

Radiation dose and image quality for adult interventional cardiology in Chile. A national survey.

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INTRODUCTION

- Today no one would doubt that Interventional cardiology (IC) procedures plays an important role in the diagnosis and treatment of cardiac vascular diseases. However, they represent a main artificial sources of ionizing radiation to the population, generating high levels of radiation dose to patients and staff.
- In Chile, since 2008 was adopted the European protocols DIMOND and SENTINEL for commissioning (characterize) X-ray fluoroscopy systems, because their radiation protection legislation does not consider this type of measurements. Evaluation of dose settings and image quality of any X-ray system, are the first quality controls to consider in any patient dose survey, altogether with the accuracy of the dose indications.

PURPOSE

- Investigate at a national level, the differences in dose settings and image quality among X-ray systems used in adult IC procedures, when used in the same geometrical setup simulating the clinical practice.

The study was part of the International Atomic Energy Agency (IAEA) program 'Strengthening Radiological Protection of Patients in Medical Exposures (TSA3), RLA/9/057'.

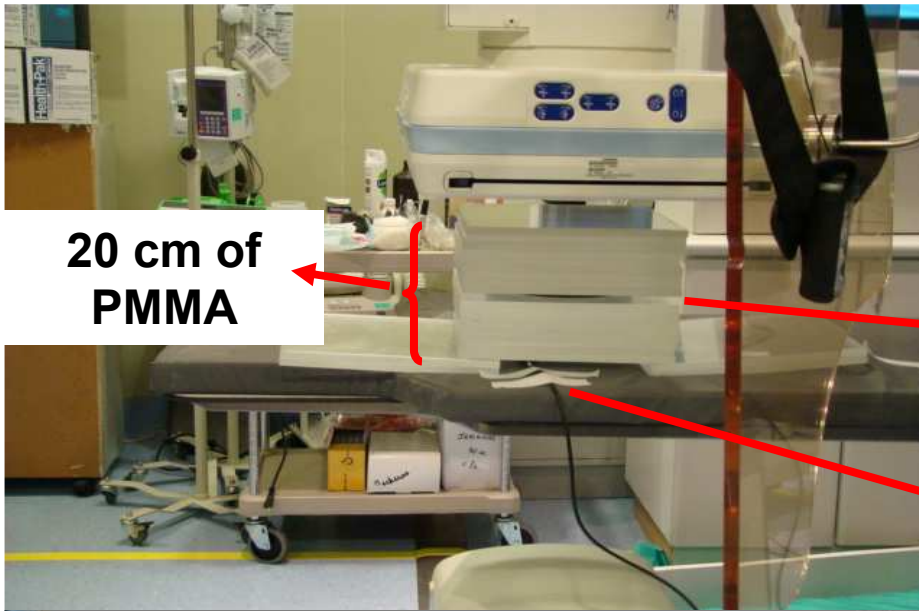
MATERIAL AND METHODS

Table 1. X-ray fluorosocopy systems evaluated in the survey.

ID no.	Manufacturer	Model	Image detector	Year of installation
1	Siemens	Axiom Artis dBC, biplane	Flat Detector	2008
2	Philips	Allura Xper FD20, monoplane	Flat Detector	2005
3	General Electric	Innova, biplane	Flat Detector	2007
4	Siemens	Artis VB31E, monoplane	Flat Detector	2008
5	General Electric	Advantx, monoplane	Image Intensifier	1994
6	General Electric	Rebuilt, monoplane	Image Intensifier	2000
7	Philips	Integris Allura	Image Intensifier	2003
8	General Electric	Rebuilt, monoplane	Image Intensifier	2000
9	Siemens		Image Intensifier	2004
10	*	Rebuilt, monoplane	Image Intensifier	1997

*Manufacturer unavailable

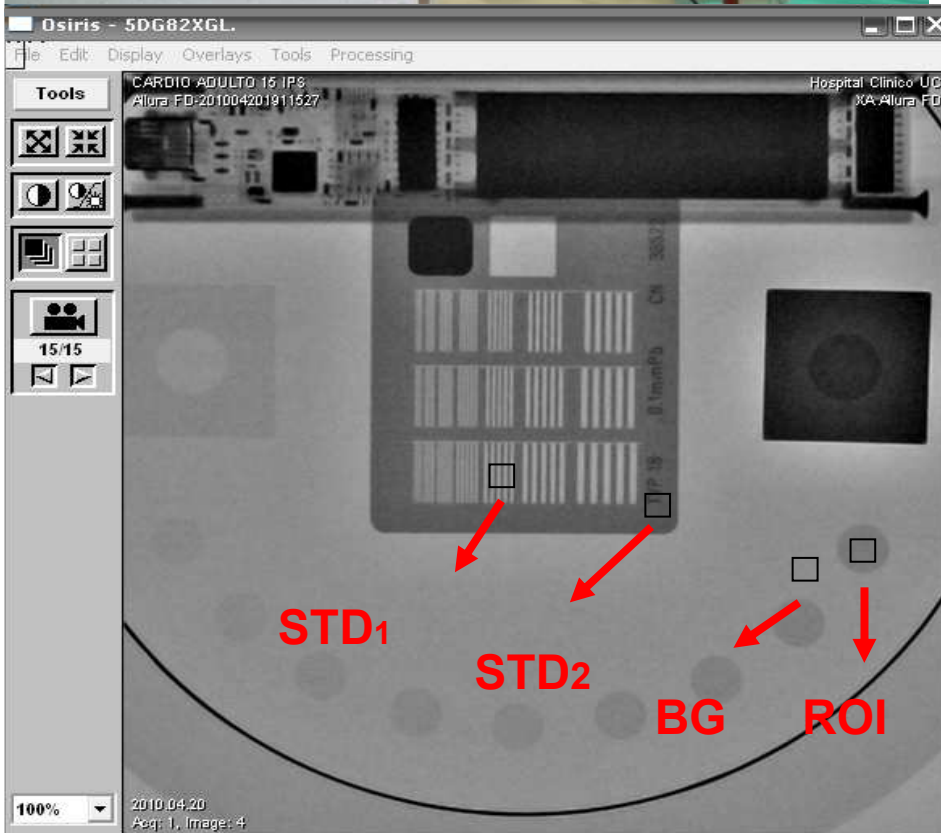
MATERIALS AND METHODS



20 cm of PMMA

Test objects (Leeds TOR FG-18) at isocenter, to evaluate the image quality.

Measurement ESAK, with solid-state detector Unfors Xi.



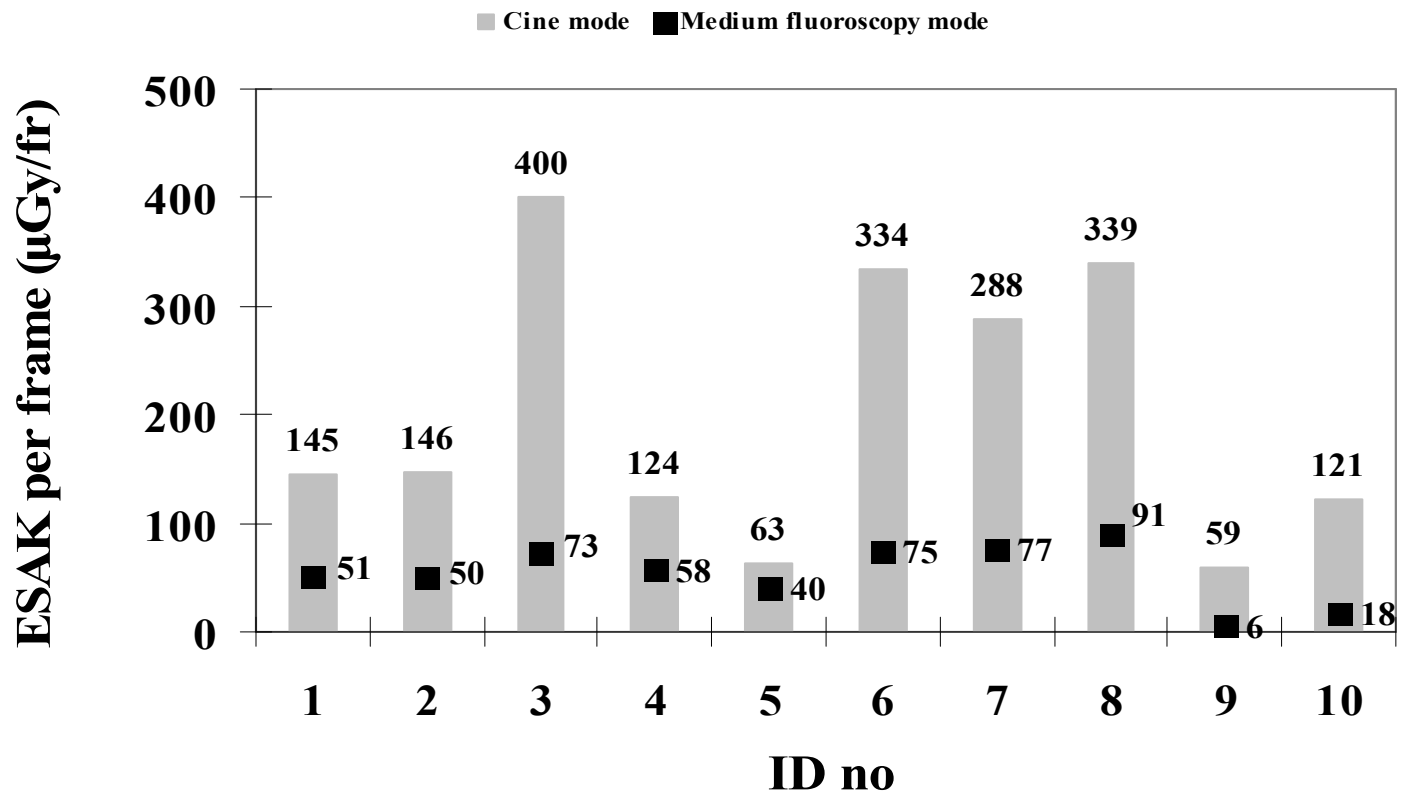
Numerical parameters used to evaluate the image quality

$$SNR = \frac{[BG - ROI]}{\sqrt{\frac{(STD_{ROI}^2 + STD_{BG}^2)}{2}}} \quad (\text{Signal-to-noise ratio})$$

$$HCSR = STD_1 - STD_2 \quad (\text{High contrast spatial resolution})$$

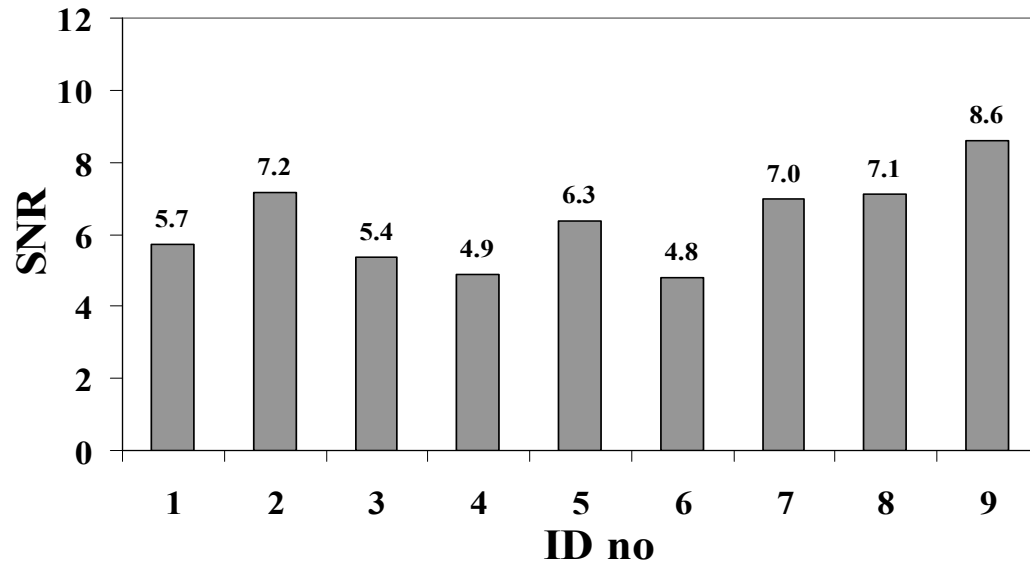
$$FOM = \frac{SNR^2}{ESAK} \quad (\text{Figure of merit})$$

RESULTS AND DISCUSSION

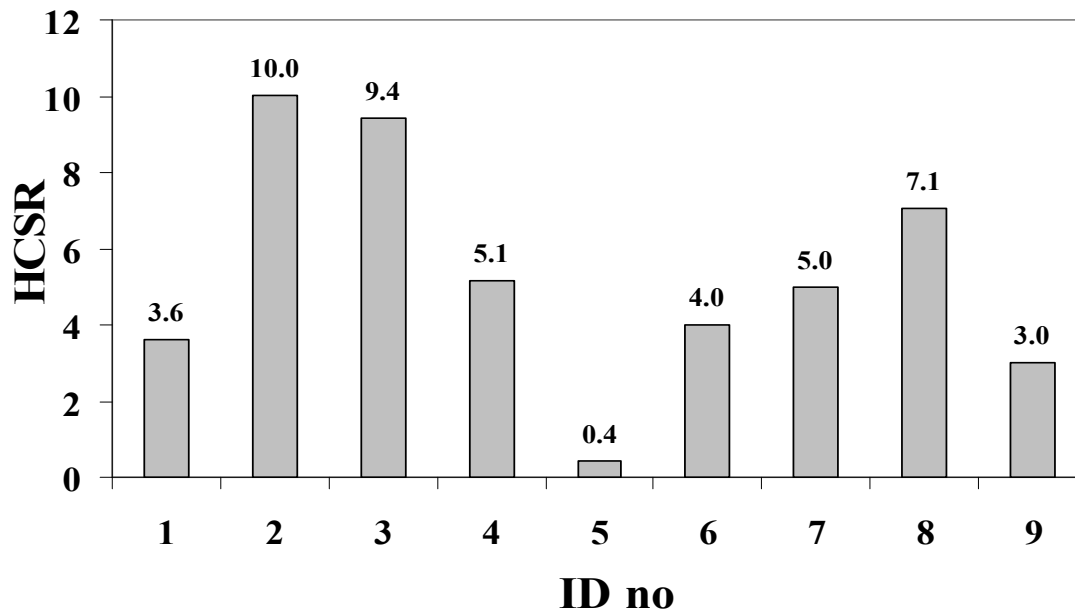


The ratios of maximum to minimum values measured for 20 cm PMMA were 15.1 for MF and 6.8 for CI modes.

RESULTS AND DISCUSSION

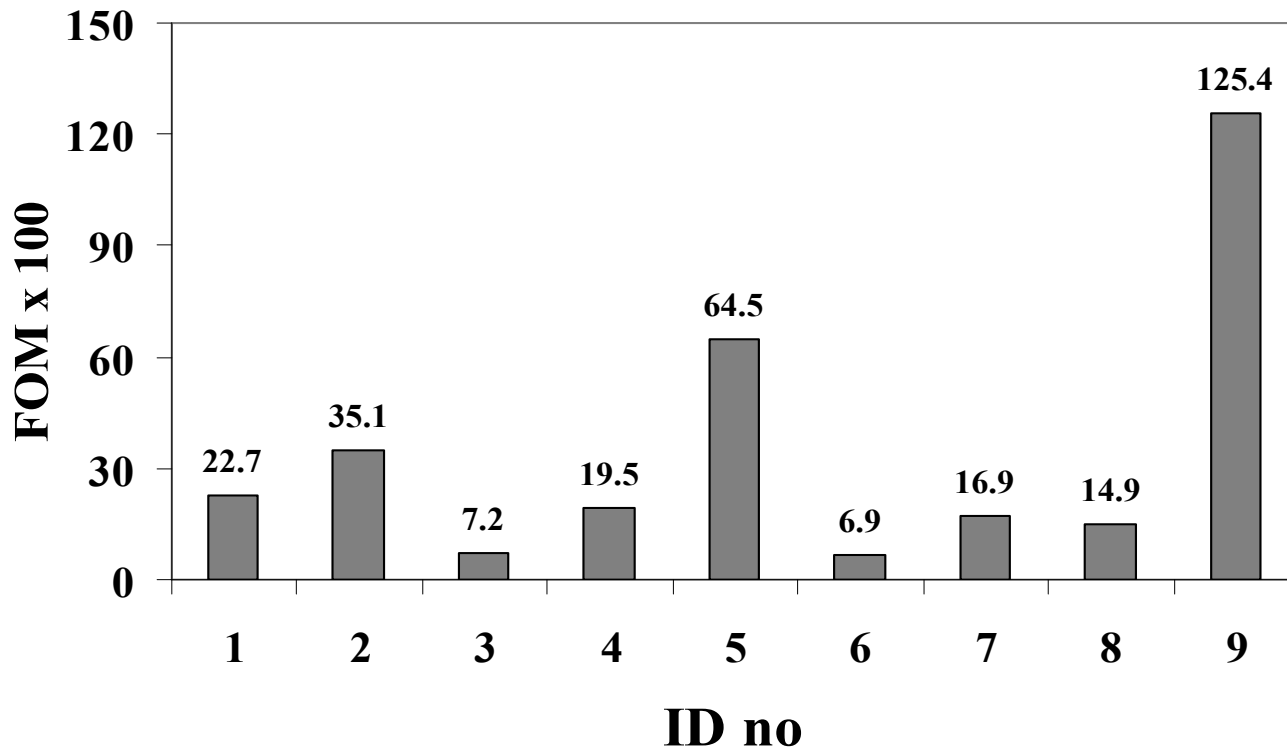


These results should have a direct relation with the ESAK per frame values, type of technology and years of functioning, nevertheless, this condition is not clearly revealed in the present paper.



The X-ray system no. 2 (Phillips Allura Xper FD20) is the one which presents the best results for both image quality parameters evaluated (SNR and HCSR).

RESULTS AND DISCUSSION

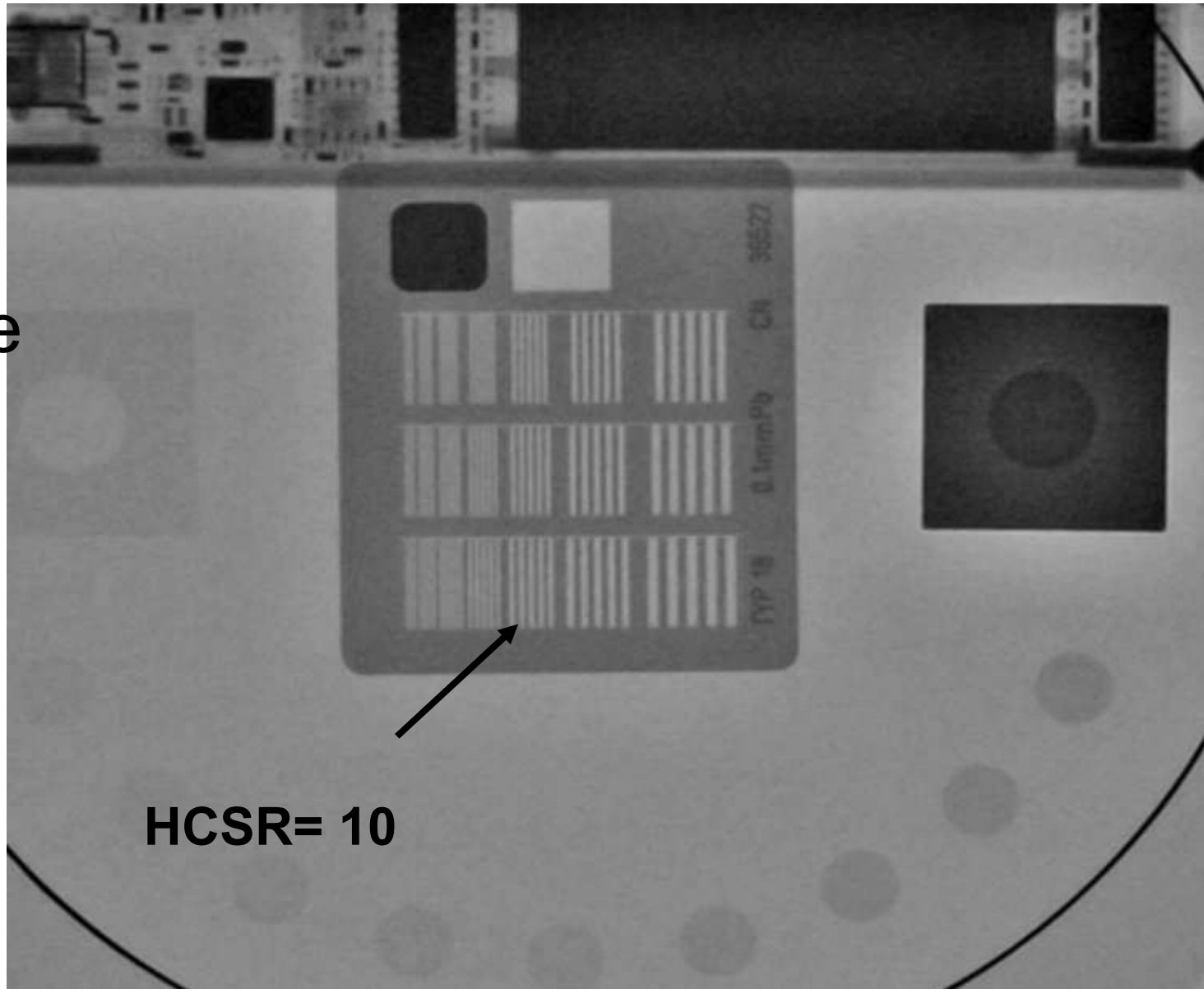


The parameter figure of merit FOM has previously been used by other authors for the optimization of signal detectability in digital imaging, relating the image quality and dose per frame needed to obtain such image. On our research we found maximum and minimum FOM values from 125.4 to 6.9. The FOM proposed does not evaluate the cost in terms of image quality for the HCSR parameter versus dose.

RESULTS AND DISCUSSION

ID.no. 2

Better image



CONCLUSIONS

- The results derived from of the dose values and image quality parameters of the X-ray systems involved in the present national survey, show important differences and points out to need to launch an optimization program.