

DATAMED II  
Training Course  
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Patient dose assessment  
in fluoroscopy and interventional procedures

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# Content

Fluoroscopy guided diagnostic and therapeutic (interventional) procedures of interest in DATAMED II  
Technical and dose quantity of interest  
Effective dose: conversion coefficients  
Recommendations and pitfalls

**Table 3: Radiography/fluoroscopy (excluding interventional procedures)**

Region of body	Specific exam types	DOSE DATAMED exam categories	UNSCEAR 2000 categories
GI tract (Neck + chest + abdomen)	Oesophagus (Ba swallow) Stomach & duodenum (Ba meal) Small intestine (Ba follow) Enteroclysis (small intestine enema)	Oesoph. & stomach & small intestine	GI tract (upper)
	Colon (Ba enema)	Colon	GI tract (lower)
	Defecography	Defecography	
Biliary tract	Retrograde cholangiography Operative cholangiography Intravenous cholangiography T drain cholangiography Transhepatic cholangiography Endoscopic retrograde cholangio-pancreatography (ERCP) Retrograde pancreatography Cholecystography	Biliary tract	Cholecystography
Uro-genital tract	Intravenous urography (IVU)	IVU	Urography
	Retrograde pyelography Nephrostography	Kidneys & ureters	
	Retrograde cystography Micturitional cysto-urethrography (MCU) Urethrography	Bladder & urethra	
	Hysterosalpingography	Gynaecological	
	Spinal cord	Cervical myelography Thoracic myelography Lumbar myelography Sacral myelography Whole spine myelography	Myelography
Joints	Temporal-mandibular joint arthrography Shoulder arthrography Hip arthrography Elbow arthrography Wrist arthrography Knee arthrography Ankle arthrography	Arthrography	Included in Limbs & joints (Table 2)
<i>Angiography</i>	Cerebral angiography Petrous phlebography	Cerebral angiography	Cerebral angiography
	Coronary angiography (CA) - coronary arteries only - cor arts + L ventricle - cor arts + L ventricle + aorta Thoracic aortography	Cardiac angiography (angiocardiography)	Cardiac angiography
	Bronchial arteriography Pulmonary arteriography Upper venacavography	Thoracic angiography	All angiography (including cerebral & cardiac)
	Abdominal aortography Renal arteriography Mesenteric arteriography Lower venacavography Renal phlebography Suprarenal phlebography	Abdominal angiography	
	Pelvic arteriography Ovarian phlebography Spermatic phlebography	Pelvic angiography	
	Upper & lower limb arteriography Upper & lower limb phlebography	Peripheral angiography	

Fluoroscopy procedures from 225 specific types of examinations or procedures (RP154)

# Interventional procedures (RP154)

....  
+ every day new coming procedures

**Table 5: Interventional Radiology**

Region of the body	Specific procedure types	DOSE DATAMED procedure categories	UNSCEAR 2000 categories	UNSCEAR 2001 categories
Head & neck	Cerebral dilatation/stenting Cerebral embolisation (AVM, aneurysm, tumor) Cerebral thrombolysis Head & neck puncture	Cerebral interventions	All interventional	Cerebral
Chest	Coronary dilatation/stenting (PTCA)	PTCA	All interventional	Cardiac (PTCA)
	Cardiac pacemaker fitting (temporary or permanent)	Pacemaker		Cardiac
	Central venous line fitting	Hickman line		Vascular (non-cardiac)
	Cardiac thermo-ablation Valvuloplasty IVC (caval) filter fitting Oesophagus dilatation/stenting Thoracic dilatation/stenting  Thoracic embolisation Thoracic thrombolysis Thoracic region biopsy Electrophysiology	Other thoracic intervents.		Cardiac
Abdomen	Bile duct dilatation/stenting Bile duct drainage Bile duct stone extraction Renal artery dilatation/stenting Renal drainage Lithotripsy Nephrostomy	Biliary & urinary systems	All interventional	Other
	TIPS (liver)	TIPS		Vascular (non-cardiac)
	Abdominal dilatation/stenting  Abdominal embolisation Abdominal thrombolysis Abdominal region biopsy	Abdominal interventions		Other
Pelvis	Pelvic vessel dilatation Pelvic vessel embolisation Pelvic vessel thrombolysis	Pelvic interventions	All interventional	
Limbs	Upper limb dilatation Upper limb embolisation Upper limb thrombolysis Popliteal dilatation (behind knee) Lower limb dilatation Lower limb embolisation Lower limb thrombolysis Limbs biopsy	Limb interventions	All interventional	

# Procedures in the TOP20 list

## ***Radiography/Fluoroscopy***

8. Ba meal

9. Ba enema

10. Ba follow

11. IVU

12. Cardiac angiography

## ***Interventional***

20. PTCA

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225

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**Table A1.2 RADIOGRAPHY/FLUOROSCOPY (mostly involving use of contrast media)**

Exam Type	Specific exams included in 'Exam type'	Common Technique	Common indications
8. Ba meal	Ba meal (stomach & duodenum)	2-3 minutes fluoroscopy 5-20 images	Preoperative analysis for certain stomach lesions and for postoperative monitoring after gastric and oesophageal surgery
9. Ba enema	Ba enema (colon)	~2 minutes fluoroscopy 5-10 images	Inflammation, suspected tumour, control after surgery and for occlusive syndromes
10. Ba follow	Ba follow (small intestine) Small bowel enema	~5 minutes fluoroscopy 5-20 images	Small bowel disease (e.g. Crohn's disease, malabsorption syndromes)
11. IVU (Intravenous Urography)	IVU (kidneys, ureter and bladder)	Several AP radiographs after IV injection of iodine contrast medium	Haematuria, renal colic, infection of urinary organs, dilation of excretory organs, unexplained backache, urological tumour
12. Cardiac angiography	Coronary angiography Left or right ventriculography	~5 minutes fluoroscopy Several hundred images	Atheromatous arterial disease or coronary anomaly, spastic angina. Systolic or diastolic dysfunction. Mitral, tricuspid, aortic or pulmonary valve dysfunction.

**Table A1.4      INTERVENTIONAL PROCEDURES**

<b>Exam Type</b>	<b>Specific exams included in 'Exam Type'</b>	<b>Common Technique</b>	<b>Examples for indications</b>
20. Coronary angioplasty (PTCA)	PTCA	Catheter access via femoral or brachial artery, balloon inflation at constriction, stenting may be performed	Angina or painless myocardial ischemia in relation to one or several coronary lesions. Acute myocardial infarction.

# Technical and dose quantities

## **Fluoroscopy time and number of acquired images**

Not well correlated with patient dose

Good indicators of the complexity of the procedure, the skill of the operator and procedure protocol

## **KAP (DAP)**

Useful quantity for the assessment of effective dose

Good indicator of the complexity of the procedure, operator skill, procedure protocol and equipment performance

KAPfluoro and KAPimages can provide additional information the technique used

## **Cumulative incident air-kerma (Ki) at the IRP**

Useful quantity to monitor skin dose



# Recommendations

## Sample size:

Diagnostic procedures: 20-40 patient/installation

Therapeutic procedure: 40-100 patient/installation

Sample of hospitals

## Quantities:

To collect: Fluoro time, no.images, KAP

## Data analysis:

To assess for each installation:

- Median values are good indicators of typical procedure to compare with RLs or literature values
- Mean values are necessary for dose assessment
- Max/min is indicator of procedure variability (variability in pathologies, skills of operators, etc.)

To compare practice between installations:

- Compare median values
- (Assess national RLs)

# To calculate effective dose

Computational tools

(e.g. PCXMC –MonteCarlo, NRPB SR222, GSF, ...):

Require knowledge of irradiation geometry and radiographic parameters (kV, HVL, dose, field size, beam orientation and patient skin entrance point)

Good exercise (data collected manually or from DICOM objects – Dosimetry Report)

To use averaged conversion factors (procedure and patient body area dependent) - *recommended*

# Example: conversion coefficients for cardiac procedures

$$E = c * KAP$$

REF	PROCEDURE	N°	<KAP> (Gycm2 )	<E> (mSv)	<E/KAP>
Betsou et al., BJR, 71 (1998)	CA	86	30.4	5.6	0.18
Broadhead et al, BJR ,70(1997)	CA	2174	40.6	9.4	0.23
Lobotessi et al, RPD,94(2001)	CA	18	58.3	13	0.22
Leung et al, BJR 69 (1996)	CA	90	14	3.1	0.22
Ospedale di Udine	CA	1146	40.3	8.6	0.21
Betsou et al., BJR, 71 (1998)	PTCA	86	43.4	7.9	0.18
Broadhead et al, BJR ,70(1997)	PTCA	214	56.3	14.2	0.25
Ospedale di Udine	PTCA	516	66.5	14.3	0.21
Broadhead et al, BJR ,70(1997)	RF Ablation	81	95.1	17.3	0.18
<i>Ospedale di Udine (2006)</i>	<i>RF Ablation</i>	<i>12</i>	<i>45.7</i>	<i>8.2</i>	<i>0.18</i>
<i>Ospedale di Udine (2006)</i>	<i>PM/defibrillator</i>	<i>28</i>	<i>0.3</i>	<i>0.1</i>	<i>0.33</i>

# To calculate effective dose: recommended conversion coefficients (RP154)

**Table 10: Generalised E/DAP coefficients for radiographic/fluoroscopic examinations**

<b>Exam type</b>	<b>E/DAP (mSv/Gy cm<sup>2</sup>)</b>
1. Chest (PA + Lat) High kV Chest (PA + Lat) Low kV	0.18 0.10
2. Cervical spine	
3. Thoracic spine	0.19
4. Lumbar spine	0.21
6. Abdomen	0.26
7. Pelvis & hip	0.29
8. Ba meal	0.2
9. Ba enema	0.28
10. Ba follow	0.22
11. IVU	0.18
12. Cardiac angio.	0.2

# To play attention ...

## Frequency evaluation

Ba meal & barium enema & IVU: the procedure can produce more procedures (abdomen + Ba examinations or IVU) but dose is measured for the whole procedure

A cardiac therapeutic procedure can be registered as 1 CA + 1 PTCA. Is dose measured for the whole procedure?

Reimbursement system can affect frequency and dose evaluations

# To play attention ...

KAP values:

Is a common QC practice in the country to check the calibration of KAP meters?

For undecouch examinations is the table attenuation taken into account.

Typical attenuation factors are 10-20%

Are operators aware of the different dose unit provided by machines (Gycm<sup>2</sup>, mGym<sup>2</sup>, cGycm<sup>2</sup>, uGym<sup>2</sup>, etc ) and possible registration errors?

Is PACS/RIS dose value accuracy checked?

# Equipment without KAP meter ...

Median Fluoroscopy time and no. of acquired images allow to compare the practice with published or available data from other installations and assign appropriate KAP value to the installation  
Or, leave to the DATA MED group to assign the mean dose from the whole database

Good work !!!!!!!!!!!!!!!!