

**RADIATION PROTECTION PROCEDURE
NUMBER : 24**

**PROCEDURE FOR USE OF DIAGNOSTIC REFERENCE LEVELS
FOR RADIODIAGNOSIS¹**

Setting DRLs

The Radiation Protection Adviser (RPA) will act as the IRMER Medical Physics Expert with regard to Diagnostic Reference Levels (DRLs).

DRLs for standard procedures will be recommended by the RPA, for adoption by individual radiation departments. These will usually be based on national and/or European recommendations. The RPA will review these annually, and issue new DRLs when necessary.

Where departments believe that different DRLs are appropriate, this should be discussed with the RPA, clinical lead, Radiation Protection Supervisor (RPS), and departmental manager. Any deviations agreed should be documented, with the reasons for the change. A copy should be given to the RPA.

The DRLs included in this document are based on national recommended reference doses, and are expressed in terms of entrance surface dose, dose-area product, mean glandular dose, etc. It may be appropriate to derive "secondary" DRLs from these "primary" DRLs in more practical units for specific X-ray equipment (e.g. mAs, screening time). This may be done in consultation with the RPA.

Periodic Patient Dose Assessment

DRLs *"are not expected to be exceeded for standard procedures when good and normal practice, regarding diagnostic and technical performance, is applied."*² This can be checked using periodic patient dose assessments³ (or "dose survey") of a representative group of patients.

If the average dose from a periodic patient dose assessment is greater than the DRL then the RPS should investigate the reason for this and initiate corrective action where appropriate. Records of all survey results and investigations should be kept by the RPS.

Guidance on Undertaking Periodic Patient Dose Assessments

¹ As required by IR(ME)R 99, regulation 4(3)(c). This document may be adopted as the Schedule 1(g) Employer's Procedure.

² IRMER Schedule 1

³ IPEM/NRPB/RCR/CoR/BIR Diagnostic Reference Levels Working Party, The Newsletter of the Institute of Physics and Engineering in Medicine, 15 Nov. 2000 No 67

Conventional Radiography and Fluoroscopy

- Regular patient dose surveys should be performed in each X-ray unit for all standard radiodiagnostic examination performed in that room.
- The frequency of surveys will be determined by the RPS or departmental manager, in consultation with the RPA. The frequency should not be less than three yearly⁴
- Patient dose surveys should include at least ten patients, but preferably twenty.
- Patients should be selected who individually weigh between 60 kg (9 st 6 lb) and 80 kg (12 st 8 lb). For less frequent examinations the range may be extended from 50 kg (7 st 12 lb) to 90 kg (14 st 2 lb).
- The average patient dose should then be compared to the diagnostic reference level. If the average survey dose is greater than the reference level the RPS should investigate the reason for this and initiate corrective action where appropriate.

Mammography

- Regular dose surveys are performed as part of the Regional Mammography QA programme.

Dental X-Ray Examinations

- The DRL for intra-oral examinations is set at the cone end dose. That for panoramic examinations is set at the dose width product. These are measured annually as part of the Radiation Protection Survey. Values higher than the DRLs are highlighted to the RPS.

Angiographic & Complex Interventional Examinations

- The NRPB 2000 review of patient doses has recommended some reference dose values for complete examinations on adults, which will be considered for acceptance as DRLs at the next Department of Health DRL Working Party, due to meet in 2005.

C.T. Examinations

- The procedure will be similar to that for *Conventional Radiography and Fluoroscopy*.

⁴ IPEM Report 77, Recommended Standards for the Routine Performance Testing of Diagnostic X-ray Imaging Systems, PEM/CoR/NRPB

Paediatric X-Ray Examinations

- Currently, there is only limited guidance on DRLs for children. The situation will be kept under review by the RPA. Dose surveys (e.g. DAP or kV & mAs) should be undertaken in order to establish local DRLs.

Nuclear Medicine Examinations

- DRLs are set at the ARSAC activity limits. Therefore, a survey is not necessary.

DIAGNOSTIC REFERENCE LEVELS – CURRENT & PROPOSED

Examination		Reference value – Proposed as DRL. To be considered in 2005. Source (1)	
Lumbar Spine	AP	6 mGy ESD	1.6 Gy.cm ² DAP
Lumbar Spine	Lat	14mGy ESD	3.0 Gy.cm ² DAP
Lumbar Spine	LSJ	26 mGy ESD	3.0 Gy.cm ² DAP
Thoracic Spine	AP	3.5 mGy ESD	
Thoracic Spine	LAT	10 mGy ESD	
Cervical Spine	AP		0.4 Gy.cm ² DAP
Cervical Spine	LAT		0.4 Gy.cm ² DAP
Abdomen	AP	6 mGy ESD	3.0 Gy.cm ² DAP
Pelvis	AP	4 mGy ESD	3.0 Gy.cm ² DAP
Chest	PA	0.2 mGy ESD	0.12 Gy.cm ² DAP
Chest	Lat	1.0 mGy ESD	
Skull	AP	3.0 mGy ESD	
Skull	PA	3.0 mGy ESD	
Skull	Lat	1.5 mGy ESD	
Barium enema			31 Gy.cm ² DAP
Barium meal			13 Gy.cm ² DAP
Small bowel en			50 Gy.cm ² DAP
Barium swallow			11 Gy.cm ² DAP
Ba follow thro'			14 Gy.cm ² DAP
IVU			16 Gy.cm ² DAP

• *Mammography X-Ray Screening*

Examination	Reference value	Source
Screening	2 mGy MGD _s ⁵	(3)(8)

• *Dental X-Ray Examinations*

Examination	Reference value	Source
Mandibular molar	2 mGy ⁶	(4)
Panoramic	65 mGy.mm ⁷	(5)

⁵ Mean glandular dose for a standard breast model

⁶ Patient entrance dose free-in-air (i.e. spacer end dose without backscatter)

⁷ Dose-width product

• *Angiographic & Complex Interventional Examinations*

Examination	Reference value
	Source (1)
Biliary drainage/intervention	54 Gy.cm ² DAP
Femoral angiogram	33 Gy.cm ² DAP
Hickman line	4.0 Gy.cm ² DAP
Hysterosalpingogram	4.0 Gy.cm ² DAP
IVU	16 Gy.cm ² DAP
MCU – Micturating cystourethrogram	17 Gy.cm ² DAP
Nephrostogram	13 Gy.cm ² DAP
Nephrostomy	19 Gy.cm ² DAP
Retrograde pyelogram	13 Gy.cm ² DAP
Sialogram	1.6 Gy.cm ² DAP
T-tube cholangiogram	10 Gy.cm ² DAP
Venogram	5.0 Gy.cm ² DAP
Coronary angiogram	36 Gy.cm ² DAP
Oesophageal dilation	16 Gy.cm ² DAP
Angioplasty	17.4 Gy.cm ² DAP
Myelogram	28.6 Gy.cm ² DAP
Pacemaker (Permanent Insertion)	27 Gy.cm ² DAP

• *C.T. Examinations*

Examination	Reference value. Source (6)	
	CTDI _w ⁸	DLP ⁹
Routine head	60 mGy	1050 mGy.cm
Routine chest	30 mGy	650 mGy.cm
Routine abdomen	35 mGy	800 mGy.cm
Routine pelvis	35 mGy	600 mGy.cm

• *Paediatric X-Ray Examinations*

⁸ Weighted CT dose index

⁹ Dose-length product

Examination		Reference value. Source (7)	
		Infant	5 year old
Chest	AP ¹⁰	80 µGy ESD	-
	PA/AP	-	100 µGy ESD
	LAT	-	200 µGy ESD
Skull	PA/AP	-	1500 µGy ESD
	LAT		1000 µGy ESD
Pelvis	AP	200 µGy ESD	900 µGy ESD
Abdomen	AP/PA	-	1000 µGy ESD

Complete Examination	Reference value. Source (2)	
	Age(yrs)	DAP/exam
MCU	0	0.4 Gy.cm ² DAP
	1	0.9 Gy.cm ² DAP
	5	1.1 Gy.cm ² DAP
	10	2.1 Gy.cm ² DAP
	15	4.7 Gy.cm ² DAP
Barium Meal	0	0.7 Gy.cm ² DAP
	1	2.0 Gy.cm ² DAP
	5	2.0 Gy.cm ² DAP
	10	4.5 Gy.cm ² DAP
	15	7.2 Gy.cm ² DAP
Barium Swallow	0	0.8 Gy.cm ² DAP
	1	1.6 Gy.cm ² DAP
	5	1.3 Gy.cm ² DAP
	10	2.7 Gy.cm ² DAP
	15	4.6 Gy.cm ² DAP

Sources of DRLs

- (1) NRPB-W14, Doses to Patients from Medical X-ray Examinations in the UK – 2000 Review. Published June 2002. Tables 23 & 24.
- (2) --ditto-- table 25
- (3) Documents of the NRPB, Vol 10, No 1, 1999 - paragraph 53
- (4) --ditto-- paragraph 62
- (5) --ditto-- paragraph 65
- (6) --ditto-- table 11
- (7) --ditto-- table 13
- (8) Protocol for Quality Control of Mammography X-ray, etc. (Yorks. Region, Jan 98) - Appendix C7
- (9) IPEM/NRPB/RCR/CoR/BIR Diagnostic Reference Levels Working Party & Department of Health Diagnostic Reference Level Working Party – January 2000.
- (10) IPEM/NRPB/CoR, National Protocol for Patient Dose Measurements in Diagnostic Radiology, NRPB, 1992 (Table 3)

¹⁰ newborn