Radiation protection of patients and staff in diagnostic nuclear medicine and hybrid imaging

14:00 **S. Mattsson, Sweden**
Introduction of the topic

14:10 **A. Hosono, Japan**
Radiation protection challenges and trends in PET/CT

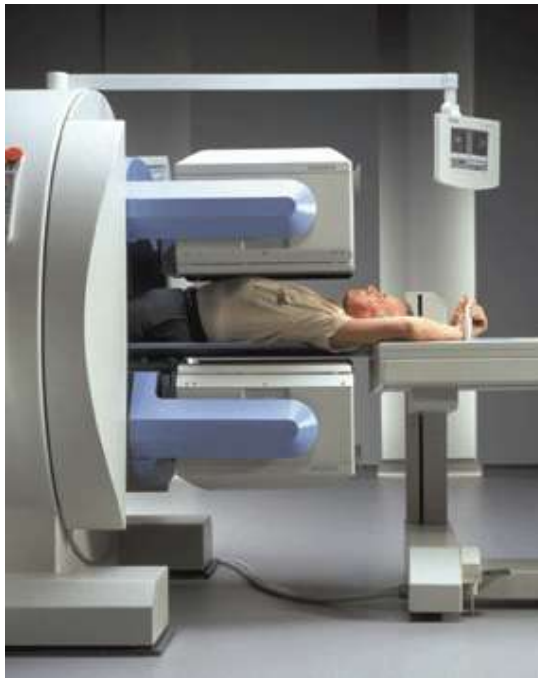
14:35 **D. Newman, ISRRT**
Dose reduction in nuclear cardiology

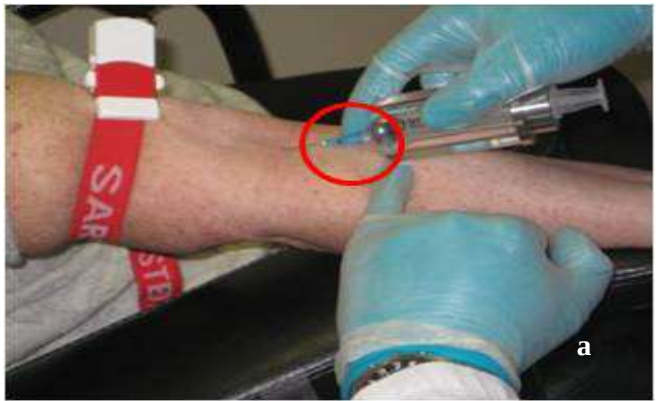
15:00 **F. Vanhavere, Belgium**
Assessing and reducing exposures to nuclear medicine staff

Summary of Contributed Papers:

15:25 **A. Rojo, Argentina**

15:50 **Discussion** 16.30





IAEA
International Atomic Energy Agency
Atoms for Peace

International Conference on Radiation Protection in Medicine
Setting the Scene for the Next Decade
Bonn, Germany, 3 - 7 December 2012

Radiation protection of patients and staff in diagnostic nuclear medicine and hybrid imaging

Introduction of the topic

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Nuclear medicine stands for a small number of investigations compared to diagnostic radiology

Examples:

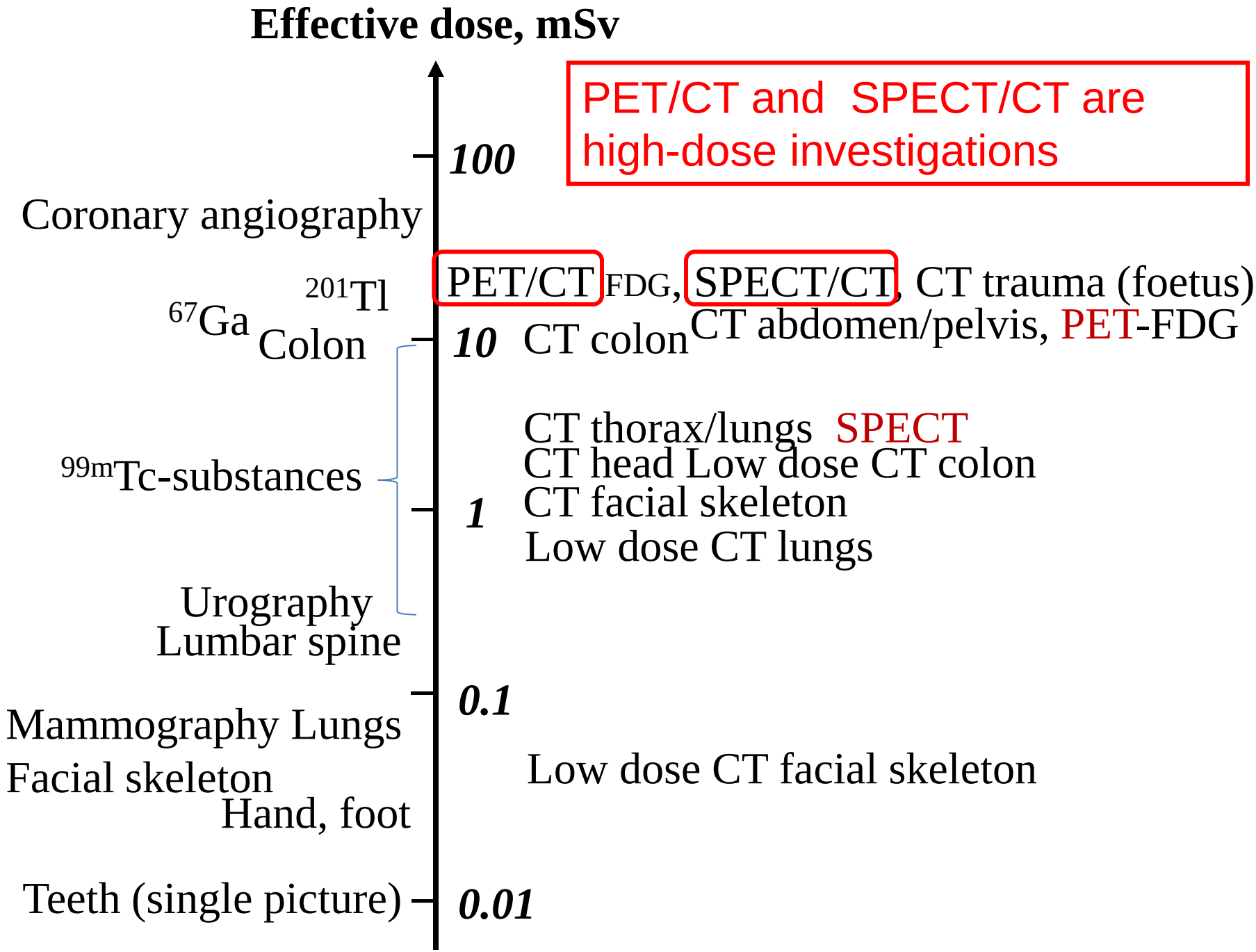
Globally (1997-2007): 1% of diagn radiol exams (35 milj./y)

Sweden (2005): 2%

USA (2006): 5% of investigations ⇨ 26% of collective dose

Nuclear medicine is expanding

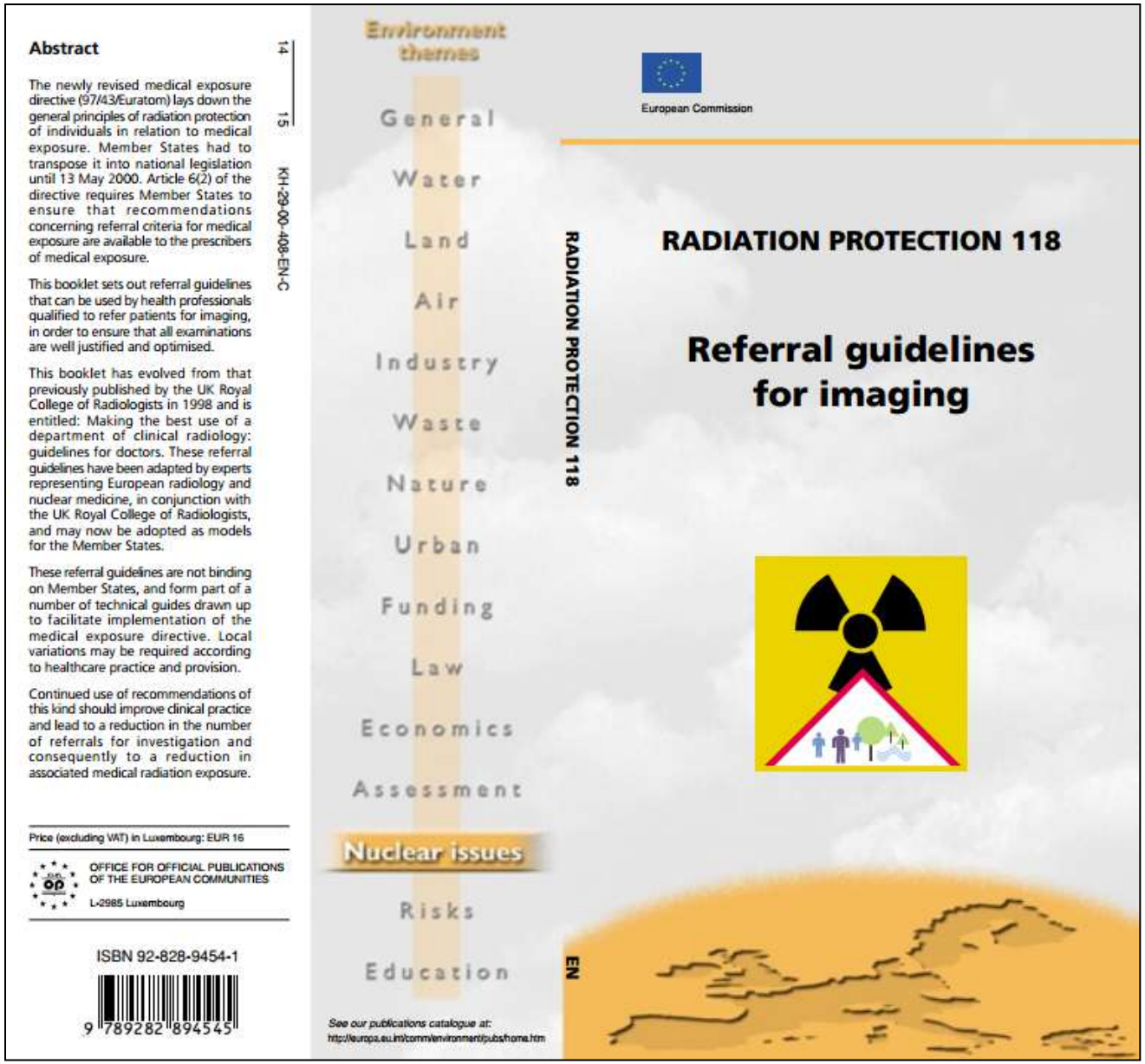
- Growing use of hybrid imaging; PET/CT and SPECT/CT (now also PET/MRI)
- Oncology and also neurological and cardiac diagnostic procedures
- Increasing use of radiotracers in surgical practices
- New radiopharmaceuticals (increasing importance of PET-substances and shortlived radionuclides)


Effective dose, mSv
PET/CT and SPECT/CT are high-dose investigations
100
Coronary angiography
PET/CT FDG, SPECT/CT, CT trauma (foetus)
201Tl
67Ga
Colon
10
CT colon
CT abdomen/pelvis, PET-FDG
CT thorax/lungs SPECT
CT head Low dose CT colon
99mTc-substances
1
CT facial skeleton
Low dose CT lungs
Urography
Lumbar spine
0.1
Mammography Lungs
Facial skeleton
Low dose CT facial skeleton
Hand, foot
Teeth (single picture)
0.01

Principles of radiation protection

- Justification
- Optimisation
- Dose limits (staff) and other constraints

Justification



Abstract

The newly revised medical exposure directive (97/43/Euratom) lays down the general principles of radiation protection of individuals in relation to medical exposure. Member States had to transpose it into national legislation until 13 May 2000. Article 6(2) of the directive requires Member States to ensure that recommendations concerning referral criteria for medical exposure are available to the prescribers of medical exposure.

This booklet sets out referral guidelines that can be used by health professionals qualified to refer patients for imaging, in order to ensure that all examinations are well justified and optimised.

This booklet has evolved from that previously published by the UK Royal College of Radiologists in 1998 and is entitled: Making the best use of a department of clinical radiology: guidelines for doctors. These referral guidelines have been adapted by experts representing European radiology and nuclear medicine, in conjunction with the UK Royal College of Radiologists, and may now be adopted as models for the Member States.

These referral guidelines are not binding on Member States, and form part of a number of technical guides drawn up to facilitate implementation of the medical exposure directive. Local variations may be required according to healthcare practice and provision.

Continued use of recommendations of this kind should improve clinical practice and lead to a reduction in the number of referrals for investigation and consequently to a reduction in associated medical radiation exposure.

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RADIATION PROTECTION 118

European Commission

RADIATION PROTECTION 118

Referral guidelines for imaging

EN

Optimisation (I): Image quality

Methods for Characterising and Evaluating **Image Quality**
Two methods for evaluating image quality:

A. Physical characteristics (can be measured or calculated)

1. Spatial Resolution
2. Contrast
3. Noise

B. Observer performance studies (subjective evaluation):

- Visual inspection of images

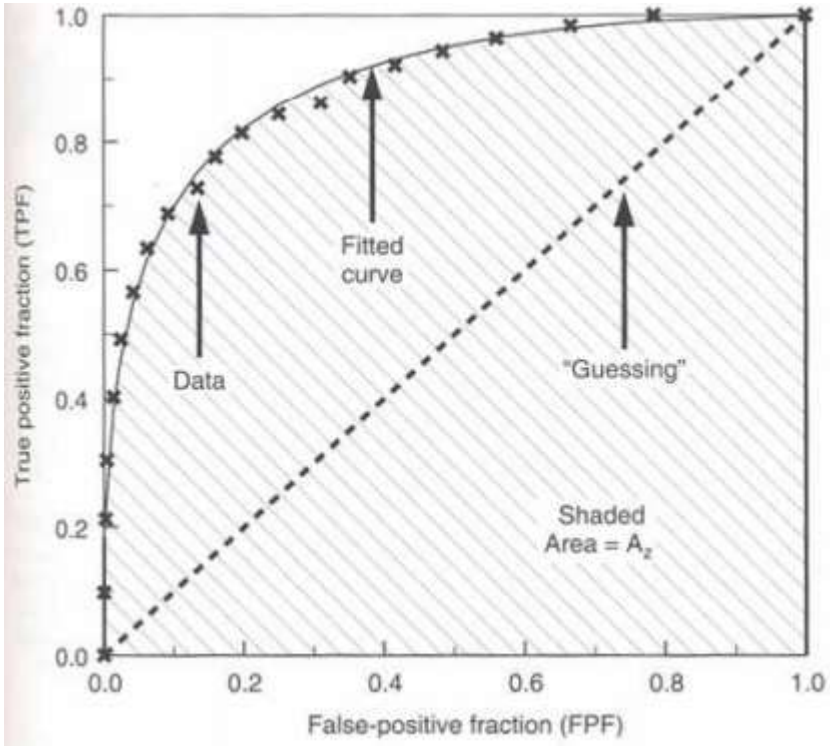
1. Contrast – detail phantom studies
2. Receiver Operating Characteristic (ROC) Studies

ROC studies

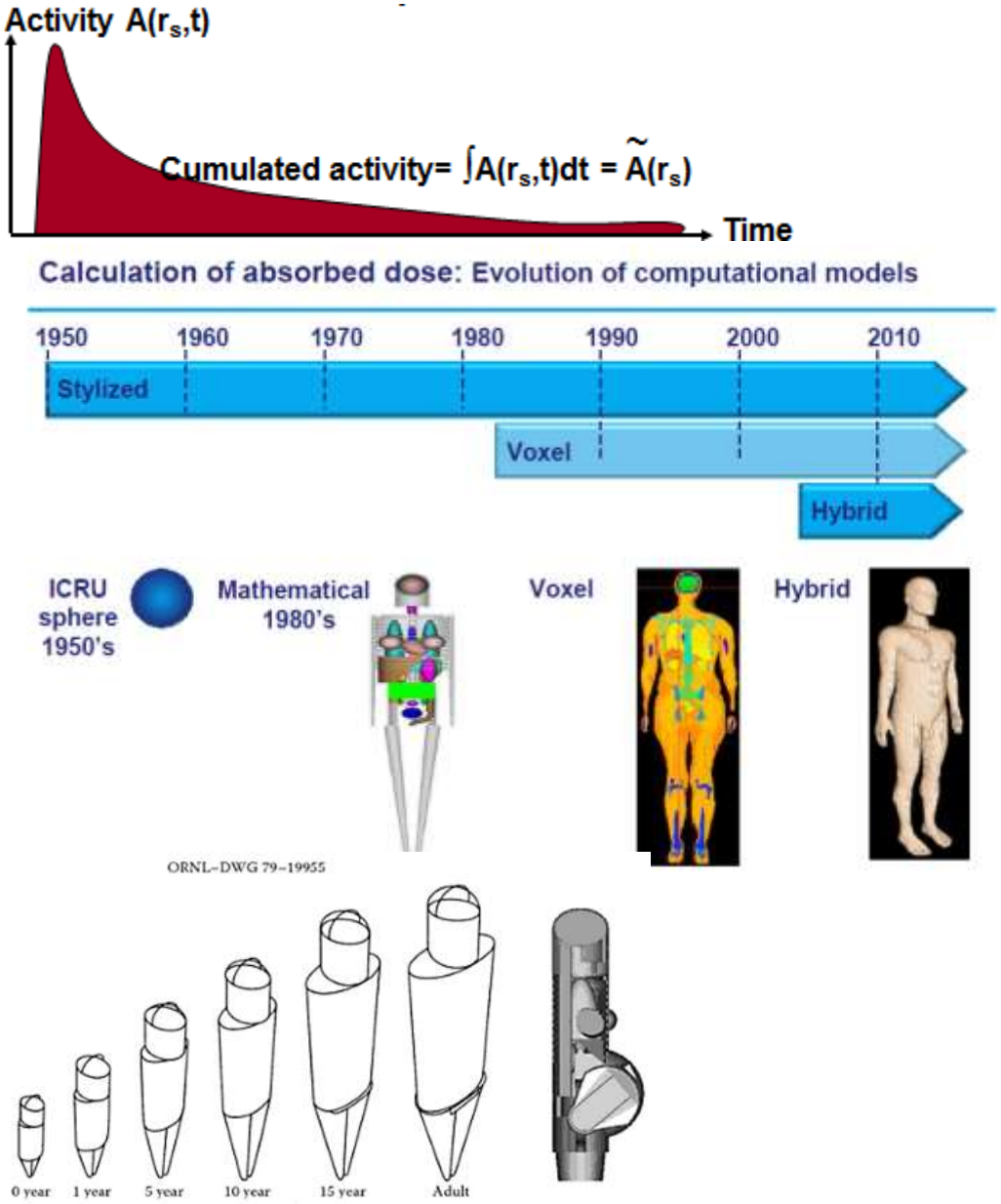
True status (S)	Test result (T): Positive (+)	Test result (T): Negative (-)
Disease (+)	TP	FN
No disease (-)	FP	TN

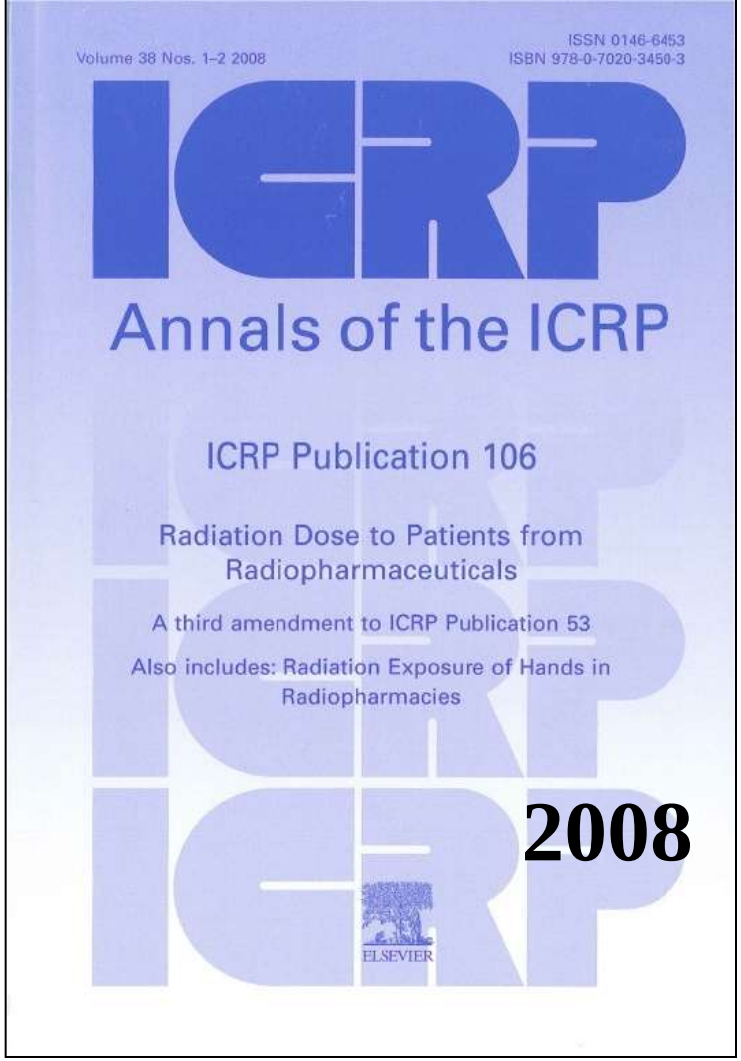
Sensitivity= TP/TP+FN

Specificity= TN/TN+FP



Optimisation (II): Dose





ICRP Publication 106 (A third amendment)

33 radiopharmaceuticals in current use. Recommendations on breast feeding interruptions.

Typical mean whole body foetal doses

Radio-nuclide	Procedure (substance)	Adm. Activity MBq	Early pregnancy mGy	Nine months mGy
^{99m}Tc	Bone (phosphate)	750	4.7	1.8
^{99m}Tc	Lung perfusion (MAA)	200	0.5	0.8
^{99m}Tc	Lung ventilation (aerosol)	40	0.2	0.1
^{99m}Tc	Thyroid (pertechnetate)	400	3.8	3.7
^{99m}Tc	RBC	930	4.8	2.5
^{99m}Tc	Liver (colloid)	300	0.6	1.1
^{99m}Tc	Renal function (DTPA)	750	5.9-9.0	3.5
^{67}Ga	Abscess/tumour (citrate)	190	16	25
^{123}I	Thyroid uptake (iodide) [1)]	30	0.5	0.3
^{131}I	Thyroid uptake (iodide) [1)]	0.55	0.04	0.15
^{131}I	Metastases (iodide) [1)]	40	2.5	11

Pregnancy

[1)] Foetal thyroid doses are much higher than foetal body doses, viz. 5-15 mGy/MBq for ^{123}I and 0.5-1.1 Gy/MBq for ^{131}I

Breast feeding - Interuption after a nuclear medicine investigation

Radiopharmaceutical	Interruption
^{14}C-labelled	
Triolein	No
Glycocholic acid	No
Urea	No
^{99m}Tc-labelled	
DISDA	No[*,†]
DMSA	No[*,†]
DTPA	No[*,†]
ECD	No[*,†]
Phosphonates (MDP)	No[*,†]
Gluconate	No[*,†]
Glucoheptonate	No[*,†]
HM-PAO	No[*,†]
Sulphur colloids	No[*,†]
MAA	12 h
MAG3	No[*,†]
MIBI	No[*,†]
Microspheres (HAM)	12 h
Pertechnetate	12 h
PYP	No[*,†]
RBC (in vivo)	12 h
RBC (in vitro)	No[*,†]
Technegas	No[*,†]
Tetrofosmin	No[*,†]
WBC	12 h

Breast feeding

ICRP Publ 106

Radiopharmaceutical	Interruption
I-labelled	
^{123}I-BMIPP	>3 weeks[‡,§]
^{123}I-HSA	>3 weeks[‡,§]
^{123}I-iodo hippurate	12 h
^{123}I-IPPA	>3 weeks[‡,§]
^{123}I-MIBG	>3 weeks[‡,§]
^{123}I-NaI	>3 weeks[‡,§]
^{125}I-HSA	>3 weeks[‡]
^{125}I-iodo hippurate	12 h
^{131}I-iodo hippurate	12 h
^{131}I-MIBG	>3 weeks[‡]
^{131}I-NaI	>3 weeks[‡]
Others	
^{11}C-labelled	No[¶]
^{13}N-labelled	No[¶]
^{15}O-labelled	No[¶]
^{18}F-FDG	No
^{22}Na	>3 weeks[‡]
^{51}Cr-EDTA	No
^{67}Ga-citrate	>3 weeks[‡]
^{75}Se-labelled agents	>3 weeks[‡]
^{81m}Kr-gas	No
^{111}In-octreotide	No
^{111}In-WBC	No
^{133}Xe	No
^{201}Tl-chloride	48 h

IF YOU ARE BREAST- FEEDING, PLEASE NOTIFY THE STAFF BEFORE YOU HAVE YOUR INJECTION FOR THE NUCLEAR MEDICINE EXAMINATION

Thank you for listening!

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