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# Image Quality and Optimization Dose for Chest Examination in Computed Radiography and Digital Radiography

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## Introduction

In recent years, digital radiography (DR) has replaced screen-film radiology also computed radiography (CR). DR was promoted faster processing, comfortable workflow, greater transfer and storage image data. Whereas, it comes with expensive price tag. With the many advantages, DR is popular worldwide among user, while CR continues to be used in workstation. It is therefore of interest to compare their benefits, consider the relative dose of CR and DR for optimal quality image and determine reasonable radiation dose.

In medical practice chest examination is the detail for screening diagnostic clinical in the common.The purpose of this study is to study chest examination optimal exposure for acceptable images in CR and DR while maintaining a low dose of radiation. This eventually led to the comparison of imaging quality and radiation dose for optimization of chest x-ray techniques. The optimal protocol will be used for patient undergoing chest x-ray at Siriraj Hospital. The result will provide the next decision for purchase the new x-ray machine.

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## Material and Method

The X ray equipments are in the Radiology Department, Faculty of Medicine Siriraj Hospital. For Digital radiography,The equipment used is the Philips the Digital Diagnost system with flat panel detector. The Digital Diagnost system is Eleva Workspot. The computed radiography equipment is FCR velocity U Upright image reader.

The phantom PBU- 60 made of Uretane base resin with radiology absorption and Hounsfield number approximately that of human body property. Phantom is thick

20 cm. (at chest)

The phantom was set chest x-ray in PA upright position is studied with twenty-five exposures using varying kVp and mAs. Starting 1.6, 2, 4,8 and 10 mAs in every 70, 77, 85, 96 and 102 kVp

Point of measurement surface air kerma is 15 cm above skin of phantom and reading in milligrays from the ionization chamber (Unfors Xi) in the same exposures. The effective doses were estimated using the ESAK to effective dose conversion coefficients depending on kVp. Optimal image results were gathered through qualitative evaluations by three radiologists and the entrance skin dose of the phantom. The protocol is implemented on routine chest x-ray examination. Three radiologists of similar experience evaluated fifty images by blind type units and exposure parameters to scored resolution, contrast and noise.

Intraclass correlation coefficient and Spearman's rank correlation coefficient are used to determine on the entrance surface air kerma of CR and DR; exposures technique were statistically significant.

## Result

In CR and DR, chest X-ray were set in twenty-five exposures by varying kVp and mAs. All of 25 exposures are measured by surface air kerma technique. The comparison of entrance surface air kerma between CR and DR are as shown in the graph below.

In every exposures setting, entrance surface air kerma of CR and DR were significant correlation (95%CI = 0.993). As shown in Intraclass correlation coefficient graph below.

For chest examination, entrance surface air kerma are mostly dependant on mAs, slightly kVp and type x-ray unit according to correlation coefficient Sig. (2-tailed) 0.905, 0.375 and 0.026, respectively. CR and DR are slightly dependent as shown in Spearman's rho.

Optimal image results were gathered through qualitative evaluations by three radiologists. The following chart compares the score between CR and DR in 25 exposures.

The average image scoring in DR are higher than CR in every exposures. The exposure no.6, image scor-

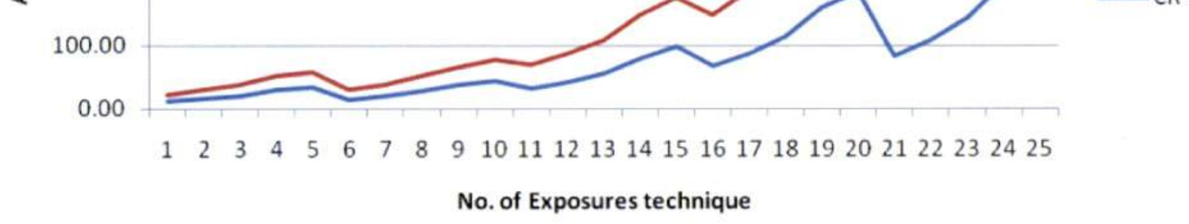


**Figure 1** Comparison of ESAK between DR and CR

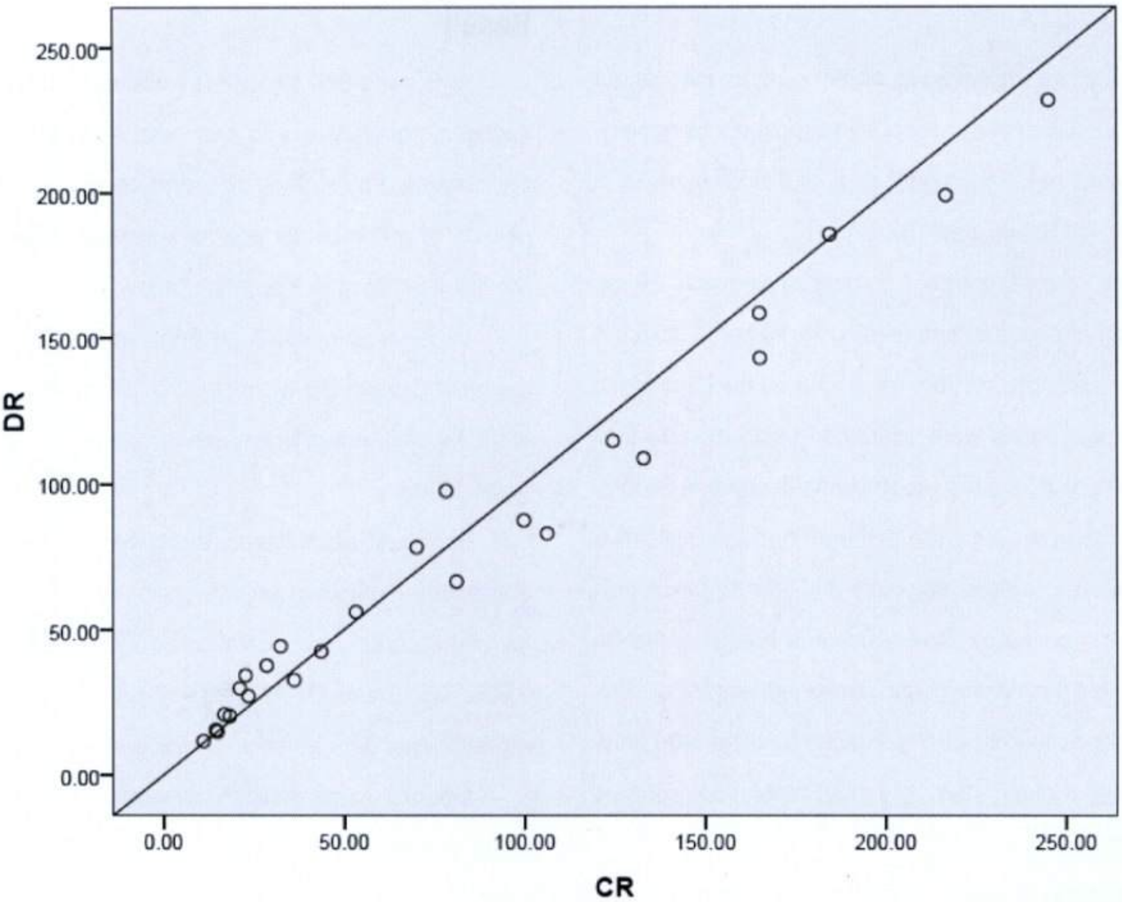


Figure 2 Correlation significance between entrance surface air kerma(µGy) of CR and DR

Table 1 Correlation coefficient Sig. (2-tailed) with Dose, mAs, kVp and type

**Correlations**

| | | | Dose | mAs | kVp | Type |
|---|---|---|---|---|---|---|
| Spearman's rho | Dose | Correlation Coefficient | 1.000 | .905** | .375** | .026 |
| | | Sig. (2-tailed) | | .000 | .007 | .856 |
| | | N | 50 | 50 | 50 | 50 |
| | mAs | Correlation Coefficient | 0.9 | 1.000 | .000 | .000 |
| | | Sig. (2-tailed) | | | 1.000 | 1.000 |
| | | N | 50 | 50 | 50 | 50 |
| | kVp | Correlation Coefficient | .375** | .000 | 1.000 | .000 |
| | | Sig. (2-tailed) | 0.01 | 1.000 | . | 1.000 |
| | | N | 50 | 50 | 50 | 50 |
| | Type | Correlation Coefficient | 0.03 | .000 | .000 | 1.000 |
| | | Sig. (2-tailed) | 0.86 | 1.000 | 1.000 | |
| | | N | 50 | 50 | 50 | 50 |

**. Correlation is significant at the 0.01 level (2-tailed).
*Type : CR and DR

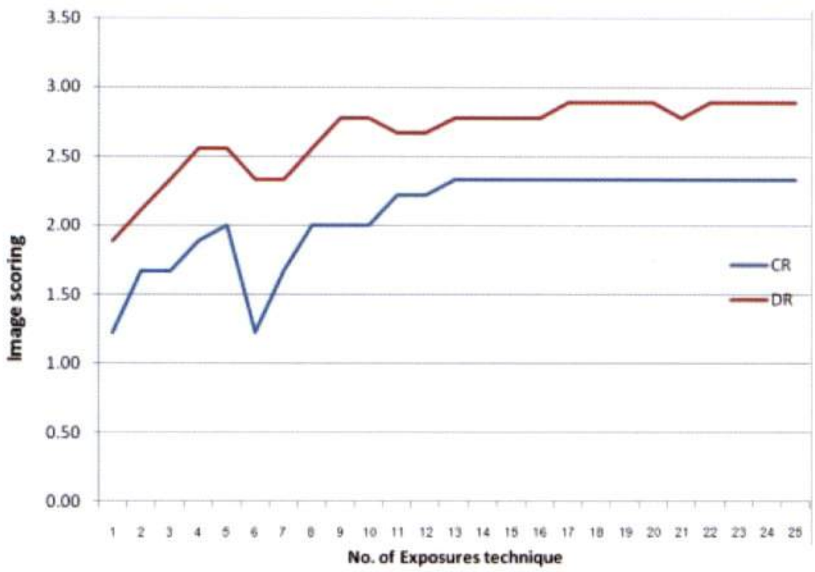


**Figure 3** Average image scoring of CR and DR

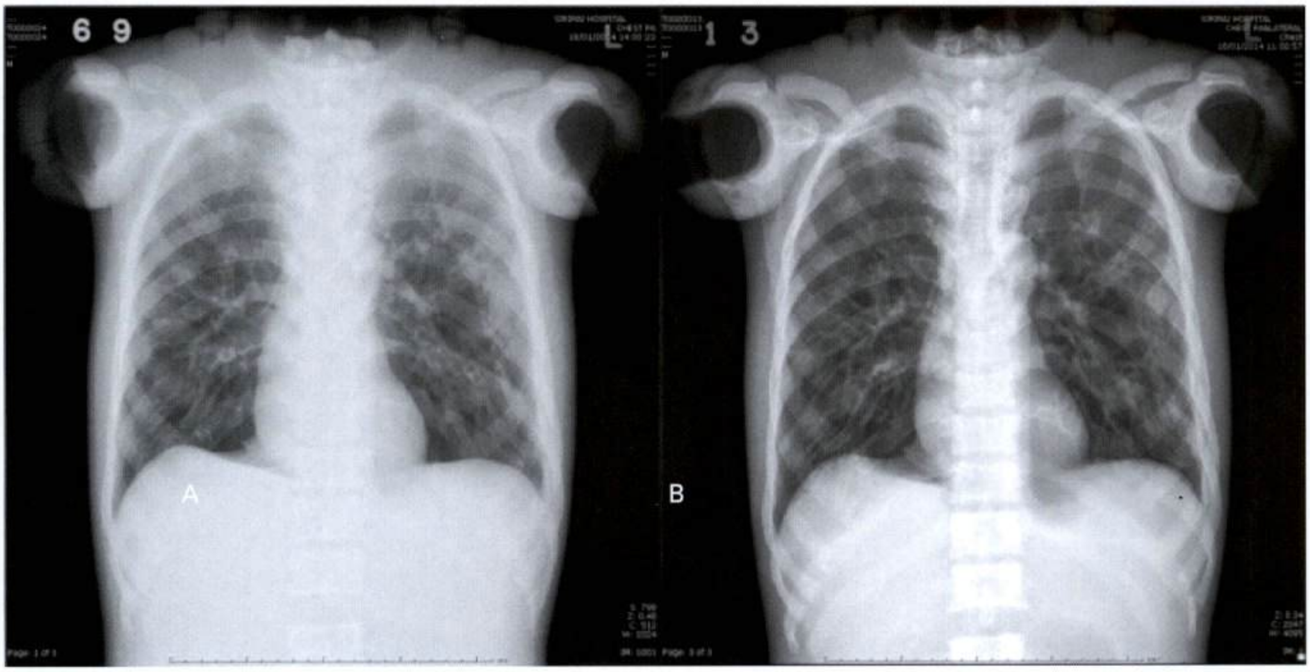


**Figure 4** A 85 kVp and 4 mAs in CR, B 70 kVp and 2 mAs in DR

ing of CR is gap at 1.2 from the mAs changing. And the CR image scoring from 12-25 exposures outcome in PLATO trial.

## Discussion

Although the DR dose is higher, it can give higher image resolution than CR in a low exposure range. The study shows that the optimal protocol for chest radiograph in CR is 85 kVp and 4 mAs and those DR is 70 kVp and 2 mAs.

Radiation dose from our protocol is 0.053, 0.015 mGy in CR and DR, respectively; both are lower than

IAEA DRL for chest PA of 0.4 mGy.

## Conclusion

It is beneficial for a comparison of radiation dose between CR and DR clinically, with a view of preventing radiation hazard to patients. In this research, optimization between radiation dose and image quality found that DR technology provided more satisfactory result in chest radiography because radiation dose from DR are significantly lower than that in CR, in achieving image of similar quality.

The limitation of this study is the direct measurement of patient dose using the gold standard method of TLD that has not been performed and the thickness of phantom can only represent normal patients (20cm). Finally, this protocol result is just an approximate for all patients. The protocol can be adjusted to each patient depending on their physical size and pathology.

**References**

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