DIAGNOSTIC X-RAY EQUIPMENT EVALUATION IN BRAZIL

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As in many countries all over the world, also in Brazil there was a marked increase of medical X-ray installations and the number of examinations "per capita" during the last decades. Up till now there are a very little statistics regarding frequency of X-ray examinations the main factors affecting radiation exposure and the conditions of the equipment available.

After 1977, the IRD had the possibility to perform a survey on the main part of diagnostic X-ray installations all over the country. Till the moment we have checked 790 X-ray machines.

This program included statistics as well as tests of the technical conditions. These tests included: radiation quality (i.e. kilovoltage and filtration), tube out put, beam collimation and protection devices.

About 34% of the X-ray equipment tested in this work are used for dental radiography and 66% are used for other routine examinations includind fluoroscopy and those performed by mobile units.

Table I presents a survey of the number of physicians (radiologists), radiographers, examinations per month, films used and lost, in 10 big Hospitals, where 120 X-ray machines are installed. When these measurements have been performed, around 10% of the machines were not functioning because of different reasons, mainly due to technical failures and lack of a correct place to be installed and/or of trainned people to run them.

TABLE 1. Survey of 120 diagnostic X-ray machines.

Number of Hospitals	10
Number of X-ray Machines	120
Physicians (Radiologists)	80
Radiographers	260
Examinations per Month	51100
Films Used per Month	157300
Films Lost per Month	4000

RADIATION QUALITY

Regarding radiation quality in practice means testing the coincidence of the quilovoltage indicated at the control panel with the quilovoltage applied to the tube and the inherent filtration. As it was proved impossible to use a voltage divider in such a field test we choose the method published by Ardran and Croods (1) for determination of the quilovoltage. It is based on film dosimetry using a special film-screen combination in specially prepared cassette. One half of the cassette contains a pair of high resolution screens and the other half a pair of high speed screens.

The cassette is covered with a sheet of lead in which two rows of holes are cut, one over each pair of screens. The row on top of the high speed screens is covered with a copper step wedge. When a film is exposed in this cassette it will show a row of spots with identical optical density resulting from the high definition screen an another with decreasing optical densities, according to the different copper thicknesses covering the high screen causing the exposure of this part of the film. From the spot in this row which shows the same optical density as the spots in the other row one can get the applied quilovoltage by means of a calibration curve established for this device.

TOTAL FILTRATION

The total filtration was determined by means of HVL measurement at a certain kV value determined in the described way. The total filtration corresponding to measured HVL was taked from NCRP Report 33. (2)

TUBE OUTPUT

The purpose of measuring the tube output under defined conditions was to get an idea about the conditions of the tube, i.e., the age or, if necessary, the power of an unknown gerator type.

The dosimeters used were a calibrated Baldwin Farmer with a 30 cc chamber and a Pitman with a 35 cc chamber.

EXPOSURE TIME

As most installations did not include an automatic

exposure control the correct functioning of the timing was of special importance. This was checked with an electronic device, developed by our Institute, covering a range of 1 ms up to 900s.

COLIMATION OF THE USEFULL BEAM

When the tube housing was equiped with a ligth beam collimator the coincidence of the light field with the radiation field was checked by exposing a film.

When only cones were available the field size in the plane of the patients surface, i.e., 20 cm above the table top was calculated. In Table 2 we can see the type of collimators used in the machines of this national survey.

TABLE 2. Type of collimator

Cone	36 %
Light Beam Diaphragm	51 %
Without Collimator	13 %

SPECIFIC TESTS

Besides this basic program applicable to all installations a few more tests were done in special cases like image amplifiers with TV chains and tomographic equiment. These tests consist of measuring the dose rate to the skin of the entrance side and to the entrance of the image amplifier using a phantom.

With tomographic equipment the simetry of the tomographic movement and the coincidence of the indicated height of the plane with the height of the plane with the actual height were tested according to ICRU Publication 89. (3)

RESULTS

From all the measurements realized in each X-ray equipment, we got for: total filtration, kivoltage, exposure time and field size the figures shown in Table 3.

TABLE 3. Survey of 522 Diagnostic X-ray Machines

Kind of test	Correct (%)	Not correct (%)
Total Filtration	38	62
Kilovoltage	58	42
Exposure Time	63	37
Field Size	46	54

In regard to Radiation Protection, 40% of the rooms were in wrong conditions related to the staff and the public. We emphasize that almost all the X-ray Departments

visited do not use any personal dosimeter.

In the field of Odontological X-rays, we found that 30% of the rooms were incorrect in relation to radiation protection.

In conclusion, from 268 Odontological X-rays machines checked, only 9% were working in correct conditions, in regard to the technical parameters and the radiation protection.

Finally, Table 4 presents the figures for the technical parameters checked in the 268 machines.

TABLE 4. Survey of 26% Odontological X-ray machines

Kind of test	Correct (%)	Not correct (%)
Total Filtration	79	21
Kilovoltage	54	46
Exposure Time	52	48
Field Size	70	30

REFERENCES

1. Ardran, G.M., Crooks, H.E. (1968): Brit. J. of Radiology, 41, 198.

2. National Council on Radiation Protection and Measurements (1968): Report No 33.

3. National Bureau of Standards (1963): Handbook 89