The installation and implementation of a hospital-wide image management system and a speech recognition dictation system has had a dramatic and positive impact on radiology report turnaround times at Elmhurst Hospital Center, a 543-bed municipal teaching hospital located in New York City's Borough of Queens. The "lost film" problem has been eliminated. As a result, the percentage of unreported examinations has dropped from 25% to less than 1%. These performance improvements have significantly benefited the entire medical staff. With the successful implementation of a HL-7 standards-based radiology information system (RIS), a speech recognition dictation system, around-the-clock staffing of Board Certified radiologists, and a picture archiving and communication system (PACS), report turnaround time improved dramatically. Eighty-six percent of all examinations now are reported formally within a 12-hour period compared with a 3% average before implementation of the changes. However, with the use of the PACS and speech recognition technologies, new problems have arisen within the radiology department. These technologies, designed to enhance communications capabilities, also have significantly reduced the amount of clinician/radiologist dialogue. Easy and rapid access to patient images and reports has had a detrimental effect on that face-to-face consultations with clinicians, which were commonplace before PACS, and now have almost completely disappeared. The radiologist/clinician interchanges, which occurred frequently before a final report was dictated, often resulted in better understanding of the clinical problem and, hence, a more meaningful final report. Although a conferencing feature to facilitate communication exists within the PACS, it is not utilized by the clinicians. The dilemma is that as information about patients is made more available to the hospital staff, less information is provided about patients to the radiologists. Although the speech recognition system benefits the hospital, its staff, and the patients served by reducing clinician time awaiting a diagnostic report and reducing clinic and emergency room waiting time by the patients themselves, it does not necessarily benefit the radiologists who use it. Speech recognition dictation systems slow down the individual productivity of the radiologists' dictation process by at least 25%. Radiologists are assuming the role of transcriptionists as well as diagnosticians. Mistakes occur that would not with the use of a traditional dictation system and professional transcriptionists.

KEY WORDS: picture archiving and communication systems, continuous speech recognition systems, Radiology report turnaround time, radiology workflow, radiologist consultation, filmless radiology.

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By May 2000, with the use of a PACS, the percentage of unreported cases at the end of each month had dropped from approximately 25% in 1997 to 0.3%, as derived from the RIS management data. This small percentage of unread cases was caused by the misplacement of x-ray requisitions and is similar to the unread case statistics of other medical institutions with hospitalwide PACS installation.\(^2\) This analysis contains both anecdotal and quantitative information.

**REACTION BY CLINICIANS**

The response to a physician satisfaction questionnaire indicated that the clinicians generally were pleased with the accessibility of images and reports in a very timely manner. The clinicians who responded (21%) estimated that each saved 30 minutes a day on average as a result of the PACS. The orthopedic clinic, for instance, now ends at 5:00 PM instead of 7:00 PM because of the rapid turnaround of images because of PACS.

Because report turnaround time has diminished steadily, the expectations by the clinicians for immediate access to these reports has escalated. This is true especially with respect to the emergency room clinical staff. Examinations for emergency patients receive STAT priority and are dictated immediately, with a 1-minute time interval to transfer the report via the radiology information system to the hospital information system and then be populated into PACS. Whereas previously, emergency room clinicians would wait hours for reports, they now expect instantaneous reports. As a result, some of the physicians with really emergent cases who do not see a report associated with images displayed on the ER PACS workstation immediately walk over to the radiology department next door and seek out the radiologist reporting STAT emergency images. During that 1- to 2-minute walk, the dictated report has often entered the PACS system and is available to the emergency room physician to read, much to his or her surprise. However, the radiologists welcome these impromptu visits because it provides the opportunity for more clinical input and dialogue about the patient.

Occasionally, the radiology department receives irate calls from the emergency room staff that not all of the images on a particular examination are available for review. The usual cause of this is that the patient still is on the table being radiographed.

The PACS and speech recognition systems have created a new set of expectations throughout the hospital about the deliverables expected from the radiology department.

**REACTION BY RADIOLOGISTS**

Although the emergency room clinicians and others are pleased with the addition of PACS, the reaction by radiologists has been much more mixed. The radiologists like the ability to retrieve previous studies promptly, to magnify and window/level computed radiography and digital radiography images, and equalize the appearance of portable images from day to day. Soft tissue findings on computed radiography, such as varicose veins, can now be identified. Through the combined use of magnification and window/leveling tools, pneumothoraces are evaluated more easily, and questionable fractures can be confirmed. These were the most frequent compliments by the radiologists. All of these capabilities facilitate the diagnostic process.

However, the speech recognition dictation system in particular, and to a lesser degree, its lack of integration with the PACS, has reduced perceived individual radiologist productivity.

In June 2000, approximately 6 months after the introduction of PACS and 17 months after the introduction of speech recognition dictation, a formal survey of our 10 regular staff radiologists was conducted. (At that time, we were using Talk Technology's TalkStation Radiology Version 1.2 and Agfa IMPAX Version R4.0) The radiologists were asked: “Does the combination of PACS and voice recognition take more or less time than manual hanging of films on a view box and the use of ordinary dictation equipment?” Given the choice of categories of less time, the same amount of time, or more time spent in increments of 25%, 50%, 100%, or 200%, 2 radiologists reported an increase of 25%, and the remainder reported an increase of more than 100%. (This survey did not factor in the amount of time that a radiologist used to spend proofreading a traditionally transcribed report, which would reduce the overall percentage of time perceived being spent in the speech recognition reporting process. These data had never been measured previously within our department.)

A portion of the slowdown could be attributed to the number of mistakes made when the speech recognition dictation system was utilized. All of