



Novel cassette-sized, flat-panel digital radiography (DR) system: Initial clinical and workflow results versus computed radiography (CR)

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Purpose

Radiology has been at the leading edge of computer technology innovations in modern medicine, and, as a result, a number of complex and expensive technologies have been incorporated into the everyday practice of medical imaging [1]. Each new technology brings changes in workflow that can affect a range of personnel, the use and configuration of departmental space, and patient management within the radiology department setting. Among the most important quantitative measures is technologist productivity, which is a crucial element in determining operational efficiency and cost in a filmless imaging department [2].

One area of current discussion in the medical imaging marketplace is the nature of differential gains in technologist productivity offered through the two principal digital radiographic technologies, computed radiography (CR) and direct radiography (DR) [3,4,5,6]. CR represents the older but very versatile and economically attractive system that is equally suited for integrated systems as well as for cassette-based imaging at the bedside. DR systems offer superb image quality based on their high dose efficiency. While for a long time, only integrated systems suited for a large patient throughput were on the market, mobile DR systems have recently become available [7].

We hypothesized that total examination time difference between a CR and a novel mobile DR system would be statistically significant. Thus, the purpose of our study was to compare workflow efficiency between a conventional computed radiography (CR) system and a novel, portable, and wireless, flat-panel DRX-1 detector.

Methods and Materials

Observational time-motion analyses were performed at one site at which CR and DR systems are used concurrently (Fig.1). The workflow steps of both systems were identified and equalized as much as possible. The times required for examination preparation, patient positioning, exposure, post-acquisition processing, and for the examination as a whole, were recorded by a neutral observer. Timing differences between CR and DRX-1 were compared, and all data were analyzed by using commercially available statistical software. Nine general radiographic exam types were selected with roughly 50 patients per exam type (Fig.2-5). All exams in the study were performed by the same radiographers to minimize interoperator differences.

Examination preparation

Examination preparation was a composite of multiple individual steps, including selection of the patient and the body part at the modality workstation, selection of the exposure parameters, and cassette positioning.

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Patient positioning

This segment included the patient positioning (patient had already entered the room in which the radiographic examination was to be performed) and lasted until the technologist left the room.

Exposure

This segment comprised the actual image acquisition time.

Post-acquisition processing

A composite of three steps for cassette-based CR and two steps for cassette-based DRX-1. The two common steps were cassette readout and post-processing, including image manipulation, and the single step unique to CR was transport of the CR imaging pates to the plate reader. Image manipulation time was the time required for the technologist to review the image on the modality workstation and make any necessary adjustments to the image (annotations, window and/or level adjustments) and lasted until the "send to PACS" command was issued.

Radiographic system

A Bucky Diagnost ceiling system 2/4 and a Bucky Diagnost VS wallstand (both Philips, Eindhoven, the Nederlands) were used for both CR and DR.

CR system

The CR system used was the FCR Profect CS (Fujifilm, Tokyo, Japan) with DSR (Dual-Side IP Reading), which enables the extraction of image data from both sides of the imaging plates. All cassettes used in this study were Fuji IP cassettes type CC.

DR system

The DR system was the Carestream Health DRX-1 system (Carestream Health, Rochester, NY, USA), which is a digital radiographic image-capture system. The DRX-1 detector is a thin, flat-panel, x-ray detector housed in a special cassette that conforms dimensionally to the ISO 4090 standard and contains a full-field TFT (thin-film transistor) readout array and integrated electronics for data storage and transmission (Fig.6). Images were acquired by the DRX-1 system detector (image size: 35 x 43 cm, pixel pitch: 0.139 mm, weight: 3.9 kg) and were transmitted to the system console for storage, processing, display and distribution to our facility network

Images for this section:

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Fig. 1: A = CR workstation, B = DR (DRX-1) workstation, C = CR cassette readout, D = Storage of CR imaging plates, E = Exposure unit,



Fig. 2: Image taken with the DRX-1 system



Fig. 3: Image taken with the DRX-1 system

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Fig. 4: Image taken with the CR system

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Fig. 5: Image taken with the CR system



Fig. 6: DRX-1, a flat-panel, digital radiography (DR) system

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Results

A total of 941 examinations (CR, n=474; DRX-1, n=467) were timed in this study. Total examination time differences (TD) between CR and DRX-1 (mean 26.44 sec.; median 26.99 sec.) were found to be statistically significant (P < .001), with DRX-1 proving faster than CR. The single step in the examination that was found to be the largest contributor to time difference was post-acquisition processing (TD between CR and DRX-1, mean 26.58 sec.; median 25.91 sec.), a composite of multiple individual steps, including cassette transport (CR, mean 13.22 sec.; median 12.74 sec.), cassette readout (TD between CR and DRX-1, mean 3.21 sec.; median 10.4 sec.) and post-processing (TD between CR and DRX-1, mean 3.21 sec.; median 3.11 sec.) (Fig.1, Tab.1).

Images for this section:

Work-Flow Segment	Mean CR Time (sec) 19.78	Mean DR Time (sec) 19.42	Mean Time Difference (sec) 0.36
Examination preparation			
Patient positioning	32.20	30.81	1.39
Exposure	2.44	4.33	-1.89
Post-acquisition processing	50.95	24.37	26.58
Entire examination	105.37	78.93	26.44

Fig. 1: CR and DR (DRX-1) times for one-view radiographic examinations

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Conclusion

Overall radiographer time was significantly shorter when performing exam-related tasks with the DRX-1 system than when performing comparable tasks with CR, a difference that appears to result largely from technology configuration.

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