

CURRENT STATE OF A DOSIMETRIC EVALUATION PROGRAMME IN DIAGNOSTIC RADIOLOGY INSTALLATIONS IN SPAIN

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INTRODUCTION

The Medical Physics Group at the School of Medicine of the Complutense University of Madrid, started a programme on the study of radiation doses in relation to Diagnostic Radiology in the area of Madrid in 1986, in cooperation with the Department of Health and Consumer Affairs, and several Madrid area hospitals as well as some Outpatient Centers.

In Spain, the National Health Service (NHS) (through the National Institute of Health, INSALUD), potentially cares for the health of approximately 94% of the population. This figure reaches 99% at the Community of Madrid. Radiological examinations are performed mainly in Hospitals and Outpatient Centers (the latter making up a first link in the patient's radiological diagnosis). Private Diagnostic Radiology is used by the remaining 6% of the population (not taking into account the population attended in military hospitals), and by patients who in spite of having access to NHS Diagnostic Radiology Services, prefer to choose the private sector for different reasons.

Besides the data we obtained during the first year of study from four large Madrid-area hospitals (and a few outpatient centers); we have used data furnished by the Department of Health and Consumer Affairs, the INSALUD (1, 2) and other sources (3).

Hospitals involved in the project serve 36% of the population of the Autonomous Community of Madrid (CAM). The data available from outpatient centers, refer to 31% of CAM population. Those from the private sector were obtained from 16 centers (according to the documentation presented at the CSN by these centers, for licensing of their corresponding installations) (4).

The studies and reports from the National Institute of Statistics (INE) enabled us to know the population values of the different Autonomous Communities, their age distribution and number of offspring, which made it possible to derive the child expectancy as a function of age (which we assumed identical for the whole of the Spanish territory, due to lack of better data sources) and to calculate the genetically significant dose (GSD).

NUMBER OF RADIOLOGICAL EXAMINATIONS

The number of annual examinations per 1000 inhabitants in the Autonomous Community of Madrid has been estimated from detailed information obtained up to present as the programme runs its course

and confirmed with film area used, together with the data from Outpatient Centers contributed by different sources (1, 3). This figure has been extrapolated to the rest of Spain from the data supplied by the INSALUD (2).

The following figures could then be established with this information:

a) Comm. of Madrid: 4 825 000 inhabit.(12.4% of the whole of Spain)

200 examinations/1000 inhabit./year	(in hospitals)
230 examinations/1000 inhabit./year	(in outpatient centers)
150 examinations/1000 inhabit./year	(in private sector)

TOTAL: 580 examinations/1000 inhabit./year
(not considering labor control, military or dental examinations)

b) Spain as a whole: 38 800 000 inhabitants

140 examinations/1000 inhabit./year	(in hospitals)
223 examinations/1000 inhabit./year	(in outpatient centers)
127 examinations/1000 inhabit./year	(in private sector)

TOTAL: 490 examinations/1000 inhabit./year
(not considering labor control, military or dental examinations).

FREQUENCY OF SOME EXAMINATIONS PER 1000 INHABITANTS

In order to perform the analysis of frequency of hospital radiological examinations, we mainly used data obtained from the San Carlos University Hospital (HUSC), since we considered it a center not presenting distortions with regard to its functioning and patient population served during the year of the analysis (1986). Also, this hospital has a very good data processing center which enabled us to compare through different routes, some of the data obtained.

Examination frequencies in Outpatient Centers were analysed using data from reference (3). A total number of 302 893 examinations/year referred to 9 outpatient centers in Madrid. For the private sector, data from the CSN were used (4) likewise some other information supplied by our colleagues.

PATIENT DOSE ESTIMATION

Information on over 60 000 hospital examinations with details of the technical parameters employed, operator and equipment involved, place where performed, patient sex and age, besides a smaller number of examinations performed in Outpatient centers and private offices were obtained during the first year of the project.

Using mean and range values of these parameters (kVp, mAs, screening time, etc.) measurements were made on exposure at skin level (without backscatter) in several rooms of the participating centers and for a large number of examination types (6), with properly calibrated ion chambers. In some complex examinations

(digestive tract, urinary tract, etc.), measurements of the area x exposure product were also performed, by using DIAMENTOR equipment from PTW-Freiburg. Absorbed dose (in muscle) values at the entrance were obtained in urography (7) by positioning on patient skin LiF TLD-100 chips from Harshaw. This type of measurements shall be completed shortly in a coordinated manner among some E.E.C. states.

Also, organ dose measurements have been initiated on a REMAB phantom from Alderson, especially designed for Diagnostic Radiology, utilizing between 40 and 100 TLD-100 chips, for dose estimations in each radiological examination. We have results from digestive tract examinations (following introduction of the corresponding contrast medium into the stomach), chest, conventional chest tomography, computerized tomography and urology.

With all this information and keeping in mind the variations recorded within the same center and between the different centers participating in the project, we have made an estimation (which should still be considered at the preliminary level and not as final result), of the organ doses (using phantom measurements and tables from Jones and Wall (8, 9). It can be concluded in a first estimation that the mean effective dose equivalent per radiological examination in the Madrid area is 1.81 mSv, that means 1.04 mSv per inhabitant and year (table 1). GSD values of 0.2 µGy for chest and 17 µGy for adult urinary tract examinations were also estimated.

TABLE 1

ESTIMATION OF EFFECTIVE DOSE EQUIVALENT FOR DIFFERENT MEDICAL DIAGNOSTIC X-RAY EXAMINATIONS IN THE COMMUNITY OF MADRID						
TYPE OF EXAMINATION	ESTIMATED EFF. DOSE EQUIVALENT (mSv) (a)	MEAN EFF. DOSE EQ. WEIGHTED BY FREQUENCY				
		Hospital (mSv)	Outpat. (mSv)	Private (mSv)	Total (mSv)	(%)
Skull	0.2	0.006	0.006	0.006	0.006	0.3
Spine	1.0	0.070	0.250	0.250	0.189	10.4
Chest	0.16	0.050	0.043	0.032	0.043	2.4
Abdomen	1.5	0.120	0.150	0.135	0.136	7.5
G.I. tract	10.2	0.255	1.020	1.122	0.781	43.1
Urology	7.0	0.105	0.210	0.210	0.174	9.6
Hip and pelvis	2.8	0.084	0.084	0.084	0.084	4.6
Extremities	0.1	0.015	0.014	0.020	0.016	0.9
CT	5.0	0.160	-----	0.100	0.080	4.4
Others	3.0	0.774				
	0.5		0.030	0.025	0.282	15.6
SUBTOTAL (mSv)		1.640	1.810	1.980	1.810	
EXAMINATION (%)		34%	40%	26%		
EFFECTIVE DOSE EQUIVALENT/INHABITANT				1.04 mSv		
(laboral, military and dental radiology not included)						

Assuming that the 1.81 mSv value can be extrapolated --once properly corrected with the percentages of hospital, outpatient and private radiology-- to the national whole (1.71 mSv), the 490 examinations/1000 inhabitants and year would imply 0.84 mSv/inhabitant and year in Spain.

The collective dose equivalent which would be attributed to Diagnostic Radiology in Spain would then be 32 510 man.Sv.

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