



**IRPA workshop on  
reasonableness in the  
implementation of  
the ALARA principle**

**23-24 February, 2017**



# ***Implementing ALARA in the medical sector***

*Eliseo Vano (Spanish Society of RP)*

*Radiology Department. Complutense University and San  
Carlos Hospital. Madrid. Spain. [eliseov@med.ucm.es](mailto:eliseov@med.ucm.es)*



**Hospital Clínico San Carlos**

**Comunidad de Madrid**



San Carlos Hospital in Madrid

## Content

1. ALARA and optimisation of Radiation Protection (RP) in Medicine.
2. Optimisation of medical procedures (including RP of patients and staff)
3. Some ICRP recommendations on RP optimisation in Medicine.
4. Current challenges.

- **OPTIMIZATION:**
- *Optimizing patient dose is not the same as minimizing patient dose*

## ***ICRP-93 (2014) Managing Patient Dose in Digital Radiology***



**(a)**



**(b)**

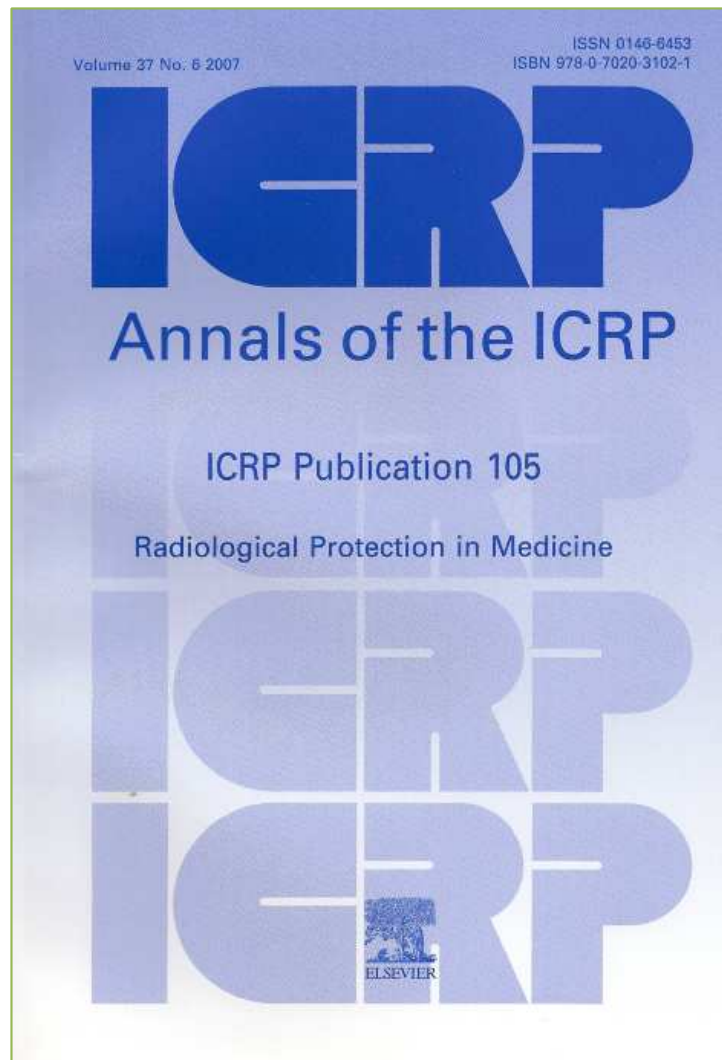
## Some initial considerations (1)

1. **Optimization of medical (and occupational) exposures** in Medicine still have some problems.
  - a) Practices with ionizing radiations in Medicine without the **necessary support of Medical/Health physicists**.
  - b) Moving from old to **new technology** in medical imaging, interventional radiology and therapy systems.



## Some initial considerations (2)

2. Sometimes we are **working in radiology without enough quality control /quality assurance** (and without patient dose evaluations, including the use of DRLs).
3. Medical exposures and **training in Radiation Protection**
  - b) Usually we have **low priority** promoting and funding education and training programmes in RP in Medicine.
  - c) **New technology in imaging and therapy** requires more efforts in training and support from the industry.



Global approach for RP in  
Medicine: **protection of  
patients and staff together**

## ***RP in Medicine (2007)***

- **ICRP-105 (Optimisation in Medicine):** The choice of protection option **directly alters the level of exposure of the patient, the staff,** and sometimes the public.
- In **ICRP-103:** The principal aim of medical exposures is to do more good than harm to the patient, **subsidiary account being taken of the radiation detriment from the exposure of the radiological staff and of other individuals.**

Volume 39 No. 4 2009

ISSN 0146-6453  
ISBN 978-0-7020-4405-2

# ICRP

## Annals of the ICRP

ICRP Publication 112

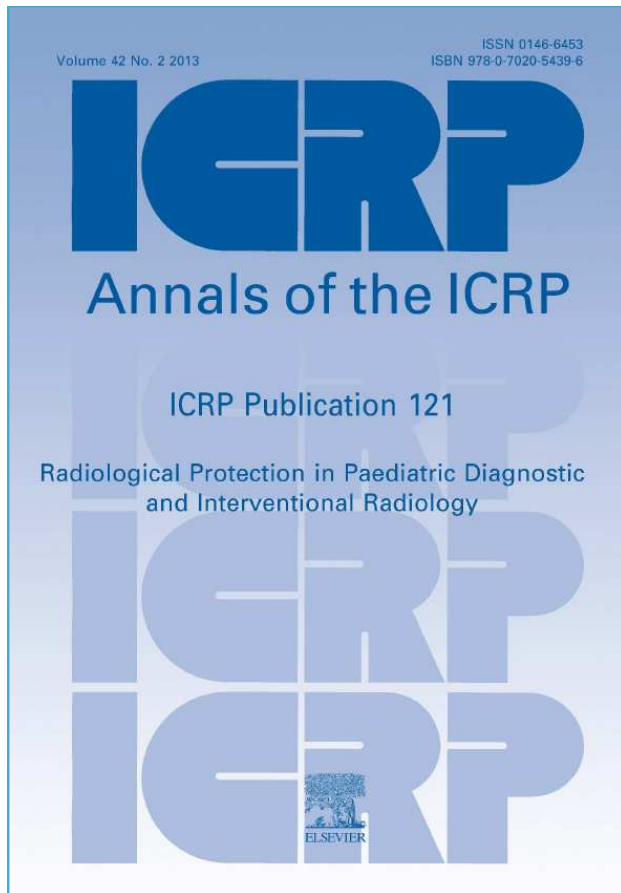
Preventing Accidental Exposures from  
New External Beam Radiation  
Therapy Technologies



### Preventing Accidental exposures from new technology in Radiotherapy (ICRP-112, 2009)

- The **new** and more sophisticated technologies **give rise to new types of accidents.**
- Approaches enabling the prioritisation of activities aimed at **reducing the frequency of occurrence of errors and their severity**, and **optimising the quality management system** so that **errors may be detected before they impact on clinical treatment.**
- Treatment planning tools **to optimise the dose distribution** for each of these new technical solutions.





## ***Radiological Protection in Paediatric Diagnostic and Interventional Radiology***

- Optimisation of RP **involves three main aspects**: a) Radiological equipment b) **Technical parameters** (tailored to paediatric patients), and c) **DRLs** for paediatric patients.
- It should be kept in mind that **the expression 'as low as reasonably achievable' (ALARA) is only part of the concept of optimization in Medicine.**
- The entire concept implies, more precisely, **keeping patient exposure to the minimum necessary to achieve the required medical objective (diagnostic or therapeutic).**

# Quality Assurance in Medical Imaging

(as defined by the World Health Organisation, 1982)

- Quality Assurance is an **organised effort** by the staff operating a facility, to ensure that the diagnostic images produced by the facility are of sufficient high quality so that they **consistently provide adequate diagnostic information** at the **lowest possible cost** and with the **least possible exposure** of the patient to radiation.

**Note that patient exposure is the last in the definition**

World Health Organization (1982).  
Quality Assurance in Diagnostic Radiology  
ISBN 92 4 154164 4, Geneva.

## Some aspects to highlight

- Relevant effort during the last years for the justification principle ... but (unfortunately) **less effort in optimization** in Medicine.
- Sometimes, **ALARA is not well understood in medical exposure of patients**: in some occasions, patient doses need to be increased for the clinical outcome.
- Most of the recent changes in **new medical technology** allow improvement in optimization (**patients and staff**).
- European (and International) **BSS are now more focused on optimization than in the past** (involvement of MPE, continuous training for new technology, DRLs, etc).
- **Ethical issues are more relevant**, specially when raising together, protection of **patients and protection of staff**.



**Radiation Management for Interventions using Fluoroscopic or Computed Tomographic Guidance during Pregnancy: A Joint Guideline of the Society of Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe with Endorsement by the Canadian Interventional Radiology Association**

© SIR, 2012

*J Vasc Interv Radiol 2012; 23:19–32*

**Pregnancy in  
Interventional  
Radiology  
(patients)**

- **OPTIMIZATION:**
- ***Optimizing patient or conceptus dose is not the same as minimizing patient or conceptus dose.***





*J Vasc Interv Radiol 2015; 26:171–181*

## STANDARDS OF PRACTICE

# **Occupational Radiation Protection of Pregnant or Potentially Pregnant Workers in IR: A Joint Guideline of the Society of Interventional Radiology and the Cardiovascular and Interventional Radiological Society of Europe**

Dauer L, Miller DL et al.

### **Pregnancy in Interventional Radiology (occupational)**

- Effective doses from **occupational exposures** resulting from FGI procedures are consistently higher than in other medical applications.

## **New Directive 2013/59/EURATOM**

### **Art. 57(d) Responsibilities:**

Wherever practicable and prior to the exposure taking place, the practitioner or the referrer, as specified by

Member States, ensures that **the patient or their representative is provided with adequate information relating to the benefits and risks** associated with the radiation dose from the medical exposure.

**Art. 9.3(a) Occupational Exposure:** the **limit on the equivalent dose for the lens of the eye shall be 20 mSv in a single year ...**



## RELEVANCE OF RISK COMMUNICATION:

*After a pelvic CT scan of a pregnant patient in the emergency department **to evaluate trauma following a motor vehicle accident**, she is seen by her primary care physician.*

*Which statement delivers the most appropriate response to her question about the **risk to the fetus**?*

- **OPTION A.** “The CT that you had two weeks ago has perhaps **doubled the risk** that your child will develop cancer before age of 19.” [0.6% vs 0.3%].
- **OPTION B.** “The CT was an important exam that **allowed the physicians to rapidly evaluate and treat your injuries** which otherwise could have placed your health and the health of your baby at risk. **The risk of adverse outcome is very small and the likelihood of normal development is still nearly the same as it is for any child.**” [96.7% vs 96.4%]

# Unintended medical exposures

- ***Unintended exposure:*** means medical exposure that is significantly different from the medical exposure intended for a given purpose (2013/59/Directive).
- Specially **relevant** for Radiotherapy and Interventional procedures.



# Avoiding unintended medical exposures

- Control of patient doses during the procedures.
- Knowledge of the trigger levels for potential radiation injuries and clinical follow-up.
- Systems for reporting and alerting on high patient doses.
- Information availability (clinical and dosimetric) from previous procedures.
- Enough knowledge of dose reduction possibilities of the used X-ray system.
- Enough support from medical physicists and trained radiographers.
- Quality Control of the radiation sources and updated Quality Assurance programmes.

# Conclusions

1. ALARA needs to **be refined** when applied to medical exposures **considering the clinical outcome**.
2. Optimization of Radiological Protection in Medicine (patients and staff) needs to be **integrated with the optimization of clinical procedures**.
3. **New technology in Medicine** requires especial effort in optimization. **More involvement of stakeholders**.
4. **Patient and staff protection** needs to be considered together. **Coordination** between competent authorities.
5. Avoidance of **unintended exposures** should be part of the optimization programme.