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Ask EuroSafe Imaging
Tips & Tricks

Paediatric Imaging Working Group

Radiation protection of children in fluoroscopy

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Introduction

Why is radiation protection of children different from adult radiation protection?

- Sensitive organs of children are closer to each other and not easy to exclude from the x-ray field.
- Tissues are more sensitive to radiation damage.
- It may take a lot of years for a radiation induced cancer to develop, but children have higher life expectancy and thus protection from cancer inducing radiation is even more important.
- Differences in body composition lead to reduced image contrast in children as compared to adults.
- Red bone marrow in children is more widespread. This means that even extremity examinations may affect red bone marrow

Paediatric radiological procedures/examinations should be carefully and individually planned

Justification of examinations/procedures

Examinations/procedures should be justified

- ICRP states that "Any decision that alters the radiation exposure situation should do more good than harm" [ICRP, 2007].
- Normally, a radiologist will closely liaise with a referring practitioner in order to ensure justification of an examination/procedure.
- Previous examinations need to be taken into account to avoid unnecessary repetitions.
- Other modalities not using ionizing radiation should always be considered.

Fluoroscopy examinations not routinely indicated

- Upper gastrointestinal contrast studies of pyloric stenosis
- Upper gastrointestinal contrast studies of children with recurrent vomiting
- Contrast enema in a child with rectal bleeding

Adapted from IAEA, 2013

Optimisation of examinations/procedures

Examinations/procedures should be optimised

- Optimisation is the most important step to take for radiological professionals. It is within their control to optimise examinations/procedures so as to reduce doses and maximise results to the extent possible.
- Paediatric protocols and settings are of utmost importance for optimised examinations/procedures:
  - Paediatric protocols need to be programmed in the equipment.
  - Protocols for children of different ages need to be set-up.

Optimisation of examinations/procedures

Optimisation tips

- Minimize fluoroscopy time
- Minimize field overlap
- Eyes, thyroid, breast and gonads should be excluded when possible
- The radiation field adjustments should be done with the light beam and not with the fluoroscopy fumction (x-ray beam)
- The anti-scatter grid should be removable and used normally for children over 8 years old, large younger children, or when very detailed images are required
- Added copper filtration should be used (e.g. 0.3 mm)

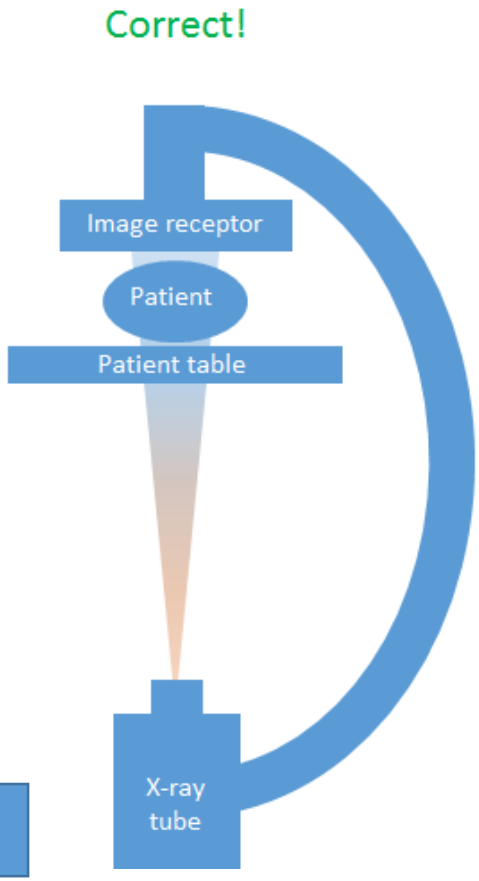
Adapted from IAEA, 2013

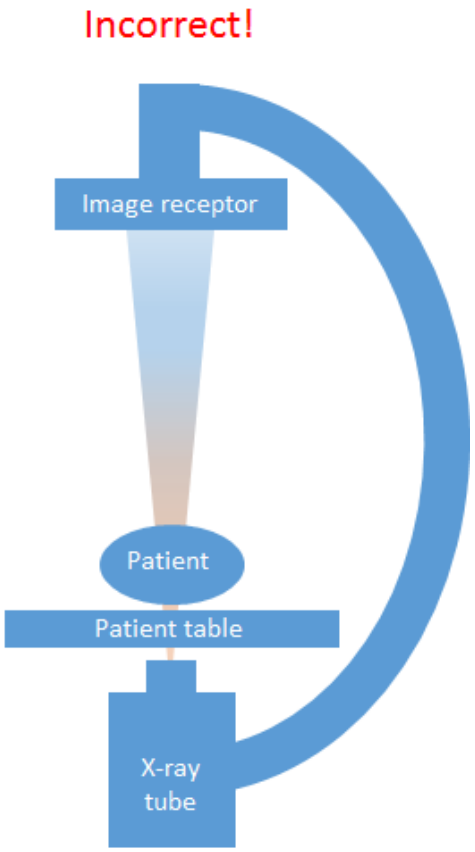
Optimisation of examinations/procedures

Optimisation tips

The x-ray tube should be under the table and as far away from the patient as possible.

The image receptor should be as close to the patient as possible





Adapted from IAEA, 2013

Optimisation of examinations/procedures

Optimisation tips

- Minimize the use of electronic magnification. Use digital zoom whenever possible
- Use pulsed fluoroscopy at 3.5–7.5 pulses/s. It should be adequate for guidance and/or monitoring of most procedures
- Use the 'last image hold' facility for static images to review the anatomy and/or findings
- Use fluoroscopy timing alerts the procedure
- A calibrated kerma area product meter needs to be available
- Patient dose needs to be recorded and reviewed

Adapted from IAEA, 2013

Dose reference levels

Dose reference levels should be used

- There are no limits for patient radiation exposure. However it is reasonable to try to keep doses as low as possible. A means to achieve this is to follow dose reference levels for the examination procedure in question. Regular comparison of dose levels to DRLs is recommended by EC and IAEA [PiDRL Report, 2017, IAEA BSS, 2014].
- DRL data for fluoroscopic and interventional procedures especially in paediatrics are limited.
- Air kerma-area product (PKA) is the recommended basic DRL quantity for radiography and fluoroscopy (ESR, 2016).
- For fluoroscopy, air kerma at patient entrance reference point (Ka,r), fluoroscopy time and number of images are recommended as useful additional DRL quantities (a multiple DRL) (ESR, 2016).

Dose reference levels/UK

DRL data for fluoroscopic and interventional procedures for United Kingdom [GOV.UK, 2016]*

	Examination/procedure		
	Kerma-area product (PKA) in mGy × cm^2		
Age	Micturating cystourethrography	Barium meal	Barium swallow
0	100	100	200
1	300	200	400
5	300	200	500
10	400	700	1800
15	900	2000	3000

**Reference doses are set at the third quartile level (i.e. 75% doses are lower than the presented values)*

Adapted from: https://goo.gl/icbd9P

Dose reference levels/EC (PiDRL)

The European DRLs for paediatric patients (PiDRL Report) include only Micturating cystourethrography as fluoroscopic examination

		Examination/procedure
		Micturating cysturethrography
Weight group kg	Age	Kerma-area product (PKA) in mGy × cm^2
< 10	0	300
10 - <15	1	700
15 - <30	5	800
30 - <60	10	750

Adapted from: http://www.eurosafeimaging.org/pidrl

References

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4. GOV.UK. National Diagnostic Reference Levels (NDRLs). https://www.gov.uk/government/publications/diagnostic-radiology-national-diagnostic-reference-levels-ndrls/national-diagnostic-reference-levels-ndrls#national-drls-for-general-radiography-and-fluoroscopy. Published 22 January 2016. Accessed 26 June 2017.
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