Quality control assessment for different X-ray fluoroscopy units in Albania

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INTRODUCTION

Fluoroscopic examinations can increase the potential for a high radiation dose to the patients and staff, consequently as a prerequisite to guarantee patient safety and the quality of examinations these X-ray fluoroscopy devices require the application of a rigorous quality control program. Quality control (QC) of radiological medical devices in Albania has started during the last decade and is applicated for the first time by the Institute of Applied Nuclear Physics (IANP) according to Decision No.404 – "For basic rules of radiologic installations in medicine" emphasizing that all healthcare institutions that use radiological equipment are obliged to pass in the process of QC not less than once in three years. Except IANP these QC tests are also carried out by other licensed private companies. The purpose of this work was to evaluate the operating conditions of fluoroscopic equipment in use in various health care institutions in Albania comparing the obtained data with those defined in the actual national radiation regulation. We present the results of some primary QC tests evaluation for 10 different fluoroscopy systems: the kilovoltage (kVp) accuracy, kVp consistency, tube output for 70 - 80kV values, the output variation with change of mAs, total filtration values at 70 kV and higher, Patient Entrance Surface Dose Rate and Image Intensifier Dose Rate.

METHODS AND MATERIALS

Different international recommendations and guidance concerning the instrumentation requirements, frequency of QC testing, tolerance levels and scope of QC tests of X-ray fluoroscopy units are selected for the final measurement procedures. Most of them belongs to IAEA and AAPM and before their application all the measurements protocols used by IANP were approved by the Albanian Radiation Protection Commission.

Measurements of radiation exposure were performed using a calibrated Radcal (AGMS - DM+) solid-state multi sensor and PMMA plates simulating the patient as is presented in figure 1.

For the Image Intensifier (II) Entrance Dose Rate measurements the detector was placed at a focus to II distance of 100 cm directly on the entrance surface of the image intensifier. For the Patient Entrance Surface Dose Rate, the detector was placed on the entrance surface of the 20 cm PMMA body phantom. The units were switched to auto mode with both kV and mA automatically set for field sizes 20-25 cm.

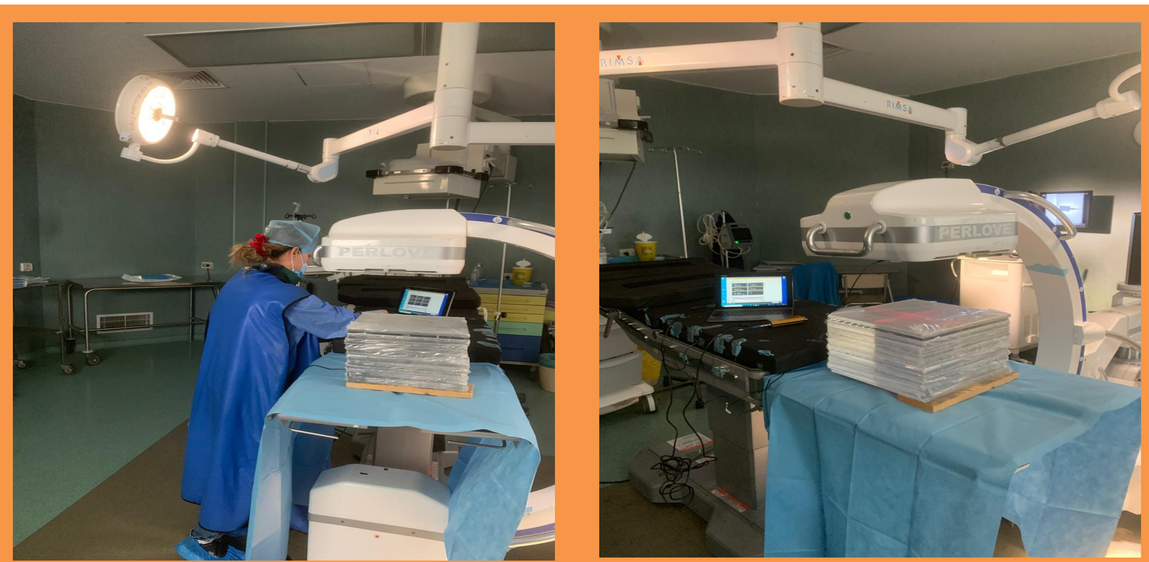

Figure 1. Quality control test measurements

RESULTS AND DISCUSSION

In this study we presented the results of seven primary QC tests evaluation that belong to 10 different fluoroscopy systems used in various radiology departments in Albanian Healthcare Institution.

The kilovoltage (kVp) accuracy, kVp consistency, tube output for 70 - 80kV values, the output variation with change of mAs, total filtration values at 70 kV and higher, Patient Entrance Surface Dose Rate and Image Intensifier Dose Rate were assessed.

From the analysis of the results it was found that: the kilovoltage (kVp) accuracy was between 1.4 - 5%, kVp consistency was between 1-3.1%, tube output for 70 - 80kV operation was between 26.1 - 60μGy/mAs. The output variation with change of mAs was between 1 - 4%. Total filtration at 70 kV and higher was between 2.6 – 4.5 mm Al. The Patient Entrance Surface dose rate ranged from 11.2 to 23.2 mGy/min in the continuous mode of operation while Image Intensifier dose rates ranged from 0.29 to 0.69 μGy/s, showing that all these parameters are within the acceptable criteria defined in the actual national radiation regulation.

CONCLUSIONS

- Based on the analysis of the results, this study showed clearly that all the fluoroscopic devices, subject of routine quality control tests were in a very good compliance with our national radiation protection acceptable criteria
- Such measurements are important both for the optimization of image quality and for radiation protection purposes

Table 1. Quality control test results for five parameters

Nr	Quality control test parameter	Hospital									
		A	B	C	D	E	F	G	H	I	J
1	kilovoltage (kVp) accuracy (%)	1.4	1.7	2.3	2.1	2.6	4.2	1.6	4.0	1.4	5.0
2	kVp consistency (%)	1.0	1.3	2.2	2.0	3.1	1.0	1.0	2.8	1.2	2.5
3	The output variation with change of mAs (%)	1.0	1.4	2.3	4.0	3.1	2.4	1.8	1.6	1.9	2.7
4	The Patient Entrance Surface dose rate (mGy/min)	23.2	23.2	22.1	22.2	11.2	11.2	17.7	19.1	19.3	22.1
5	Total filtration at 70 kV and higher (mmAl)	2.9	2.6	3.5	3.4	4.5	4.5	4.1	3.7	3.4	3.1

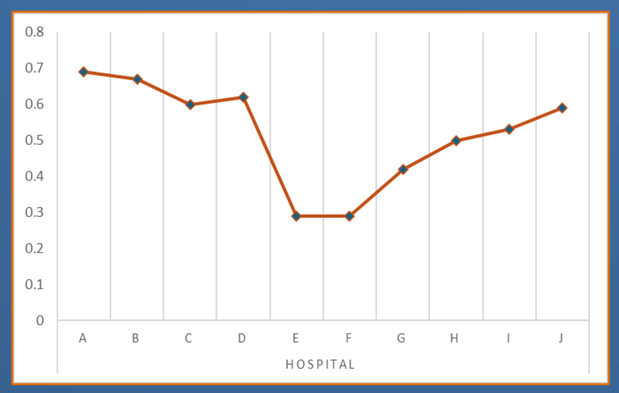

Chart 1. Image Intensifier Dose Rate (μGy/s)

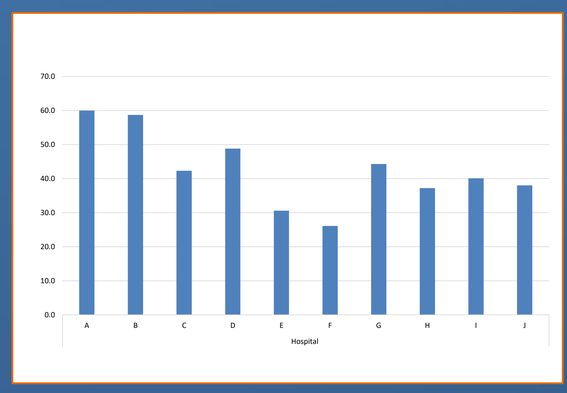

Chart 2. Tube output values for 70-80 kV operation (μGy/mAs)

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