

Impact of Digital Radiography on Clinical Workflow and Patient Satisfaction

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Compared to traditional film radiography, digital radiography is believed to improve workflow and patient throughput. Digital radiography permits the technologist to immediately view the quality of the film directly at the modality. Additional workflow improvements, therefore, should be achieved with the integration of the radiology information system (RIS). To learn more about this proposed efficacy, a study was performed at The Cleveland Clinic Foundation (Cleveland, OH) comparing timings in three groups: traditional film radiography; digital radiography; and digital radiography with RIS integration. Our data validated a timesaving of digital radiography over traditional or standard films and an even greater timesaving in a digital radiography/RIS environment. Copyright © 2000 by W.B. Saunders Company

IN A DIGITAL IMAGING environment, information from the radiology information system (RIS), which provides patient and examination data used in the radiological procedure, should be available at the modality at the time of the examination. This information should automatically be attached to the image in the appropriate Digital Imaging and Communications in Medicine (DICOM) fields before storage in the picture archiving and Communication systems (PACS). To accomplish this, the Cleveland Clinic Foundation and Canon (Palo Alto, CA) worked with IDX (Burlington, VT) to access the RIS with IDX's web browser software. Once a patient is selected from the RIS worklist, patient and examination information are downloaded to the modality. The browser window can then be minimized or hidden, and the modality control window displayed at the modality workstation. After the examination is completed, the RIS window can then be displayed again in preparation for the next patient.

Our goal was to compare both the actual procedure time and patient time involved for chest

examination in a fully RIS integrated system with that of the traditional film process. The hypothesis was that there would be a quantifiable time saving documented.

MATERIALS AND METHODS

Patient Selection

Only ambulatory patients would be compared in this study. A chest examination consisted of two films: an anterior/posterior view and a lateral view.

Equipment

For the standard film portion of the study, a Pickerchest Unit was used with a Kodak RPX-Omat Processor Model M6B (Kodak, Rochester, NY). In this typical workflow, the patient has the examination completed and is instructed to wait in the department until the film is developed. After the film is processed and checked for quality review, the patient is then either authorized to leave (film content and quality acceptable) or the patient is brought back for repeat view(s) and the quality assurance process would recur. Patient and examination information are communicated via a flashcard imprint on the film.

The Canon CXD-11 Unit with a Kodak RPX-Omat Processor Model M6B was used for the remaining two portions of the study. In the second portion, Canon digital unit only, the technologist types in basic patient and examination information by hand using the touch-screen keyboard.

The final portion of the study was Canon digital unit with RIS integration. RIS integration was achieved with the use of the IDX Imaging Suite (their web browser software). The Imaging Suite modality worklist is displayed from the touch-screen interface panel. The technologist selects the appropriate patient from the worklist and this triggers an automatic download of that patient's examination information from the RIS to the modality.

Time Measurements

The points listed in Table 1 were measured. To insure consistency, the start of the examination was determined to be the time when the technologist fully positioned the patient for their first anterior/posterior view and requested that the patient "take in a deep breath and hold it." Examination completion was determined to be the time when the lateral film had been taken and the patient was told that they "could breathe."

RESULTS

Our statistics demonstrated a significant decrease in the amount of time a patient had to remain in the Department of Radiology. Those patients who received standard chest films averaged 339 seconds in the department. This time was calculated from the moment that the patient entered the

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Table 1. Individual Timing Steps for Each of the Three Comparison Study Groups

Standard Film	Canon Digital Unit Only	Canon Digital Unit With RIS Integration
<ul style="list-style-type: none"> ● Time patient arrives in exam room ● Time exam is begun ● Time exam is completed ● Time to develop film ● Time patient is permitted to leave the department 	<ul style="list-style-type: none"> ● Time patient arrives in exam room ● Time for technologist to type in patient demographics ● Time exam is begun ● Time exam is completed ● Time patient leaves the department 	<ul style="list-style-type: none"> ● Time patient arrives in exam room ● Time for system to download patient demographics ● Time exam is begun ● Time exam is completed ● Time patient leaves the department

examination room until the time the patient was given permission to leave the department. Those clients who underwent digital chest examinations remained in the department for 139 seconds—a decrease of 59% over the standard film group.

The time saving was even more dramatic in the third arm of the study, which featured the Canon digital unit and RIS integration. On average, the patient spent 95 seconds in the department—a decrease of 72% over the standard film group and a 32% decrease over the Canon-only group. The time savings could be attributed to the average time required to directly download patient demographics from the RIS (2 seconds) versus the average time to manually input patient demographics (40 seconds).

Table 2 indicates the average of each x-ray methodology. Time is reflected in seconds. The use

Table 2. Comparison of Statistics for Each Study Group

Study Group	Procedure Time	No. of Exams	Total Time in Department	Variance in Total Time (standard film)
Standard film	37.3	88	338.9	N/A
Canon digital unit only	36.2	146	138.8	-59%
Canon with IDX integration	30.5	117	94.9	-72%

NOTE. Time is reflected in seconds.

of the Canon digital unit allows the technologist to perform the quality control review directly from the image on the modality. The patient does not need to remain in the department while the film is developed and quality control assessed as with the standard film. Our study showed the average time was 199 seconds for film development.

Integration between the digital modality and the RIS, besides reducing the amount of time the patient spent in the department, insured the accuracy of the patient demographic information.

Patient Response

Patients in the Canon/RIS group were asked if they had undergone a traditional or standard chest x-ray examination in the past. If they had, they were asked to rate this digital chest exam in comparison to the traditional chest exam and were given three choices: better, same, or worse. Thirty-three percent of the respondents rated the digital chest exam as the “same,” while the remaining 67% felt the digital chest exam was superior. Their comments generally cited the time element as a critical factor in their decision.

CONCLUSION

The results of the quantitative and subjective data showed an improvement in quality of service and patient throughput with the integration of the digital chest modality and the RIS.