centralized viewing is acceptable. These include Cardiology, Orthopedics, Neurosurgery/Neurology, Pediatric Intensive Care Unit (ICU), Neonatal ICU, the Emergency Center, Hematology/Oncology, and two shared clinics.

Dedicated PC-based viewers were assigned to areas with moderate volumes where centralized viewing is acceptable, and to augment clinical review stations. These include the Acute Treatment

Area, Urology, PICU, NICU, Cardiology, and the Emergency Center. Dedicated PCs were also employed to perform image quality assurance functions for MR, CT, and radiography/Fluorography services within Radiology.

Web-based viewers are allocated where bedside viewing is necessary, where space precludes a dedicated PC, where volume is low, and where sophisticated image manipulation is not needed. These include our Nursing units, PICU, NICU, physician's offices, conference rooms, and a variety

of other outpatient clinics and units, such as Renal Dialysis.

CONCLUSIONS

The workstation is the replacement that we propose for film. For a successful transition from conventional to filmless imaging, the type, number, and performance of workstations must match the clinical practice and volume. Information is available from the RIS to help assess needs. Other information should be collected to plan appropriate support for filmless clinical operations.