Integrated Diagnostic Workstation

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TRADITIONALLY, radiologists spend their time in a reading room near the source of the examination. Films are printed and hung for the radiologist's interpretation. If a radiology information system (RIS) is used, an examination work card is prepared to convey information about the examination ordered and to facilitate the dictation of the report. If a picture archiving and communications system (PACS) is employed, comparative studies can be prefetched and the examination can be read from the workstation. If the PACS system, RIS, and dictation systems are integrated, the process changes can be related to time-savings.

The Cleveland Clinic entered into an alpha partnership with IDX (Burlington, VT) to code-develop their new generation RIS, IDXradR. This total effort is comprised of the imaging suite (including referring physician module) and the newly redesigned IDXrad Version 10.0, replacing the Massachusetts General Hospital Utility Multi-Programming System (MUMPS)-based RIS. The imaging suite includes the technologist's worklist, the referring physician module, the radiologist's protocol worklist, and the radiologist's interpretation worklist integrated with the already existing PACS from Siemens (Island, NJ) and dictation system from Dictaphone (Stratford, CT). To accomplish this integration, the RIS is responsible for handling Digital Imaging and Communications in Medicine (DICOM)-based modality integration, PACS image query, and Dictaphone integration. Hence, integration is achieved at the system level, requiring only one log-on. A Siemens MV1000 reading station is used with access to the IDX RIS via an internet web browser, Microsoft Explorer 4.0 (Microsoft Corp, Redmond, WA). The server uses Microsoft Windows NT and SQL Server (Microsoft Corp). As the foundation, the RIS maintains the index of images linked to the PACS by the accession number (Fig 1).

THE RIS WITH PACS WORKFLOW

The PACS has been in use for 4 years and the RIS for nearly 10 years. The technologist confirms the demographics from the RIS and enters the demographics into the PACS to be applied to the image. After completing the examination, the technician routes the images to the appropriate PACS worklist. The radiologist correlates the printed work cards with the PACS worklist and selects the images to be read from the PACS. Using the dictation station, the work card bar code is swiped to identify the examination and the report is dictated. If past images are required to assist in the interpretation, the radiologist must query from the PACS. To get past interpretative reports, the radiologist must get up from the chair and retrieve them from the RIS. To facilitate the retrieval of comparative studies, the technologists print reports for the patients on the next day's schedule, and will route past studies with the new examination to the reading station. At any time, the radiologist may be interrupted by phone calls requesting protocol advice.

INTEGRATED RIS, PACS, AND DICTATION STATION

The RIS protocol work list and interpretation worklist was piloted in the musculoskeletal magnetic resonance imaging reading room and run in parallel with the current workflow.

The day before the examination, the radiologist can use the protocol worklist to document the protocol for the next day. To do this, the radiologist can soon review the scheduled cases for the next day and retrieve past interpretations and images together on the integrated RIS-PACS screen. The time savings are for requesting the films from the film library, as well as the savings of the time for the technologist to order the films and to order, print, and deliver the reports to the reading rooms. In our timings, requests from the film library resulted in the delivery of 83% of the films by the next morning. The rest were not available in the library. For the archived images queried from the PACS, all were retrieved in 3.0 hours.

The radiologist can add a comment to the protocol worklist so the technologist can follow the

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Fig 1. Basic architecture of the integrated model.

instructions at examination time (Fig 2). It is hoped that having all examination information at the radiologist's fingertips by initiating the easy retrieval of the reports and images will result in better instructions to the technologist. During our timings, the radiologist was interrupted nine times in a 7-hour reading session, and averaged 42 seconds answering each request.

The interpretation worklist presented by the RIS is used instead of the worklist from the PACS (Fig 3). It contains complete patient demographics and status of the examination. The amount of time to read an examination does not vary whether it is RIS- or PACS-based. The time to retrieve an

interpretative report via the RIS at the reading station is 6 seconds, compared with retrieving the same report from the standalone MUMPS-based RIS in 52 seconds. Accounting for part of the 52 seconds is logging onto the system, a function that is not needed in the integrated model. Soon the radiologist will no longer swipe the bar coded accession number from the Dictaphone dictation station. The information will be sent automatically from the RIS to the Dictaphone system by hitting an on-screen button.

There are small changes in the technologist's process. In their interaction with the RIS, they no longer print past reports and route the paper to the

Fig 2. IDX's protocol worklist.

Fig 3. IDX's interpretation worklist.

correct reading room. Faxing has been used to get the reports to distant reading rooms. Once fully functioning with the digital modality interface, the work cards will be eliminated, so the effort to route the cards and maintain the printers is also eliminated. The technologists must still confirm patient demographics and note examination begin and end times in the RIS. As for the PACS, they no longer need to enter patient demographics, as the correct data are sent by the RIS. The Imaging Suite will automatically associate the study-specific accession number(s) with the images in the PACS.

CONCLUSION

As the current radiology practice continues to grow and the community practice becomes more dispersed, completed examinations will be routed elsewhere for reading. This newer model eliminates the work card, uses a worklist to organize activities at the reading station, and provides global access to any previous images and reports. Having all pertinent examination and image information located in one system within the Radiology Department will provide data for better management of resources, including radiologists.