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EVALUATION METHODOLOGY AND PERFORMANCE TESTS OF IONIZATION CHAMBERS OF THE AIR KERMA AREA PRODUCT USING MATHEMATICAL SIMULATION

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1. INTRODUCTION

•The kerma-area product (P_{KA}) is a useful quantity to establish the reference levels in diagnosis of conventional X ray examinations and it is a good indicator when the dose limits for deterministic effects are achieved in interventionist procedures. The P_{KA} can be obtained by measurements carried out with a kerma-area product meter (KAP) with a plane-parallel transmission ionization chamber mounted on the X ray system. According to the International Atomic Energy Agency (IAEA), the air kerma–area product, P_{KA}, is the integral of the air kerma over the area of the X ray beam in a plane perpendicular to the beam axis , thus, according to Equation :

$$P_{\mathrm{KA}} = \int_A K(x,y)\,\mathrm{d}x\,\mathrm{d}y$$

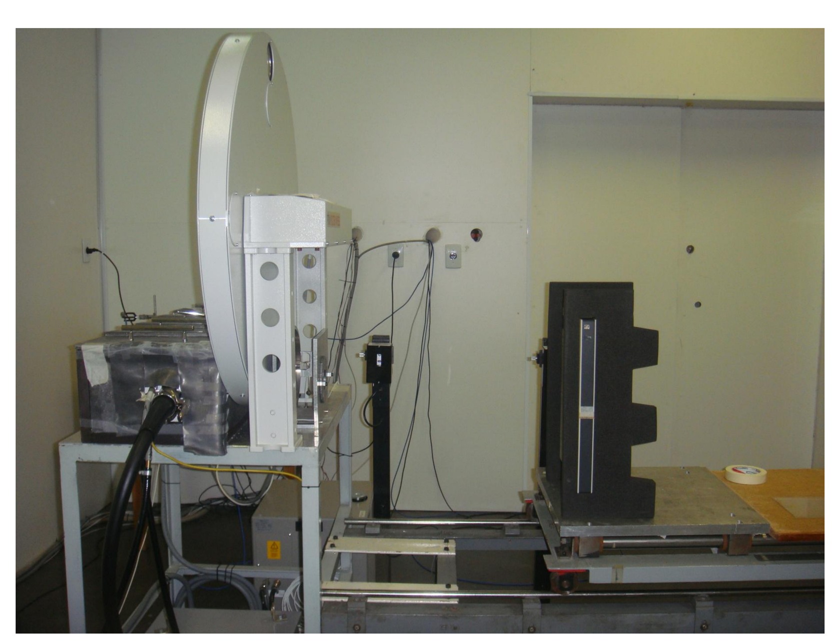
2. OBJECTIVES

Evaluate the performance of the reference KAP meter in several radiation qualities and study those parameters using the Monte Carlo method.

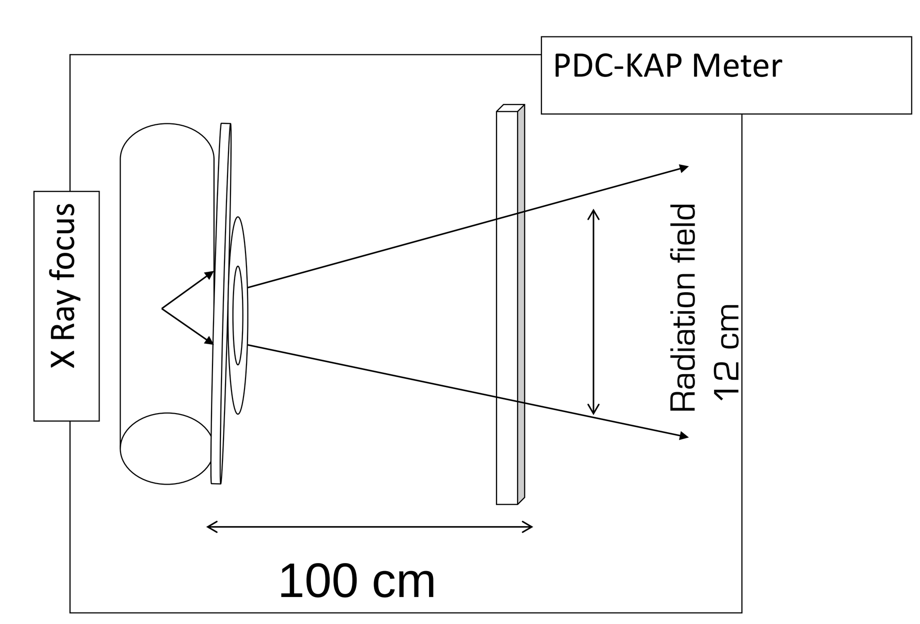
3. MATERIALS AND METHODS

Patient Dose Calibrator

Set up used to measure the parameters



Schematic view of the geometry used



The MCNP5 code was used to calculate the imparted energy in the air cavity of KAP meter and the spatial distribution of the air collision kerma in entrance and exit plans of the KAP meter and on a plane close to the patient. From these data, the air kerma-area product (PKA) and the calibration factor were calculated and its dependencies with the tube voltage, radiation beam size, additional filtration and energy were analyzed.

4. RESULTS

Table 1: Reference air kerma rate for RQR-M and the calibration coefficient (N_k),

Radiation Qualities	Voltage (kV)	Air Kerma Rate (mGy/min)	Accumulated Air Kerma (mGy)	Reference Air Kerma Rate (mGy/min)	Calibration Coefficient (N_k)
RQR-M 1	25 kV	6.7 ± 0.15	6.732 ± 0.13	9.78	1.45
RQR-M 2	28 kV	8.5 ± 0.17	8.512 ± 0.17	12.20	1.43
RQR-M 3	30 kV	9.7 ± 0.19	9.729 ± 0.19	13.83	1.42
RQR-M 4	35 kV	12.9 ± 0.25	12.91 ± 0.25	17.97	1.39

Table 2: Reference air kerma rate for RQA-M and the calibration coefficient (N_k)

Radiation Qualities	Voltage (kV)	Air Kerma Rate (mGy/min)	Accumulated Air Kerma (mGy)	Reference Air Kerma Rate (mGy/min)	Calibration Coefficient (N_k)
RQA-M 1	25 kV	0.35 ± 0.07	0.356 ± 0.07	0.470	1.34
RQA-M 2	28 kV	0.5 ± 0.01	0.540 ± 0.01	0.671	1.34
RQA-M 3	30 kV	0.7 ± 0.014	0.707 ± 0.01	0.845	1.20
RQA-M 4	35 kV	1.3 ± 0.026	1.311 ± 0.02	1.47	1.13

5. DISCUSSION AND CONCLUSIONS

The quantities for each RQR-M and RQR-A tested are reproducible for the air kerma rate and for the accumulated air kerma. The standard deviation and the equipment resolution were used to calculate the uncertainties assuring that they didn't exceed the recommended values. It is possible to realize that the PDC is an instrument that can also be used for measurements in mammography once the manual of its instrument says that the voltages function from 40 kV to 150 kV

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