A SURVEY OF CHEST MEDICAL X-RAY DOSES

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INTRODUCTION

The medical X-ray exposures due to radiological examinations are responsible for the largest contribution to the population collective dose as result of the normal use of artificial sources of radiation.. The relative impact of the medical exposures to the total dose received by the population from all kinds of radiation sources varies from country to country and in some cases within the same country (1). The dose variations observed for a specific type of examination are in general associated to several factors i.e. the type of film-ecran combination, the choice of the appropriate physical parameters of the x-ray generator (Kvp, filament current, exposure time) and finally to the film processing conditions.

At the present moment the data available in Brazil are scarce and scanty to allow a complete analysis of this question so needed by the health authorities to justify the implementation of a quality assurance and dose reduction programs. In addition, it is desirable to establish a cost effective operation based on simple administrative concepts in order to reduce the number of films retake, then increasing the life expectancy of the equipment and the number of radiological procedures.

The aim of this work was to assess the typical doses of an PA and LAT chest wall X-ray examinations in five different public hospitals (a University Hospital, a Cancer Hospital, a Navy Hospital, an Emergency Hospital and a State General Hospital), as representative of the city of Rio de Janeiro, and compare the results with the international data and recommendations available.

MATERIALS and METHODS

Chest X-ray examination was selected for this study since by far is the most frequent type of procedure requested as part of a normal medical routine in a hospital or as part of the admittance procedure for a new job.

The experimental methodology adopted for this work is very similar to the one developed by the Institute of Physical Sciences in Medicine (2) and accepted by the Common Wealth as well as by several countries in the European Community.

In-vivo measurements were conducted using chips of Lithium Fluoride (TLD-100) thermoluminescente dosimeters, manufactured by Harshaw. A conventional thermal treatment was applied to the TLD's (400°C/1h + 100°C/2h) and then they were exposed several times to a reference Co-60 gamma beam in order to group them in accordance with its relative response. A calibration factor adjusted for its well known energy dependence was assigned for each group. As result of this procedure, the typical overall random uncertainty for a dose of 1 mGy is 4% (1 σ).

For each measurement, the dosimeter was placed on the patient skin at the center of either the PA or the Lateral radiation fields, and immediately after stored in a lead box for subsequent evaluation. A minimum of 10 patients were selected in each hospital (average height of 1.6 m and 65 kg of weight) and further identified by age and sex. No changes or suggestions were made related to the selection of the radiographic parameters during the radiological procedure in each place.

RESULTS and DISCUSSION

The Fig.1 gives an overall view of the average entrance dose measured at the surface of the patients for the PA and LAT projections for all the examination rooms evaluated. By looking at the results individually by machine or institution, one is tempted to believe that the homogeneous distributions are an indicator of consistency of the operational procedures. However, when the individual patient records were analyzed, severe inconsistencies were clearly shown related to the choice of the machine parameters(kVp and current) for a

particular dimensions of the patient (height and corporal mass). This observation might be strongly related to the general level of training of the radiographers or his lack of attention to a specific machine. It is a normal practice in our Country to have the radiographer working on shifts, and as result of that, they tend to work on several different places and different machines, not being able to develop familiarity and a professional feeling about the performance of a machine.

The Table 1 shows the average dose values for this type of examination published by national (2) and international organizations (1,3) together with the values obtained by this study. It is clear that the measurement results obtained at the hospitals # 1, #3 and #5 are in good agreement with the recommended values also shown in the same table.

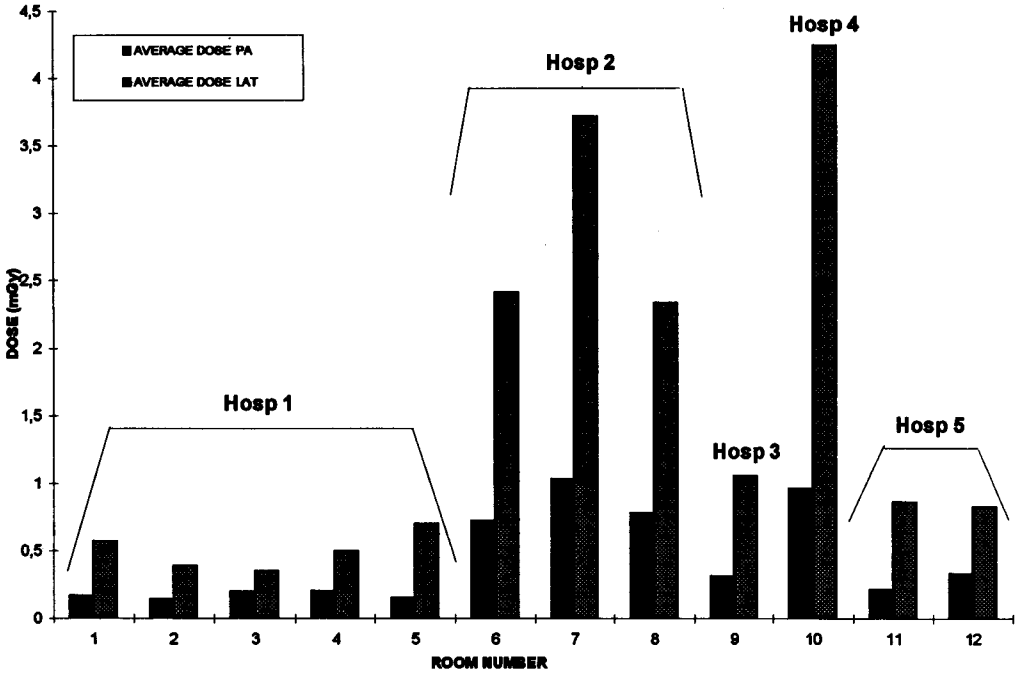

Figure 1: Average entrance dose values for the entire set of data.

However, the same positive considerations cannot be made for the results presented by the hospitals # 2 and # 4. The measured values are two times greater than the reference values presented in Table 1, as result of problems observed in the operational procedures presently adopted i.e. consistently wrong choice of physical parameters for a particular patient size, old ecrans still in use, filament current indicator and timer both running out of the specifications, dark room with light leakage without any quality control and last but no least insufficient training of the radiographers

Table 1: Comparison between the values obtained in the present work with the recommended values published by the UNSCEAR, IPSM-UK and IAEA.

INSTITUTION	AVERAGE DOSE- PA mGy	AVERAGE DOSE- LAT mGy
IPSM-UK	0.18	0.99
UNSCEAR	0.4	1.5
IAEA	0.4	1.5
PRESENT WORK	0.43	1.49

CONCLUSIONS

1 - The use of thermoluminescent dosimeters, TLD-100 to measure the entrance doses of chest X-ray examination has shown to be adequate if the necessary care is taken in its selection and a good and consistent methodology is followed for the storage, irradiation, thermal treatment and the read-out of each chip.

2 -The results tends to show that the average entrance dose for the chest x-ray examinations measured in five typical hospitals in Rio de Janeiro are very similar to the world average value published by UNSCEAR and the IAEA reference value as well. However, the results obtained in two of those hospitals strongly indicates the immediate need of a quality assurance program in order to optimize the radiological procedures generating a positive impact in the dose reduction for the population, in the operational costs and set a example for other institutions as well.

REFERENCES

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