

Image Display for Clinicians on Medical Record Workstations

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Image display on electronic medical record (EMR) workstations is an important step in widespread implementation of picture archiving and communications systems (PACS). We describe a pilot project for implementing image display capability that is integrated with the EMR software, and will allow display of images on the physician's workstation. We believe this pilot will provide valuable information about usage patterns in image display needs, which will be valuable in planning further expansion of PACS in our institution.

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KEY WORDS: PACS, computerized patient Record Image Display, image compression

DEVELOPING A method for image display on electronic medical record (EMR) workstations is crucial to widespread deployment of picture archiving and communication systems (PACS) because of the expense of PACS-vendor supplied display workstations and the additional space required for another computer monitor. The alternative of having a single PACS workstation for several clinicians (perhaps at a nursing desk) would reduce their efficiency and hamper patient education.

The EMR is the clinician's correlate of PACS and is a significant step towards integrating the many health care providers. It allows easy sharing of information to many locations at the same time and easy transmission to many geographic locations. READS¹ is a computer program developed within Mayo's Department of Radiology, which was used within the Department for image review, with occasional use for more specific purposes (e.g., immediate review of magnetic resonance [MR] imaging scans), and for research purposes. Based on usability studies of READS with clinicians, it appeared that with a few modifications, READS could become a satisfactory platform for clinical image review.

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0897-1889/97/1003-1019\$3.00/0*

DESIGN

One building on our campus, which houses a primary care outpatient practice, has been converted to a PACS. This practice is also in the lead for deployment of the EMR. Therefore, it is a good environment for testing image display on EMR workstations.

The Clinical Images Gateway and Server

The flow of information for this system is shown in Fig 1. The radiology information management system (RIMS) is the primary controller of activity in this scheme. In many cases, the modalities (MR or CT scanners) are configured to forward the image data to the clinical images gateway (CIG), although the RIMS also can direct the PACS to send an examination to the CIG. The CIG receives image data using the DICOM protocol, and compresses it using a wavelet compression algorithm.² When image data have been received, the CIG contacts the RIMS to get the server and filename under which the compressed images are to be stored. When the compression step is completed, the CIG notifies the RIMS that the data are available, and also conveys the amount of storage required, so that the RIMS can manage deletion of older compressed studies as needed.

The EMR image display application

The EMR application manager provides information to each participating application, indicating such facts as the user identifier and patient context information. The EMR image display application (hereafter referred to as QREADS) uses this information to retrieve the examination list from the RIMS. The RIMS communicates examination status information including if there is a report available and if there are images available (and if so, the server/filename). The QREADS application is shown in Fig 2.

Usage data collection

All user interactions with QREADS can be logged into a database—the identity of the user,

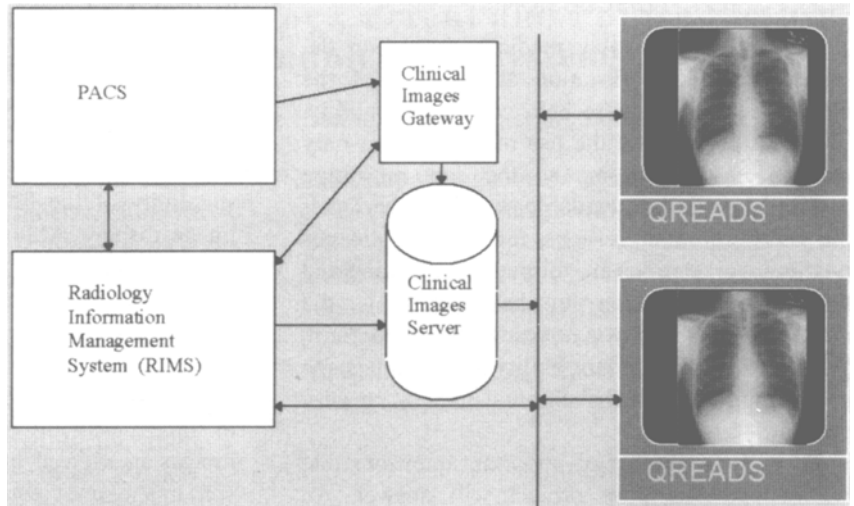


Fig 1. Information flow diagram.

location of the workstation, how frequently and when reports are viewed, how frequently and when images are viewed, and how much manipulation of viewing parameters occurs are all

stored. We believe this information will help us to characterize the usage patterns and will help to clarify the image display requirements of the EMR.

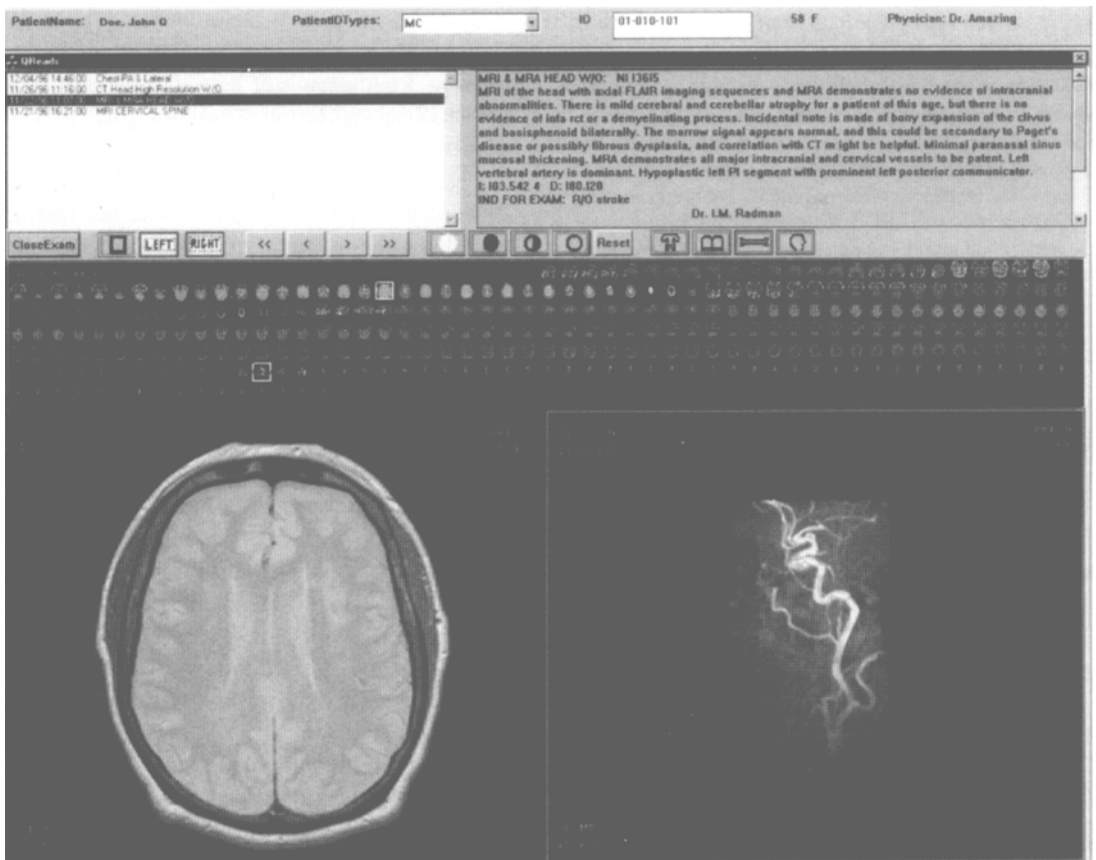


Fig 2. QREADS—the EMR display application.

DISCUSSION

The ability to display medical images on the same computer workstation as the rest of the medical record seems to be a valuable capability. The pilot project and the use of this system only recently has begun and so the data on usage patterns are not yet available, but it appears that the most common reasons for viewing images on these workstations are for patient education and for resident education. In these situations, the reduced image quality is not a significant problem. We also have provided the ability to print images to a paper printer, and have found this to be very popular.

There are a number of important questions that we believe this pilot project will answer. An important group of questions relates to usage patterns and the graphical user interface (GUI) design for the display application. Although much work has been done on this topic, studies generally have involved focused user populations such as intensive care unit physicians. We expect that the

usage patterns for outpatients will be substantially different and also expect that there will be large differences among and within specialties. Finding common patterns in usage is important to creating the optimal GUI.

Another important group of questions relates to suitability of the EMR workstations for medical image display. Although the EMR image display may be adequate for patient education, it may not be adequate for some or all clinicians. Identifying the group(s) for which it is inadequate is important in designing an institutional PACS deployment plan. Another important group of questions relates to image viewing patterns. Determining when images are viewed, and if and which old (comparison) images are viewed is necessary to calculate the capacity that an institutional PACS will need. If it is found that old examinations rarely are viewed; this could reduce substantially on-line storage requirements. If predictable patterns for old study viewing are found, this also could be valuable in creating pre-fetching algorithms.

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