

# Comparison of Workflow Efficiency between Computed Radiography (CR) system and Wireless Flat-Panel Digital Radiography (DR) system for Checkup Chest PA examination.



Suchato C, MD  
email : chirothana@bgh.co.th

Chirothana Suchato, MD<sup>1</sup>  
Peerasak Panphet, RT<sup>1</sup>  
Kedsuda Thansup, RT<sup>1</sup>  
Chulathip Boonma<sup>2</sup>

<sup>1</sup> Imaging Center, Bangkok Hospital, Bangkok Hospital Group, Bangkok, Thailand.

<sup>2</sup> Research and Development Department, Bangkok Hospital, Bangkok Hospital Group, Bangkok, Thailand.

**OBJECTIVE.** To evaluate the workflow efficiency between CR vs. wireless flat-panel DR systems for routine checkup Chest posterior-anterior (PA) erect position examinations.

**MATERIALS AND METHODS.** On routine checkup Chest PA view erect position. The work flow steps of CR and wireless flat-panel DR system were identified, including examination preparation, patient positioning, exposure, post-acquisition processing and total examination time were recorded. We only included post-acquisition processing time because time from exposure to appearance of imaging is relatively fixed.

**RESULTS.** A total of 476 patients were examined (CR, n = 244; DR, n = 232). The total time of procedure for CR system was 86.2-96.2 seconds. For the DR system it was 17.6-19.5 seconds.

**CONCLUSION.** Workflow efficiency of DR system is better than CR system in routine chest examination. Modern radiologic departments require a DR system.

**S**ince the development of the technology standard digital imaging and communications in medicine (DICOM), which is now used in hospitals worldwide, many medical applications have made rapid progress. Kruger et al<sup>1</sup> introduced the computed radiography (CR) digital imaging system in 1980 and by 1990 the digital radiography (DR) system developed. In 2001, the efficient instrument, the flat-panel detector fluoroscopy digital subtraction angiography (DSI) made its appearance. Many articles have described the advantages of using DR in various situations in comparison with CR system. By now it is conclusive that the DR system is superior to the CR system.<sup>3-10</sup> We decided to show this in the BMC by studying the workflow efficiency of DR vs. CR system during routine chest PA erect position.

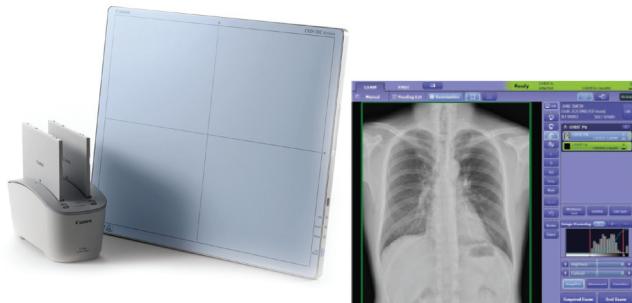
## Materials and Methods

**Keywords:**  
computed radiography, CR, digital radiography, DR, wireless flat-panel, workflow analysis, post-acquisition

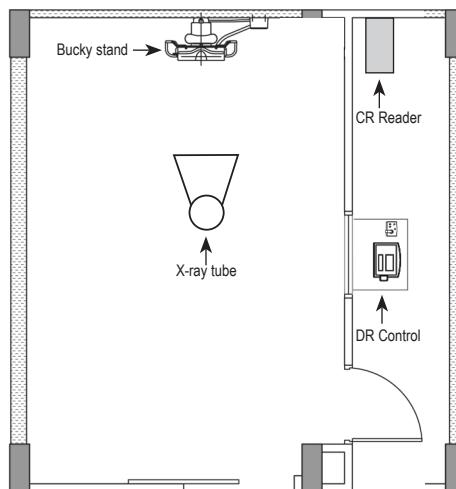
All patients were outpatients, requiring for their routine annual checkups, a PA Chest in erect position. The radiographic equipment was at a fixed distance between patients and x-ray tube exposure. Both the CR and DR readers were located about 6 meters from the radiographic equipment. The number of technicians who attended these 476 examinations was limited to 4 persons. The radiographic examination was performed with a cassette-based bucky in standing position. The CR system used for the study was the Kodak direct view 950 (Figure 1). The wireless flat-panel DR system used was the CXDI-70C Wireless (Cannon, Figure 2). All data was transmitted to the digital system for processing, image appearance and storage.



**Figure 1:** Kodak direct view 950.



**Figure 2:** The wireless flat-panel DR system-Cannon (The CXDI-70C Wireless).



**Figure 3:** Radiography unit uses bucky stand 14x17 inches for CR system digitizer cassette. For DR system; flat plate detector with wire or wireless system in bucky stand. The CR reader is installed outside the exposure room. DR with server and software connection with PACS is next to the radiographic control.

## Data collection

The workflow for each step was identified. The time was recorded for chest examination preparation, patient positioning, exposure and acquisition processing. After the positioning was done, x-ray exposure was made. Acquisition processing for CR system, included the time it took for the technician to carry the cassette from chest stand to CR reader for processing. The image manipulation time, was how long it took for technicians to review and adjust the image and then scan to the picture archiving and communication systems (PACS). Wireless flat-panel DR system time included the technician exposing the image, the data being processed until the image appeared and was then transferred to PACS.

## Results and Analysis

Using statistic analysis, we found that the mean time required to evaluate x-ray examination using the CR system was 89.3 seconds. The standard variation was 24.1

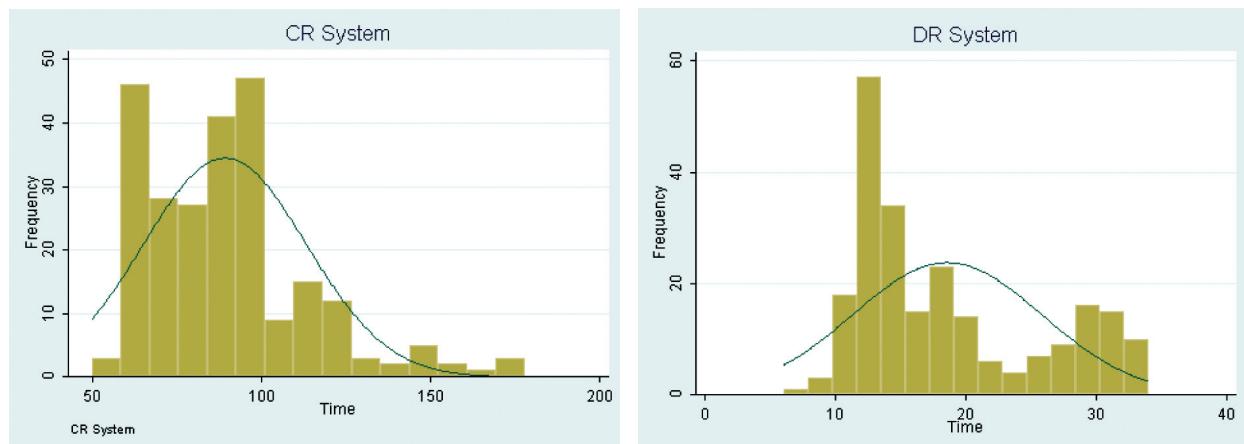
and 95% confidence interval 86.2 to 96.2 seconds. For the DR system it was 18.5 seconds with a standard deviation of 7.3, and 95% confidence interval 17.6 to 19.5 seconds.

## Conclusion

The acquisition time of the DR system was 68.6-76.7 seconds faster than the CR system. In a facility which regularly encounters a high patient volume, then it is sure that using a fast workflow DR system is advantageous. Our study with smaller patient numbers and focusing only on chest x-ray nonetheless confirmed Lehnert's findings in his CR/DR workflow efficiency comparative study.<sup>11</sup> Despite the many benefits of a DR system, it can be financially daunting to consider an entire system upgrade to digital. It should be remembered then, that hospitals can save costs by buying DR tools such as the wireless flat-panel DR system which can be retrofitted to and integrated with existing CR platforms.

**Table 1:** Standard variation of time examination by Computed Radiography (CR) system and wireless flat-panel Digital Radiography (DR) system.

Method	Patient (n)	Mean Time average (seconds)	Standard Variation	95% confidence interval
CR System	244	89.3	24.1	86.2 - 96.2
DR System	232	18.5	7.3	17.6 - 19.5



**Figure 4:** Graph shows time of chest examination between CR system and DR system

## References

1. Kruger RA, Mistretta CA, Crummy AB, et al. Digital K-edge subtraction radiography. *Radiology* 1977;125:243-5.
2. Körner M, Weber CH, Wirth S, et al. Advances in digital radiography: physical principles and system overview. *Radiographics* 2007;27:675-86.
3. Lehnert T, Naguib NN, Ackermann H, et al. Novel, Portable, Cassette-Sized, and Wireless Flat-Panel Digital Radiography System: Initial Workflow Results Versus Computed Radiography. *AJR* 2011;196:1368-71.
4. Puig S, Digital radiography of the chest in pediatric patients. *Radiology* 2003;43:1045-50.
5. Rapp-Bernhardt U, Bernhardt TM, Lenzen H, et al. Experimental evaluation of a portable indirect flat-panel detector for the pediatric chest: comparison with storage phosphor radiography at different exposures by using a chest phantom. *Radiology* 2005;237:485-91.
6. Rapp-Berhardt U, Roehl FW, Esseling R, et al. Portable flat-panel detector for low-dose imaging in a pediatric intensive care unit: comparison with a symmetric film-screen system. *Invest Radiol* 2005;40:736-41.
7. Andriole KP, Luth DM, Gould RG. Workflow assessment of digital versus computed radiography and screen-film in the outpatient environment. *J Digit Imaging* 2002;15 (suppl I):124-6.
8. Dackiewicz D, Bergsneider C, Piraino D. Impact of digital radiography on clinical workflow and patient satisfaction. *J Digit Imaging* 2000;13(suppl I):200-1.
9. Mack S, Holstein J, Kleber K, et al. New aspects of imaging distribution and workflow in radiology. *J Digit Imaging* 2000;13:17-21.
10. Reiner BI, Siegal EL, Hooper FJ, et al. Multi-institutional analysis of computed and direct radiography. Part I. Technologist productivity. *Radiology* 2005;236:413-9.
11. Lehnert T, Naguib NN, Ackermann H, et al. Novel, Portable, Cassette-Sized, and Wireless Flat-Panel Digital Radiography System: Initial Workflow Results Versus Computed Radiography. *AJR* 2011;196:1368-71.
12. Suchato C, Tularatruengnam N, Panyawong S. Design of digital radiographic rooms for general diagnostic purposes. *The Bangkok Medical Journal* 2011;2:88-94.