

PROPOSAL OF DOSE CONSTRAINT VALUES TO THE PATIENT IN DIAGNOSTIC RADIOLOGY

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INTRODUCTION

A dose constraint is the value of an individual dose not to be exceeded in the individual dose distribution considered in an optimization process. The objective of a dose constraints is to set a ceiling to the doses to individual from a source, practice or task which are considered acceptable in the optimization process at the design stage. Implicitly, as C. Zuur (1) states, dose constraints are below the relevant dose limit and usually should be established as local or national levels. Exposures for medical purposes are not subject to dose limits and hence dose constraints were recommended by the ICRP just for occupational and public exposures. However, as an effective tool for optimization for medical exposures, ICRP-60 in §180 (2) recognizes the value of applying this concept to patient diagnostic radiology with some peculiarities: "Considerations should be given to the use of dose constraints, or investigation levels, selected by the appropriate professional or regulatory agency, for application in some common diagnostic procedures. They should be applied with flexibility to allow higher doses where indicated by sound clinical judgement".

As B. Wall indicates (3), there is some interesting features in this recommendation: it suggests that for diagnostic medical exposures the dose constraints are to be used retrospectively as investigation levels for checking existing practices and not at the planning stage, as is the case for occupational and public exposures. In this practical application of ICRP concept of dose constraints to medical exposures of patients, the term reference level (4) or guidance level (5) have been indistinctly used. Unless justified by clinical judgements, appropriate action should be taken by the centres to improve practice; this could involve changes in technique or equipment to reduce doses to values below the reference level without compromising the quality of diagnostic information. When used in this manner, this has the same function as the "dose constraints".

National and sometimes local reference dose levels usually are set towards the top end of the observed range of typical practice, i.e. defined at a certain percentile such as the 75, to identify where corrective action is most urgently required. This concept is usually used at the first stages of optimization in diagnostic radiology as a level that should be obtained, however, measured doses at any other optimization stages should be clearly below, so that, new *constraints* should be imposed.

This paper analyses retrospectively the dose levels imparted to patient in some common examinations (chest, lumbar spine and mammography) at different optimization stages of different facilities to propose some local constraints for diagnostic examinations. Dose values have been obtained under routine working conditions. Centres included in the survey have been chosen all over Spain, classifying them with particular attention to the following aspects:

- Organizational aspects of the diagnostic radiology service, i.e., operational, technical and clinical criteria, as well as quality requirements.
- Evaluation and revision of routine medical protocols.
- Quality control of the radiological equipment.
- Quality criteria for the surveillance of the working procedures, with requirements of proper training of the technical staff.

MATERIAL AND METHOD

The examinations included in the survey were of the chest (postero-anterior and lateral projections), lumbar spine (AP and lateral) and mammography, since they are representative of simple examinations (4) and hence could be considered as *common* diagnostic procedures. Patient entrance surface doses were mainly estimated

from DAP (dose per area product) measurements carried out with transmission ionizing chambers. Alternatively, some data were obtained with thermoluminescent dosimeters placed at the centre and on the surface of the patient field. A previous chambers and electrometers intercomparison among the participating centres were carried out to ensure that all measurements were comparable. Data are obtained from samples higher than 10 patients in each facility. Paediatric patients were not included in the survey. Third quartile values are shown in tables.

RESULTS

Tables summarize dose levels of the aforementioned examinations and the characteristics or degree of implementation of quality assurance programmes in each facility. First level (which correlates with the highest dose reference values) corresponds to data obtained by the Medical Physics Group of the Complutense of Madrid (6) at an early optimization stage of radiation protection in diagnostic radiology. This group conducted a research project in the community of Madrid during the period 1986-1992, partly supported by the European Community, and carried out in several health centres. Those first data could be representative of the dose reference values without any implementation of quality control programmes (most data were obtained before 1989). Rest of data included in table came from services with different degrees of quality assurance implementation. Lowest local reference values could be considered representative of a facility in which all organizing aspects of the radiological services have been taken into account, also staff training on radiological protection topics and equipment quality control.

OPTIMIZATION LEVELS	L1	L2	L3	L4
1. Quality criteria for the surveillance of the working procedures, with requirements of proper training of the technical staff		X	X	X
2. Quality control of the radiological equipment.		X	X	X
3. Organizational aspects of the radiodiagnostic service i.e. operational, technical and clinical criteria, as well as quality requirements			X	X
4. Evaluation and revision of routine medical protocols				X

MEAN VALUES OF PATIENT SURFACE ENTRANCE DOSE (mGy) CLASSIFIED ACCORDING TO LEVELS OF OPTIMIZATION

Examinations	L1	L2	L3	L4	EU ¹	UK ²
Chest PA	0.50	0.35	0.18	0.12	0.30	0.20
Chest LAT	1.60	1.20	0.56	0.70	1.50	1.50
Lumbar Spine AP	20.00	11.10	7.51	3.28	10.00	9.20
Lumbar Spine LAT	45.10	22.70	17.90	8.53	30.00	22.80
Breast	13.90	5.60	4.48	-	7.00	10.00

¹ CEC reference values

² Ref (7)

CONCLUSIONS

The proposals of the introduction of dose constraints in diagnostic radiology could be a solution to ensure that patient doses do not exceed the level considered has optimum for each examination.

Each facility according to the different optimization levels that could be achieved, should adopt their own constraints values as presented in this paper, however, it is important to be aware that the imposed levels could be improved while getting new optimization procedures.

Until now the best level of optimization (L4 in table) achieved was due to the good practice of the complete radiological process, including all from the moment an examination is asked to the final clinical report is issued.

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