The introduction of Patient Dosimetry in Belgium

BVS-ABR Training Day

ALARA in the medical world

20/06/2008

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Patient dosimetry in Belgium

1. Why patient dosimetry ?
2. Belgian regulatory framework
3. Practical implementation
4. Preliminary results
5. Conclusions

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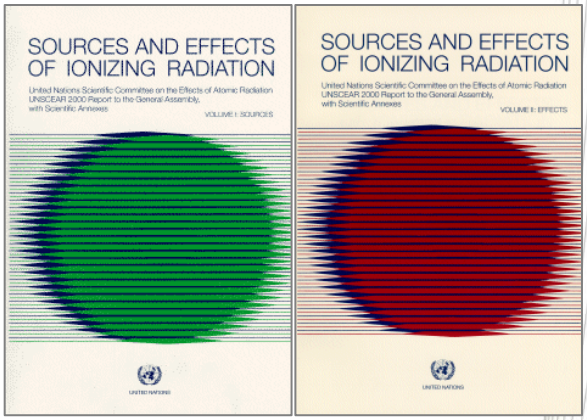
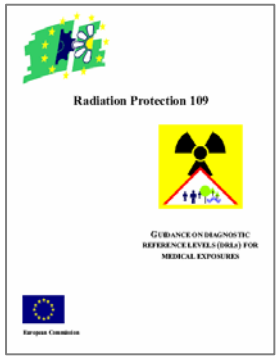
Patient dosimetry : why ?

- Contribution of medical to population dose
- Increasing number of radiological examinations (new techniques vs. conventional)
- New HD Techniques : CT, interventional RL, interventional CT, virtual CT colonography, CT coronarography,...
- Belgium : top of the world...
- Still a lot of optimization possible





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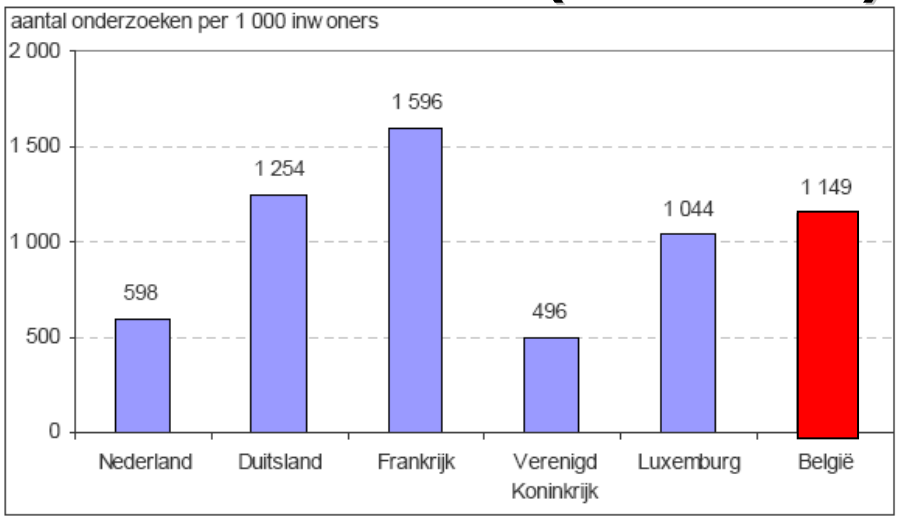
Number of radiology exams
(per 1000 inhabitants)

Unscear 1993 (1985-1990)
health care level I countries

Belgium	**1290**
Japan	1160
W.-Germany	1030
France	990
USSR/Russ.Fed.	990
Luxemburg	810
USA	800
Norway	640
Spain	570
Netherlands	530
Sweden	520
UK	480

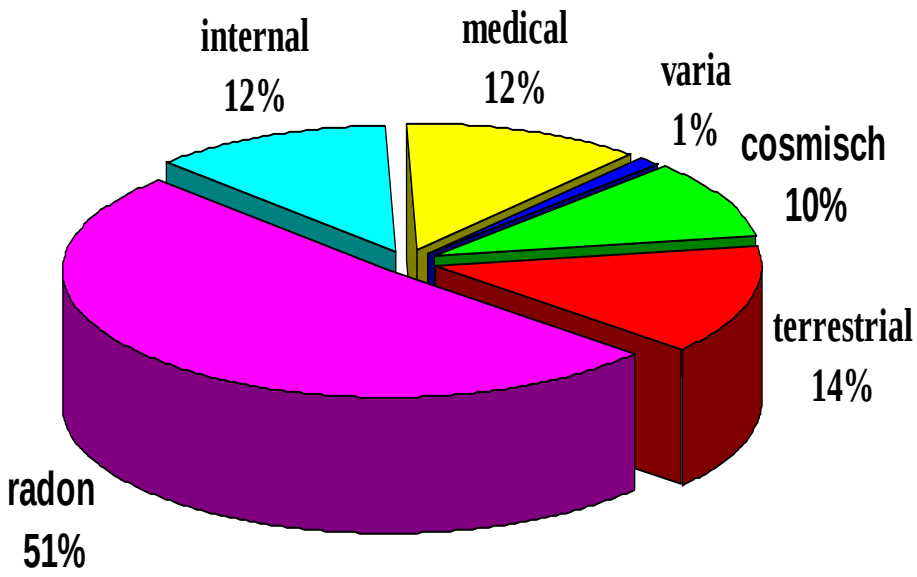
Mira 2007
based on UNSCEAR 2000 and RIZIV 2000 (1991-1995)



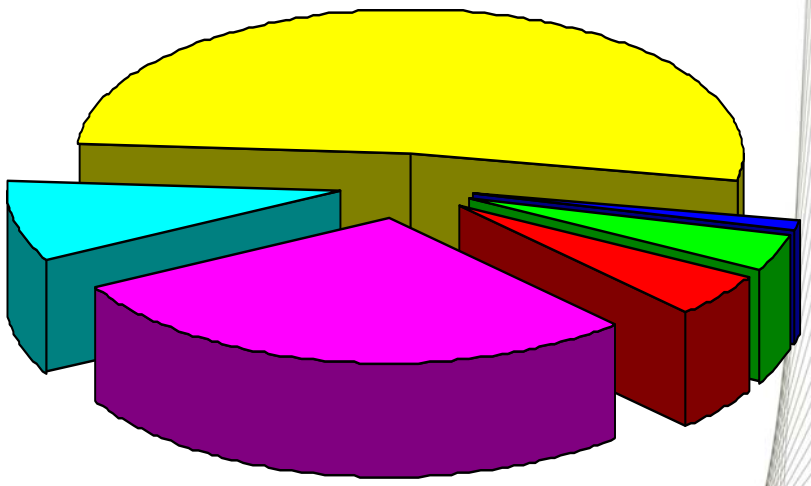
Bron: UNSCEAR, 2000 en RIZIV, 2000.

Contribution of medical to population dose

EU 1993



Belgium 2003



Publication of the High Council for Health (BE) n□8080 on CT

(dec.2006, data from MIRA 2005, RIVM/ims 2006, Hart 2004, Aroua 2002)

	BE (2003)	NL (2002)	UK (2002)
# RL examinations (per 1000 inhabitants)	1113	515	379
Contribution CT (%)	11	8	7
# NM examinations (per 1000 inhabitants)	54	18	9
Mean medical dose/inhabitant (mSv/y)	2.0	0.54	0.38

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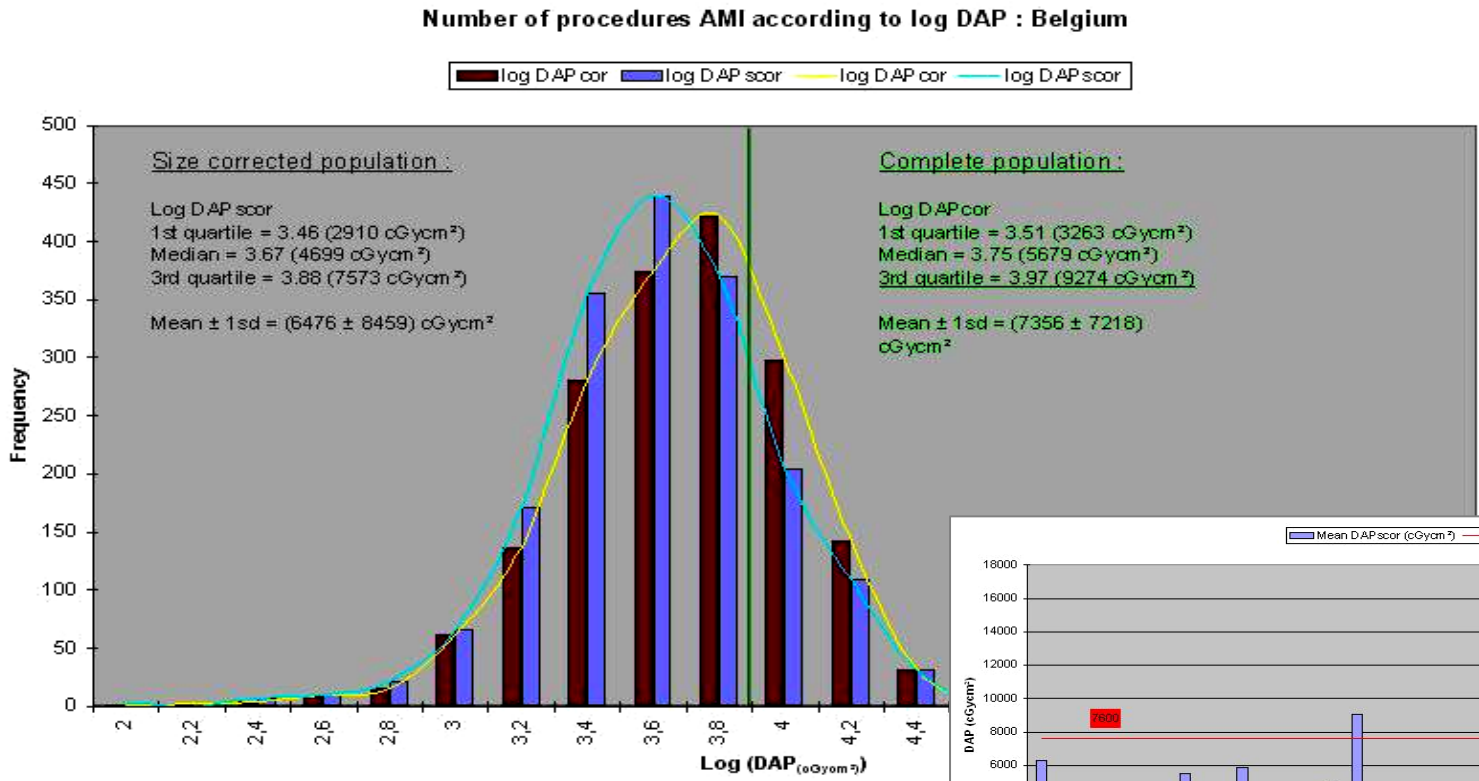
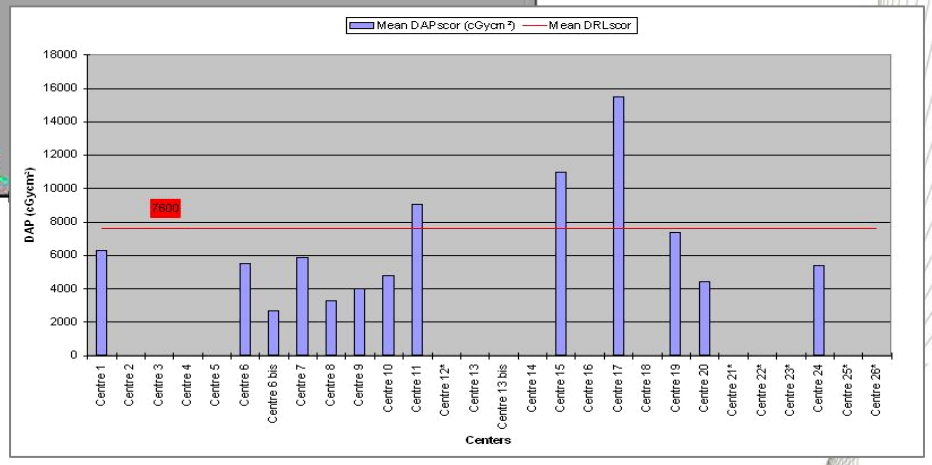
First multi centre study to investigate high-dose X-ray procedures in Belgium (2003-2006)





Angiography of the lower limbs

(M.-T. Hoornaert, H. Bosmans et al.)

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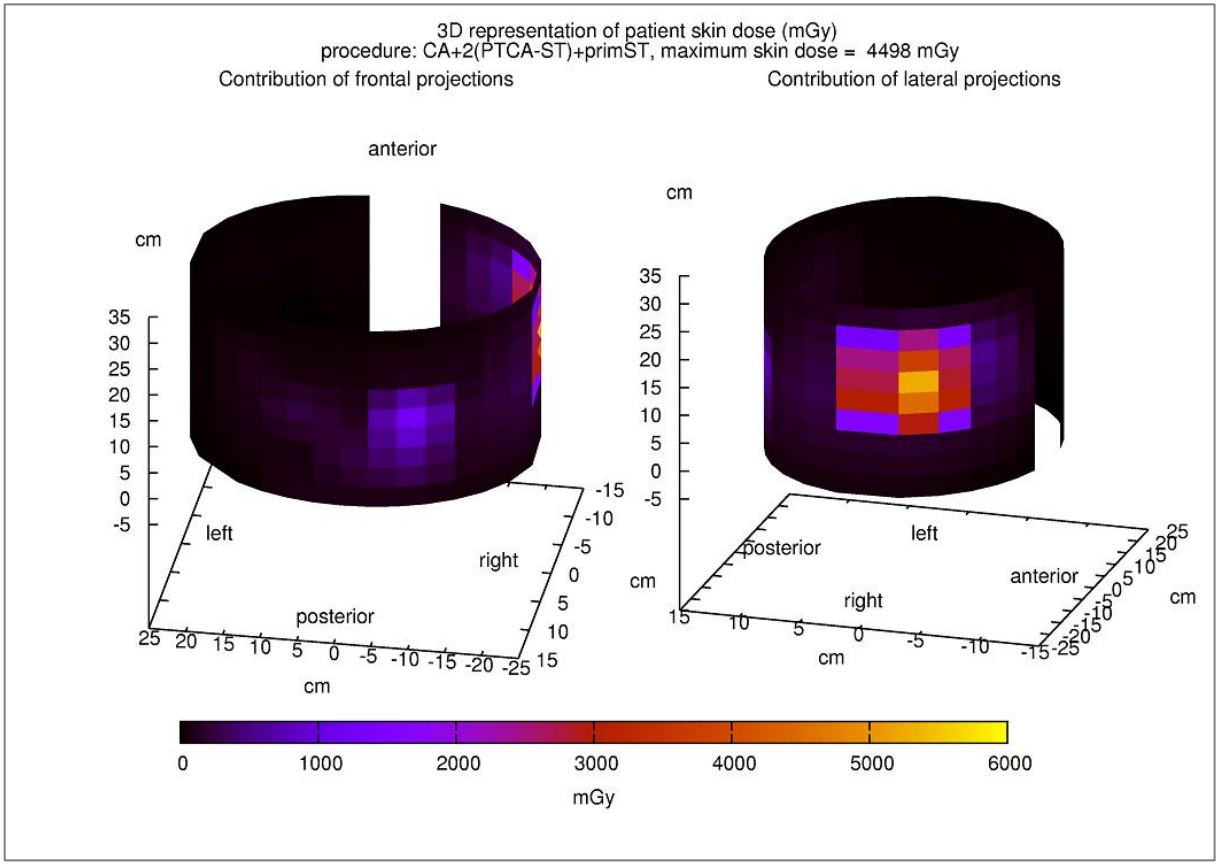
First multi centre study to investigate high-dose X-ray procedures in Belgium (2003- 2006)



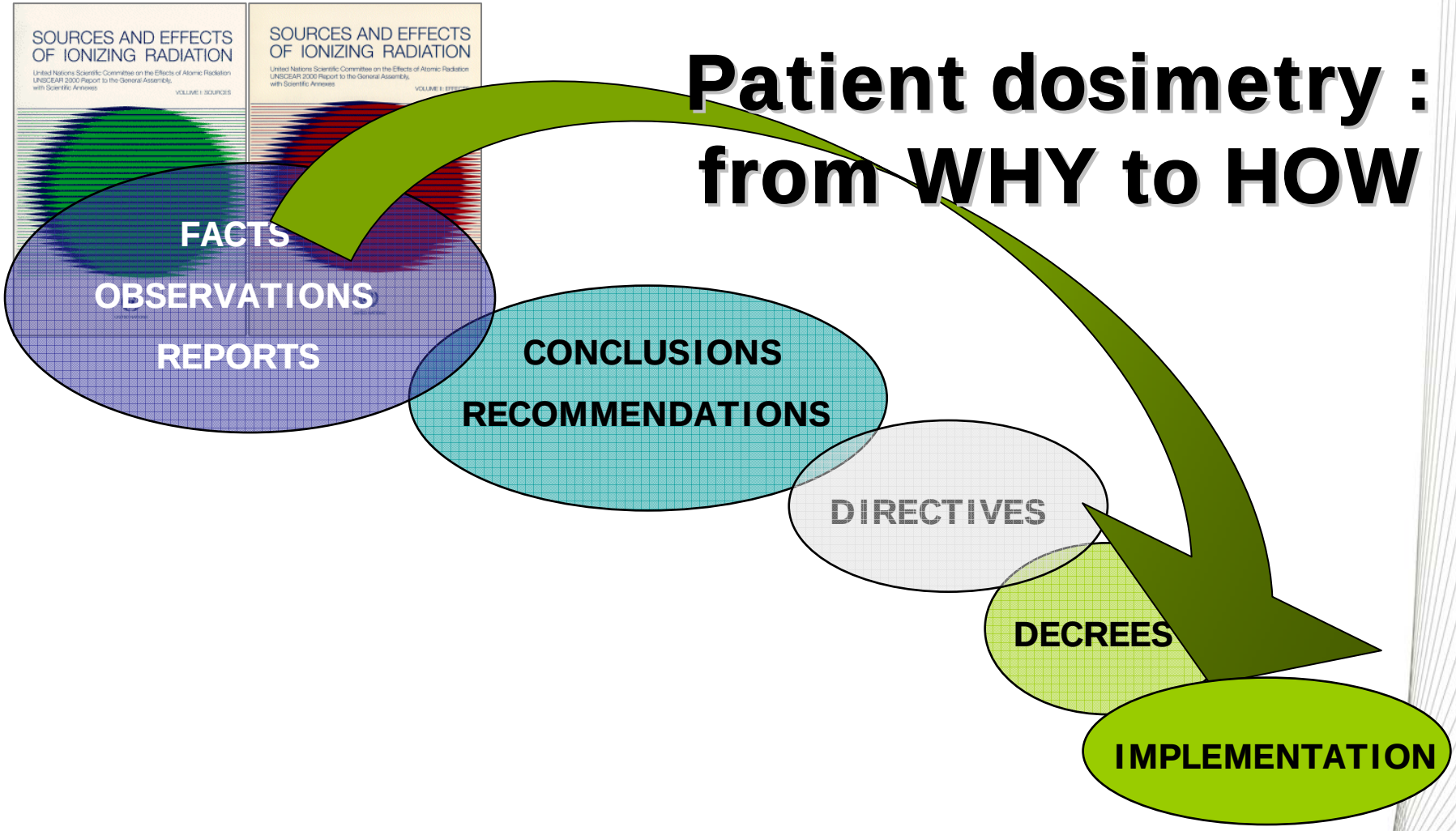
Skin Dose can be high

Correlation with
- complexity of procedure
- physician in training

But also
- fluoroscopy time
- distance skin-II

(E. Bogaert, K. Bacher, H. Thierens)

Patient dosimetry : from WHY to HOW



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Belgian Regulatory Framework : Royal Decree of July 20, 2001

clinical responsibility :
- Justification
- Optimization
- clinical evaluation of outcome
- share information
- inform about risks

Practitioner

- Collaborate in patient related dosimetry
- participate in patient dose optimization

MPE

Responsibilities
Roles

QA programs
Evaluate mean dose
- Examinations
- Frequency
- procedures

Operator

protection of patients
regulatory framework for
- measuring the dose
- national DRLs
- procedures

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Royal Decree of July 20, 2001

Daily optimization and evaluation of individual doses

- **All radiodiagnostical equipments for persons (except IO and DEXA) shall be equipped with an adequate « system » that allows to evaluate the patient dose integrated during the radiological procedure, provided such a system is available on the market (Art. 51.6.2)**

- **All doses due to medical radiological exposures shall be kept as low as reasonably achievable (ALARA) consistent with obtaining the required diagnostic information, taking into account economic and social factors (Art. 51.2.1).**

- **The medical responsibility of a practitioner includes justification and optimization (Art. 50.1). The optimization process includes among others the evaluation of the doses administered to the patient (Art. 51.2.5).**

Royal Decree of July 20, 2001

Periodic dose studies

- **For radiodiagnostic examinations, the most appropriate available diagnostic reference levels (DRL) shall be used (Art. 51.2.2)**
- **DRL : dose levels for typical examinations for groups of standard-sized patients (or standard phantoms). These levels are not to be exceeded for standard procedures when good and normal practice is applied, regarding diagnostic and technical performance (GMP, « good medical practice ») (Art. 50.1). When exceeded, corrective actions have to be undertaken after investigation (Art. 51.2.2)**
- **In order to compare with DRLs, the operator makes sure that the mean patient dose is determined for the types of examinations, the time intervals and following the procedure defined by the FANC.**

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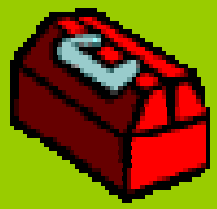

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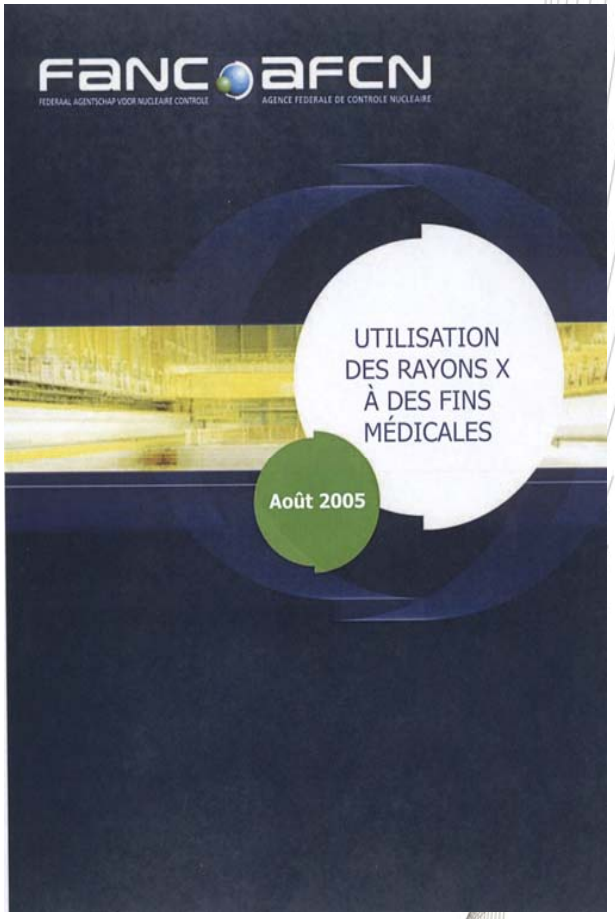
Patient Dosimetry
FANC Directives

- Realized in consultation with the Consilium Radiologicum, and, for the methodology, with the working group radiology of the BVZF/SBPH
- Published as annex of the brochure "vade-mecum Use of X rays for medical purposes", (available on www.fanc.fgov.be)
- Published in the Official Gazette (12/10/06)
- In order to define :

  1. for the dose studies:
     - frequency
     - Types of examinations
     - Methodology
     - Roles
  2. for the individual dose evaluations
     - Types of examinations
     - Methodology
     - Roles



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Objectives
of Patient Dosimetry

1. Retrospective evaluation of individual dose

2. Prevent deterministic effects

3. Optimize the dose

Patient oriented ♊ Repression tool

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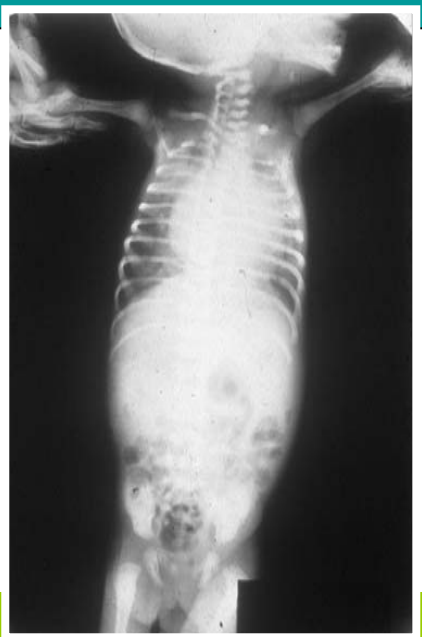
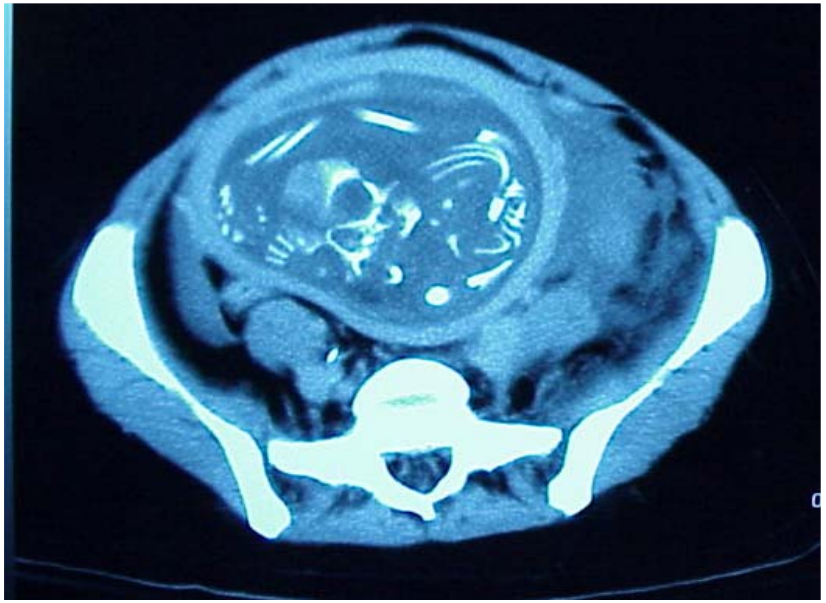
Patient dosimetry in radiology
Objectives

1. Restrospective evaluation of individual dose

- Method : DAP or alternative method
- Registering requirements :
  - children (<15 y) : always registrer the relevant parameters for RX of head/trunc/pelvis
  - Adults : for all HD examinations : parameters in DICOM-header or logbook
  - Sensitive organs : uterus and/or gonads (RX lumbar spine, abdomen, pelvis)





Patient dosimetry in radiology

Objectives

2. Prevent deterministic effects

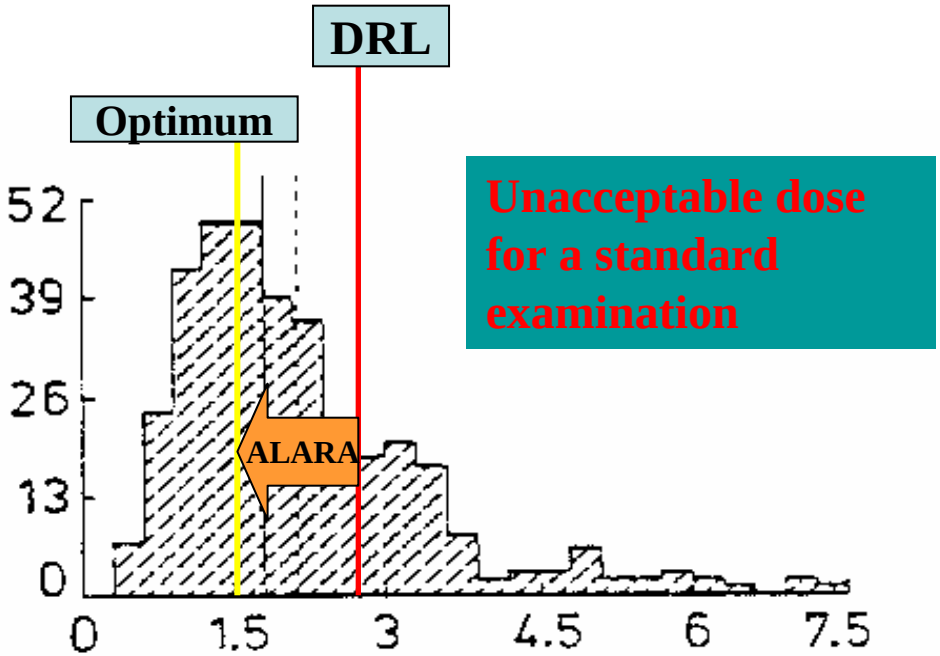
- on-line measurements for HD applications (intervential radiology)
- use of " trigger values" or "warning levels"

Patient dosimetry in radiology

Objectives

3 Optimization of the dose

- Is an element of **quality assurance**
- how ? compare **mean dose** for a given **type of examination** in a **certain centre** with the diagnostic reference level (**DRL**)



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Patient dosimetry in radiology

Three-yearly dose studies

Objective :

- Determine the dose precisely : MPE
- Eliminate bad pratices (> DRL)
- Optimize procedures (< DRL) and adapt written procedures

How ?

- DAP or TLD (CT : integrated system, mammography : specific method)

Who ?

- Method validated by MPE, rest of the process supervised by MPE
- Forms to be filled in by local staff : technologist, nurse

Number of examinations :

- Simple exam, CT : 50 successive patients or all patients during 3 months
- Dynamic, HD : 20 successive patients or all patients during 3 months

Which examinations ?

- See list 1st year + list next years (>1 examination/month)

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Patient dosimetry in radiology

Three-yearly dose studies
List of examinations

Periodic dose studies (3-yearly)

- Simple RX examinations children (< 15 y)
- Simple RX examinations adults
- HD and dynamic examinations (children + adults)
- CT (children + adults)

List for the 1st year :

Adults:

- RX lumbar spine
- RX pelvis
- CT skull, abdomen, thorax

Children:

- RX thorax and thorax-abdomen (incl. neonatologie <3 months)
- Cystography
- RX stomach (reflux examination)
- CT skull

Patient dosimetry in radiology

Three-yearly dose studies
Registration forms

ANNEXE 3. **Formulaire d'enregistrement des données relatives à la dose aux patients - examens radiologiques simples (y compris la fluoroscopie pour positionnement) sur un minimum de 50 patient par procédure ou pendant 3 mois (études de dose triennales**

Numéro de salle : ..... Numéro de téléphone : ..... E-mail : .....

RESET DAP après chaque examen ! Type de DAP : ..... Date de calibration (DAP) : .....

N°	Date JJ/MM/AA	Patient m/f	âge	poids (kg)	taille (m)	Examen	Sub	Scopie (o/n)	kV*	mAs*	DAP .....**	SSD*** (cm)	Champ****	Nombre clichés	Initiales	Remarques
1																
2																
3																
4																
5																
6																
7																

*Valeur des kV et mAs de la graphie, pas de la scopie
**Unité à compléter, p.ex. cG.cm²
***Source skin distance (distance foyer-peau) : obligatoire
****Champ : surface irradiée (x cm X y cm)

now available in excel format on

www.fanc.fgov.be

Home > Reglementering > Juridische database > Richtlijnen

Home > Reglementering > Juridische database > **Formulieren**

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What to do with the registered data ?

- **MPE : determines mean dose + median**
  - per apparatus
  - per type of examination

➡ **Feedback to the service/centre**
  - conclusions, interpretations, propositions

- **Feedback to the FANC : further exploitation of the data**
  - Collective dose
  - National DRLs

Patient dosimetry in radiology

Individual dose evaluations

Objective :

- Prevent deterministic effects (HD applications)
- Determine or estimate the individual dose
- Optimize procedures and adapt written procedures

How ?

- DAP
- Alternative methods for simple examinations (air kerma, CR specific exposure parameter, strict procedures, film-screen system)
- Alternative method for HD examinations : calculation of ESD

Who ?

- Method validated by MPE

Which examinations ?

- Simple RX examinations children head/trunc/pelvis (< 15 y) : individual retrospective evaluation
- Simple RX examinations adults : retrospective evaluation for specific situations (ex. RX abdomen pregnant woman)
- HD and dynamic examinations (children + adults) : on-line measurement
- CT (children + adults) : individual retrospective evaluation (integrated system or procedures)

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Preliminary results

Results of the 1st year

- at this moment 15% of the centers have sent their data
- not enough data yet to draw statistically sound conclusions

Active cooperation from

- the Consilium radiologicum
- the MPEs
- the local staff

Preliminary results

Example 1 : Thorax PA

- Adult
- Simple examination

- 1168 patients, of which
  - 852 for whom weight is registered (mean weight 71,47 kg)
  - 124 « standard patients » (70 3 kg) (mean weight 71,16 kg)
- 19 rooms
- 14 centers

European DRL : 1 Gy.cm² for complete examination
French DRL : 25 cGy.cm²
French procedures : mAs 1.5 – 3
kV 125 (115 - 140)

(NB the french DRL has been determined for this incidence, based on the DRL in terms of ESD)

Example 1 : Thorax PA

		kV	mAS	DAP (cGy.cm²)
All patients	Min	100	0.74	0.9
	Max	125	23.7	375.1
	Mean	113.4	2.3	34.1
	75th perc			33.9
70 ± 3 kg	Min	108	1	1.3
	Max	125	7.98	338.7
	Mean	115.3	2.3	38.5
	75th perc			36.5

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Preliminary results

Example 2 : Thorax P

- Adult
- Simple examination

- 776 patients, of which
  - 630 for whom weight is registered (mean weight 72,43 kg)
  - 124 « standard patients » (70 □ 3 kg) (mean weight 69,01 kg)
- 14 rooms
- 11 centers

European DRL : 1 Gy.cm^2 for complete examination
French DRL : 100 cGy.cm^2
French procedures : mAs 1.5 – 3
kV 125 (115 - 140)

Example 2 : Thorax P

		kV	mAS	DAP (cGy.cm²)
All patients	Min	108	1	2.61
	Max	125	96.6	722.2
	Mean	118.6	8.2	72.7
	75th perc			87.4
70 ± 3 kg	Min	108	1	8.8
	Max	125	26	435.6
	Mean	119.3	6.7	75.3
	75th perc			79.0

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Example 3: Thorax F+P

Example 3 : Thorax F+P

- Adult
- Simple examination

- 575 patients
- 5 rooms
- 5 centers

European DRL : 1 Gy.cm² for complete examination
No French DRL

All patients

	DAP (cGy.cm²)
Min	8.0
Max	630
Mean	101.6
75th perc	127

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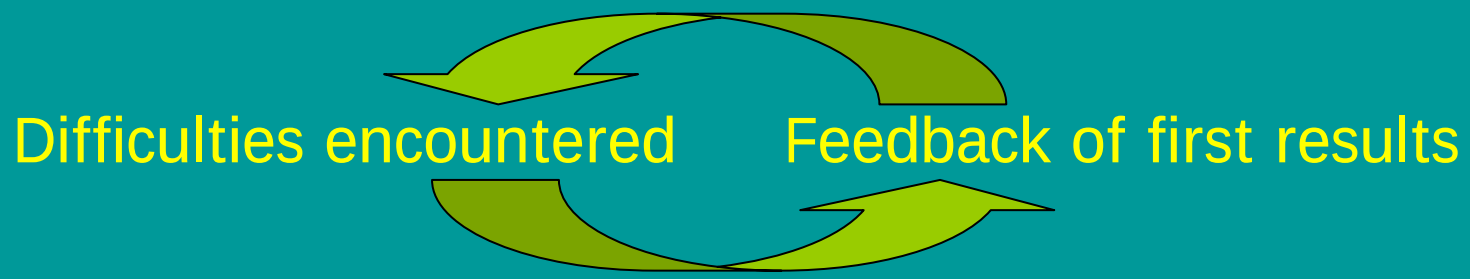
Stakeholder involvement

Feedback to the stakeholders

- **May 30, 2008 : mutual feedback meeting FANC - MPEs**



- **Autumn 2008 : Round Table Radiology**

Stakeholder involvement

Feedback from the MPEs

- Some parameters difficult to incorporate in automated data collection (ex. weight)
  - Large data sets without weight could complement obligatory data sets with weight
  - Second iteration : forms could be simplified based on experiences
- Final aim of patient dosimetry
  - NOT a repression tool but an optimisation tool !
- Involvement of MPEs in process (DRLs,…)

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Conclusions

Introduction of radioprotection in general and patient dosimetry in particular in the medical world is not « a piece of cake »

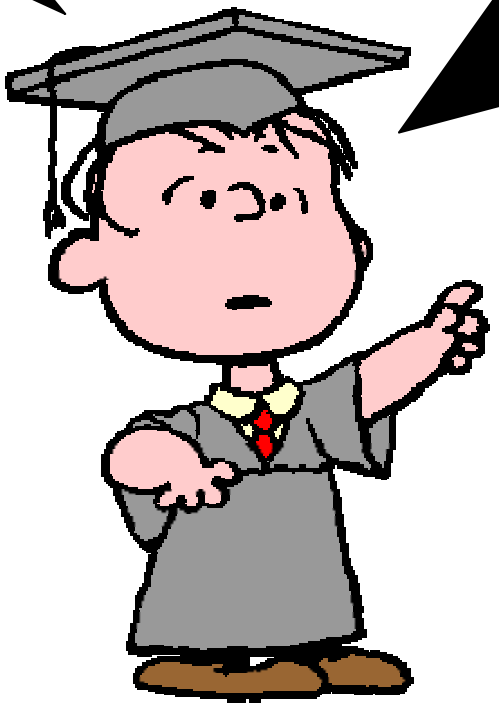
BUT progressively, this sector is becoming more conscious of the risks related to exposure to radiation, and the factor «dose due to medical exposure» is taken into account in their daily practice

ALARA is not an issue of authorities or scientists, it is the issue of ALL people involved

Today's efforts imply a direct benefit to the thousands of patients that pass a radiological examination !

Introduction of patient dosimetry in Belgium

Thank you for your attention



But even more thanks for the efforts of
-Physicists
-Radiologists
-Nurses
-technologists

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