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Ask EuroSafe Imaging
Tips & Tricks

Interventional Radiology Working Group

How to control or reduce staff doses during IR procedures

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Using protective clothing is mandatory

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In addition, it is recommended to wear protective eyewear when working with complicated procedures on a regular basis

Image from Scanflex Medical

We have to be aware of where the scattered radiation is at the different projections during the procedure

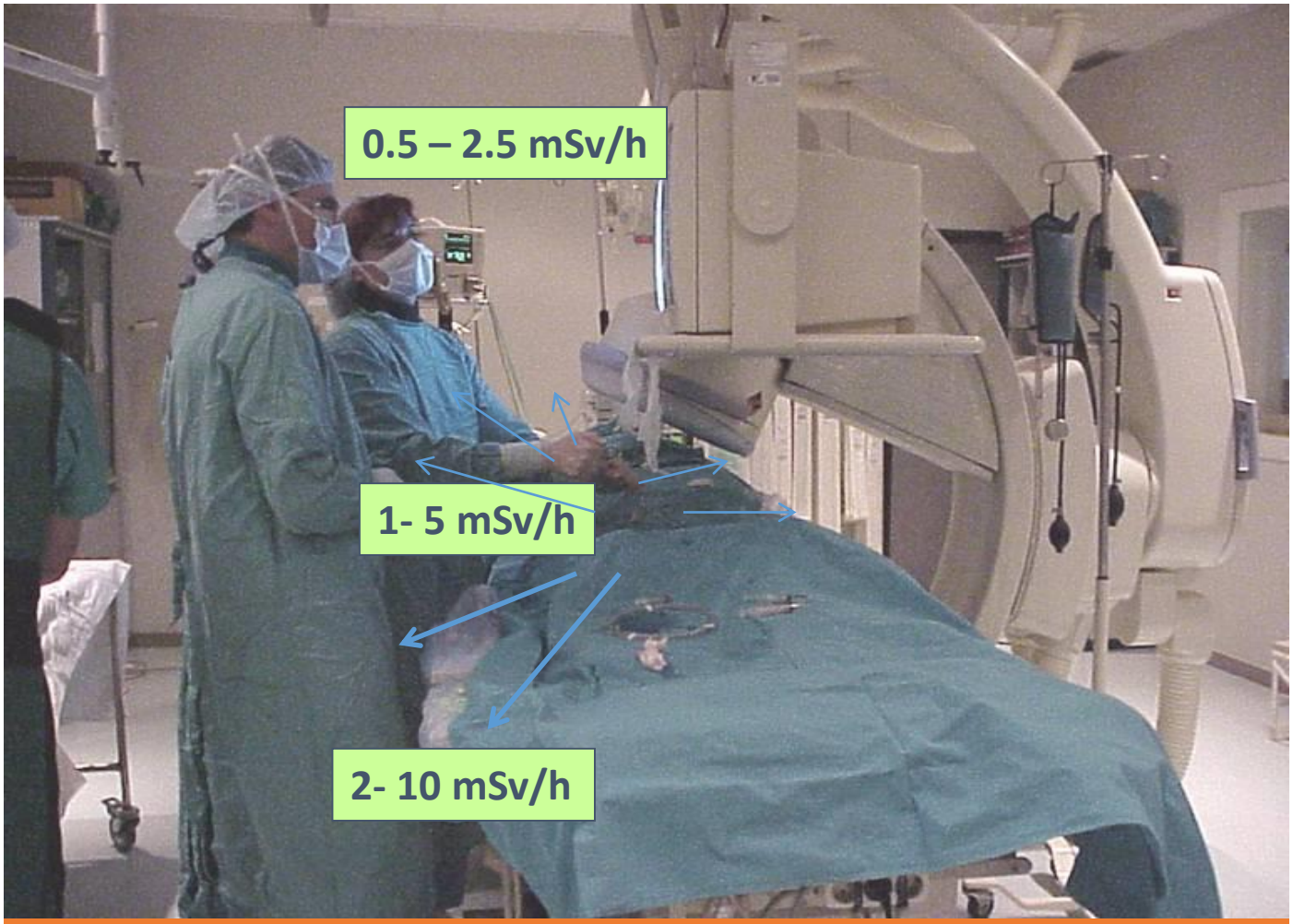
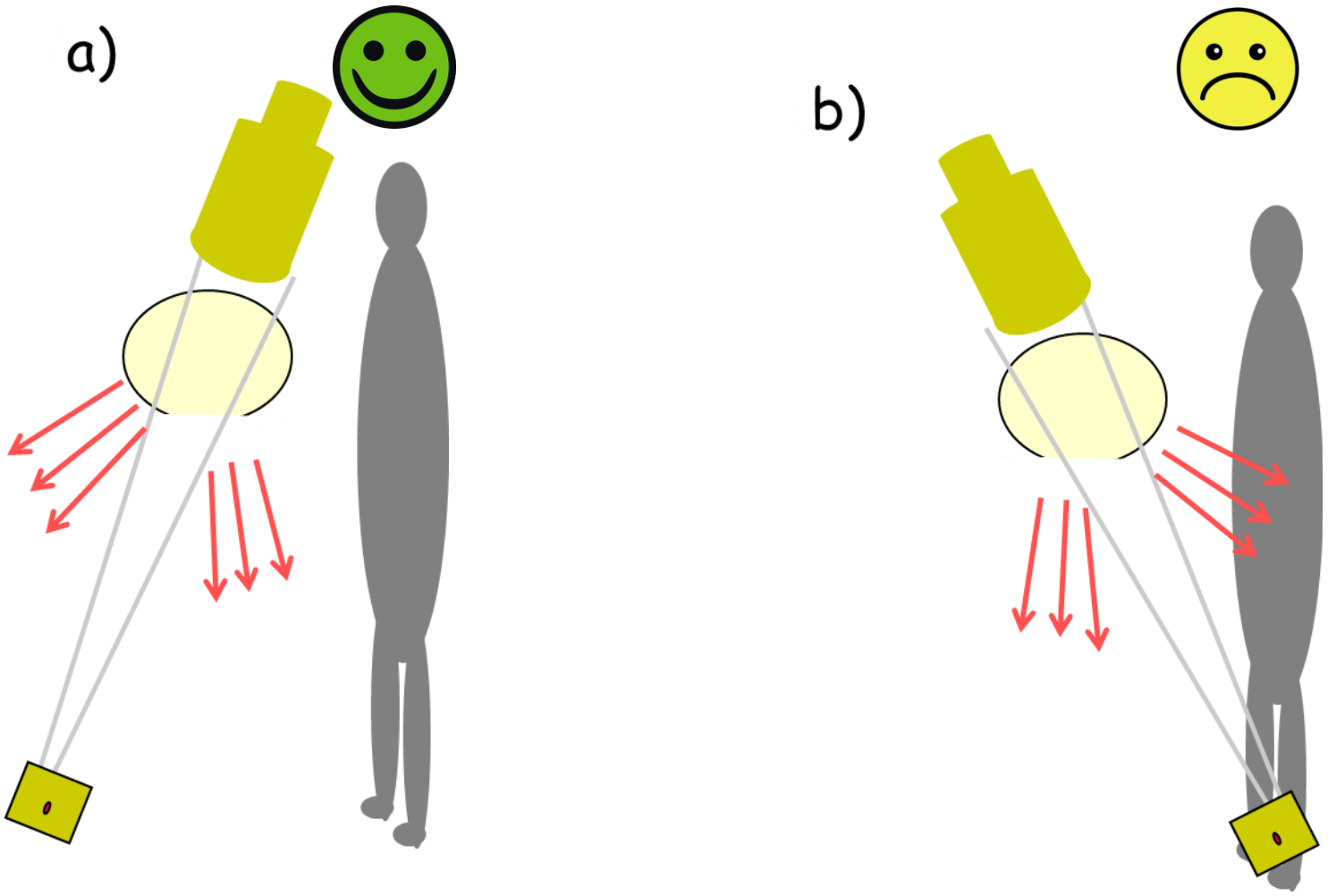


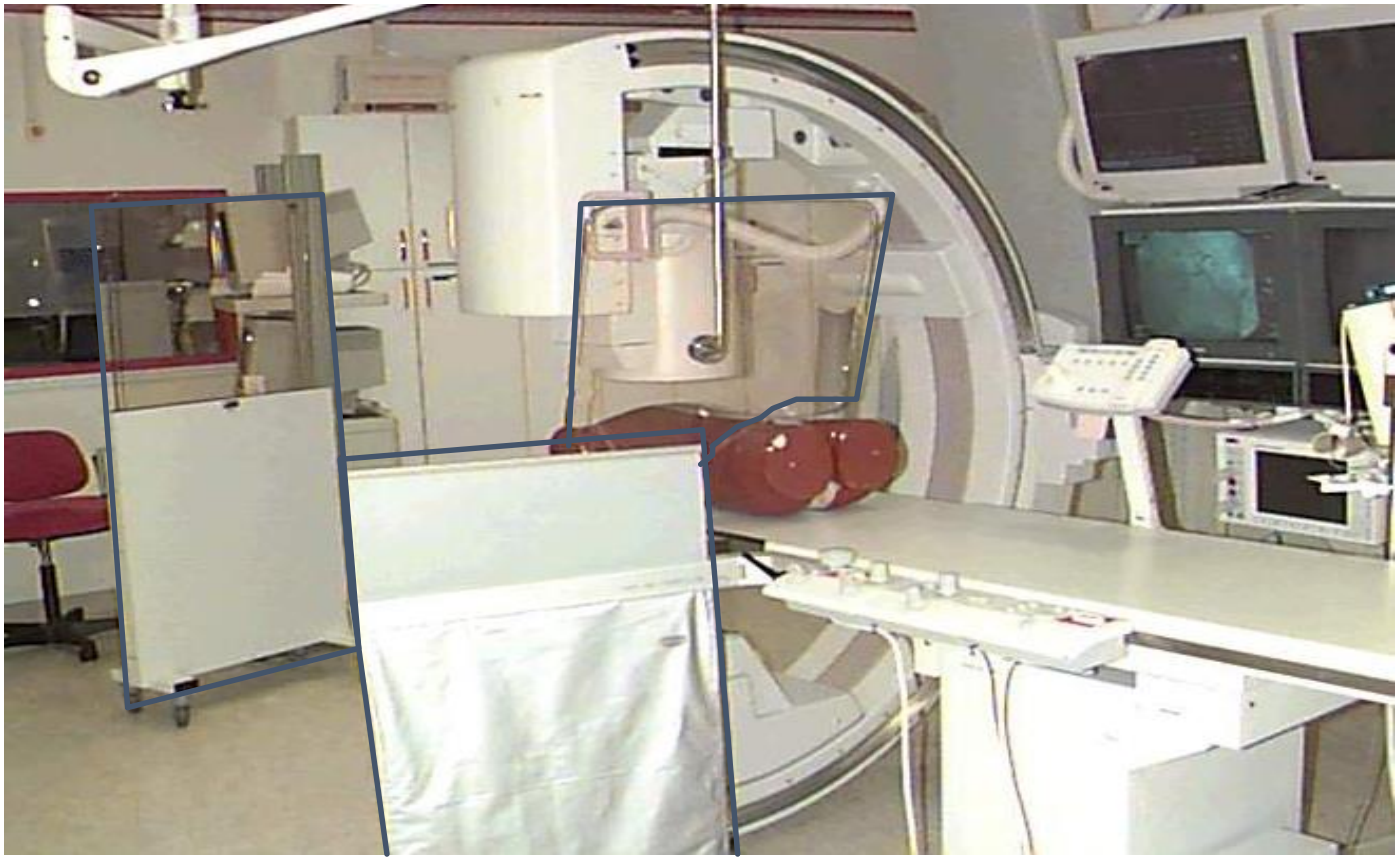
Image from “Occupational exposure and protective devices” - IAEA

The patient is the source of scattered radiation

Be aware of your positioning during IR procedures

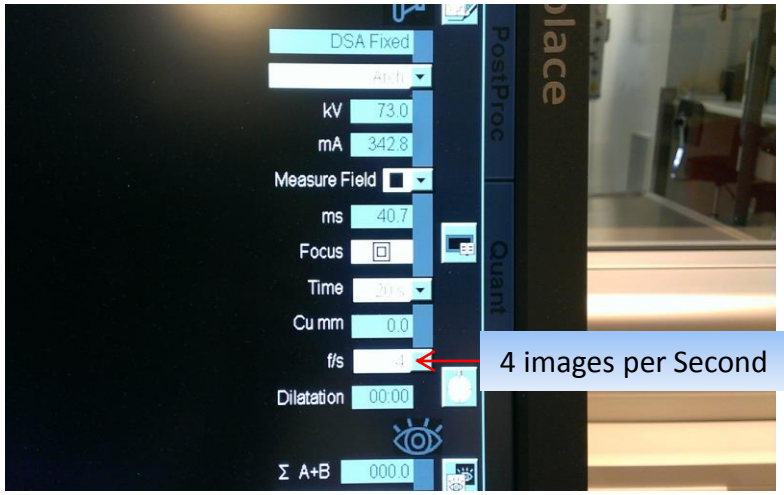


Optimise the use of additional protection devices

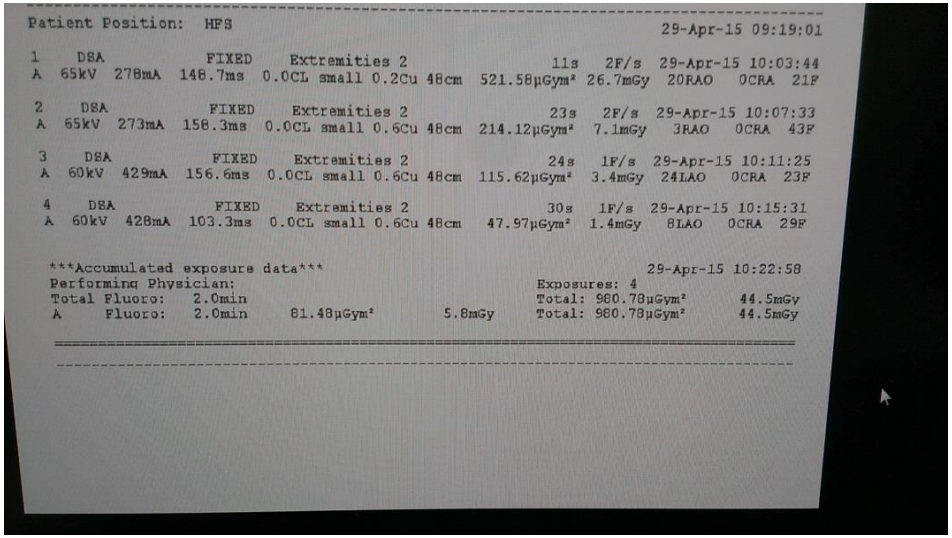


Frame rate during imaging

- Frame rate has a big influence on the total dose to the patient, and the amount of scattered radiation dose to the staff
- The imaging series make up the majority of the radiation dose during a normal IR procedure
- A critical review of the number of images in each series during an IR procedure is recommended



Distribution of radiation dose by imaging series and fluoroscopy

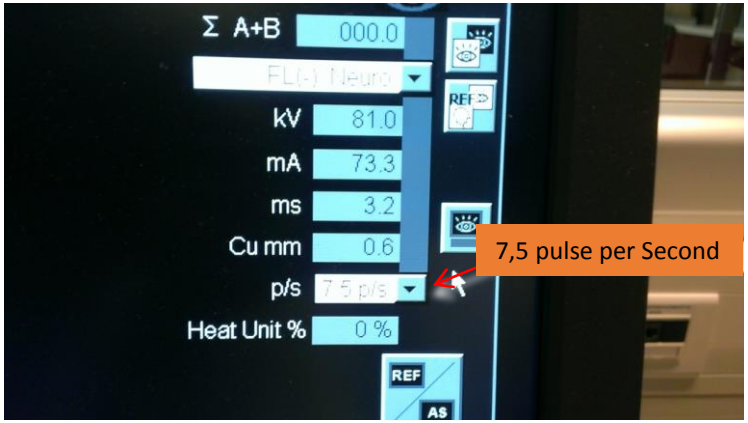


Examples from cases at St. Olav University Hospital in Trondheim/Norway:

- Lower extremity angiography (1) → 25 % of the total DAP comes from fluoroscopy and about 30 % of the total AK
- Lower extremity angiography (2) → 8 % of the total DAP comes from fluoroscopy and about 13 % of the total AK
- PCI (Percutaneous Coronary Intervention) slim woman → 35 % of the total DAP comes from fluoroscopy
- SCA (Selective Coronary Angiography) normal man → 7 % of the total DAP comes from fluoroscopy
- PCI large man→ 21 % of the total DAP comes from fluoroscopy
- SCA normal man → 28 % of the total DAP comes from fluoroscopy
- PCI normal man → 32 % of the total DAP comes from fluoroscopy

Pulse rate during fluoroscopy

- The pulse rate also has a direct impact on the patient dose and the amount of scattered radiation to the staff
- Fluoroscopy normally accounts for a smaller part of the total dose contribution than the imaging series during an IR procedure (ref. previous slide)
  - But maybe easier to change in a regular clinical environment?
  - A critical review of the number of pulses per second used during an IR procedure is recommended

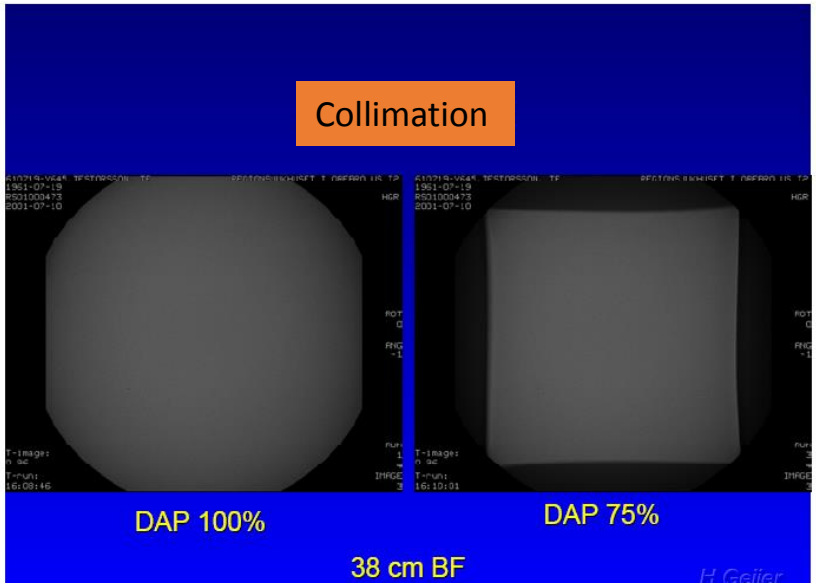


Contrast timing and imaging

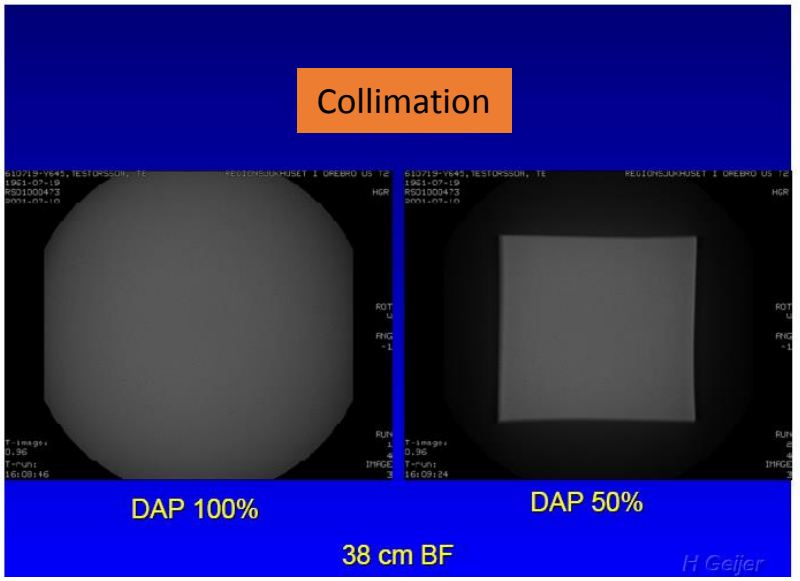
- The interventional physician starts the imaging series before the contrast begins to fill the blood vessels
- Through optimisation, you can evaluate the routines for starting the image series, avoiding too many images without contrast in the vessels
  - This can reduce the radiation dose to both the patient and the staff
- Example:
  - Cardiac series involves 15 frames per second → two seconds unnecessary exposure before the contrast arrives = 30 images

Collimation

Example of dose reduction with a small reduction in field size

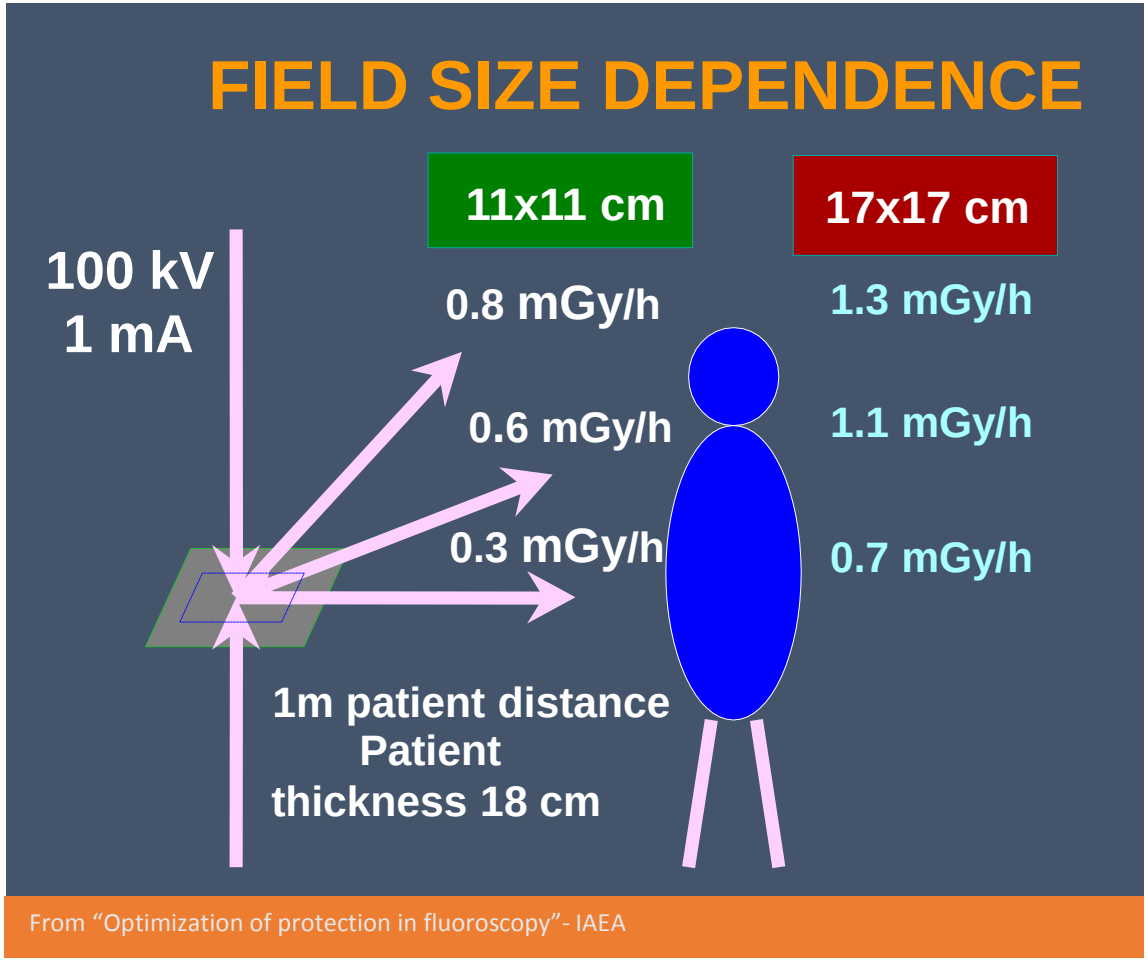


Example of dose reduction with a larger reduction in field size



Moderate collimation has a good effect on the image quality and the dose to the patient and staff because of the reduction of scattered radiation

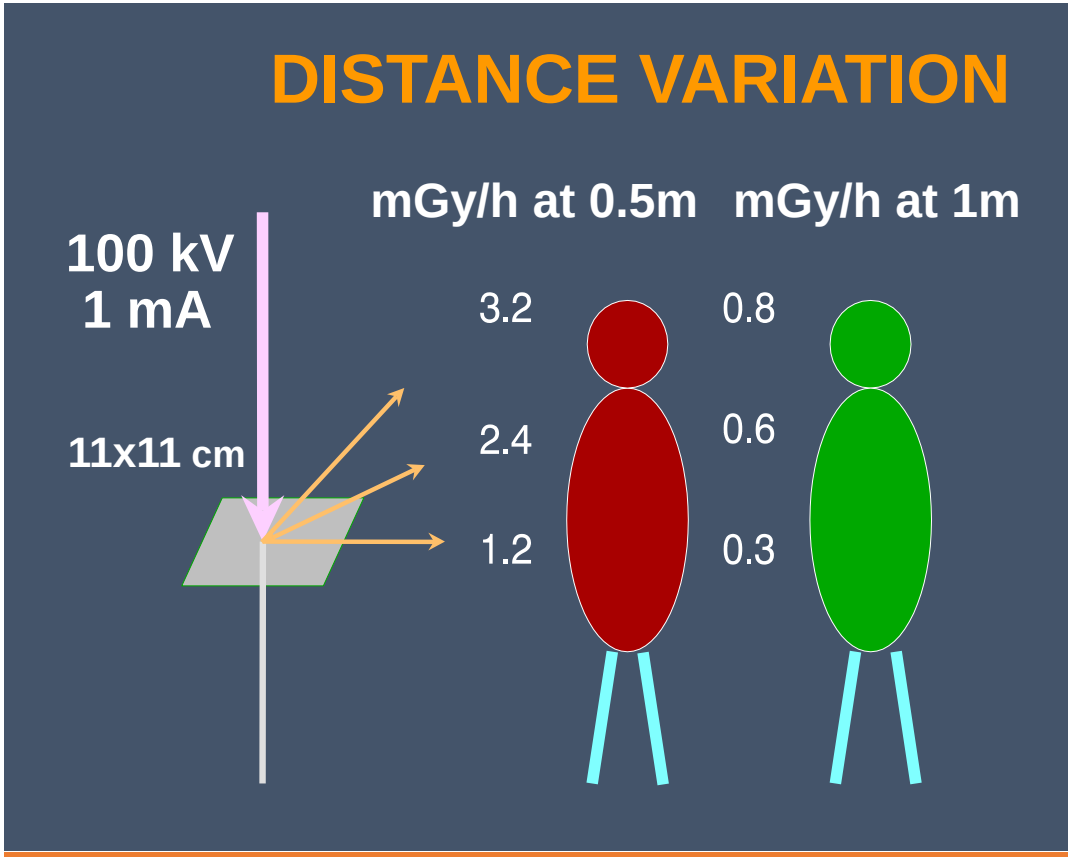
Collimation and scattered dose



From "Optimization of protection in fluoroscopy"- IAEA

Scattered dose rate is higher when field size increases

Inverse square law helps protecting the staff



From "Optimization of protection in fluoroscopy" - IAEA

Scattered dose rate is lower when distance to the patient increases

Inverse square law helps protecting the staff

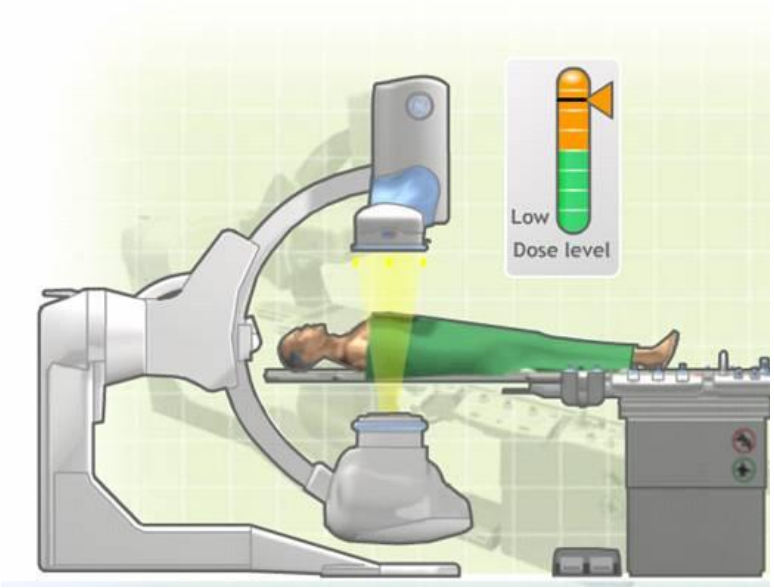
It is possible to use an extension hose to increase the distance from the radiation source

Image from «Examples of good and bad radiation protection practice" - IAEA

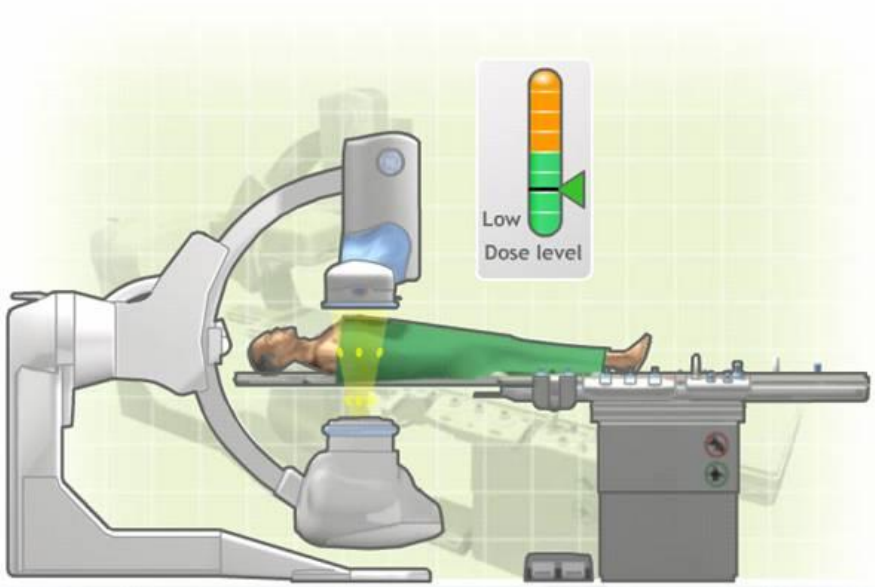
Distance between patient and detector

Short distance between patient and the detector reduces the amount of scatter to staff

1st position: Large distance between patient and detector = High dose



2nd position: Small distance between patient and detector = Low dose



From “Optimization of Radiation Protection in Cardiology” - IAEA

Short operator?

- When the operator is short, the use of a bench is recommended.
- It will make it possible to increase the tube-patient distance, which will reduce
- the patients skin dose.
- It also makes it easier to keep a short patient-detector distance to reduce scattered radiation.

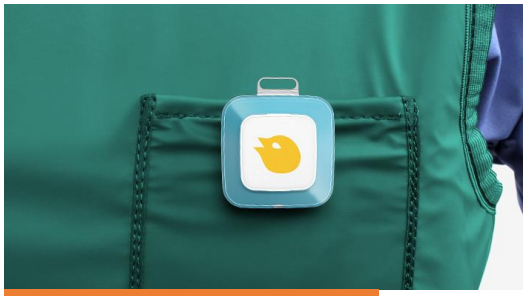
Without a bench

With a bench

This is described in the article:
Rigatelli et al, 2016 – «Impact of operators height on individual radiation exposure Measurements during catheter-based cardiovascular interventions»

Real time radiation insight

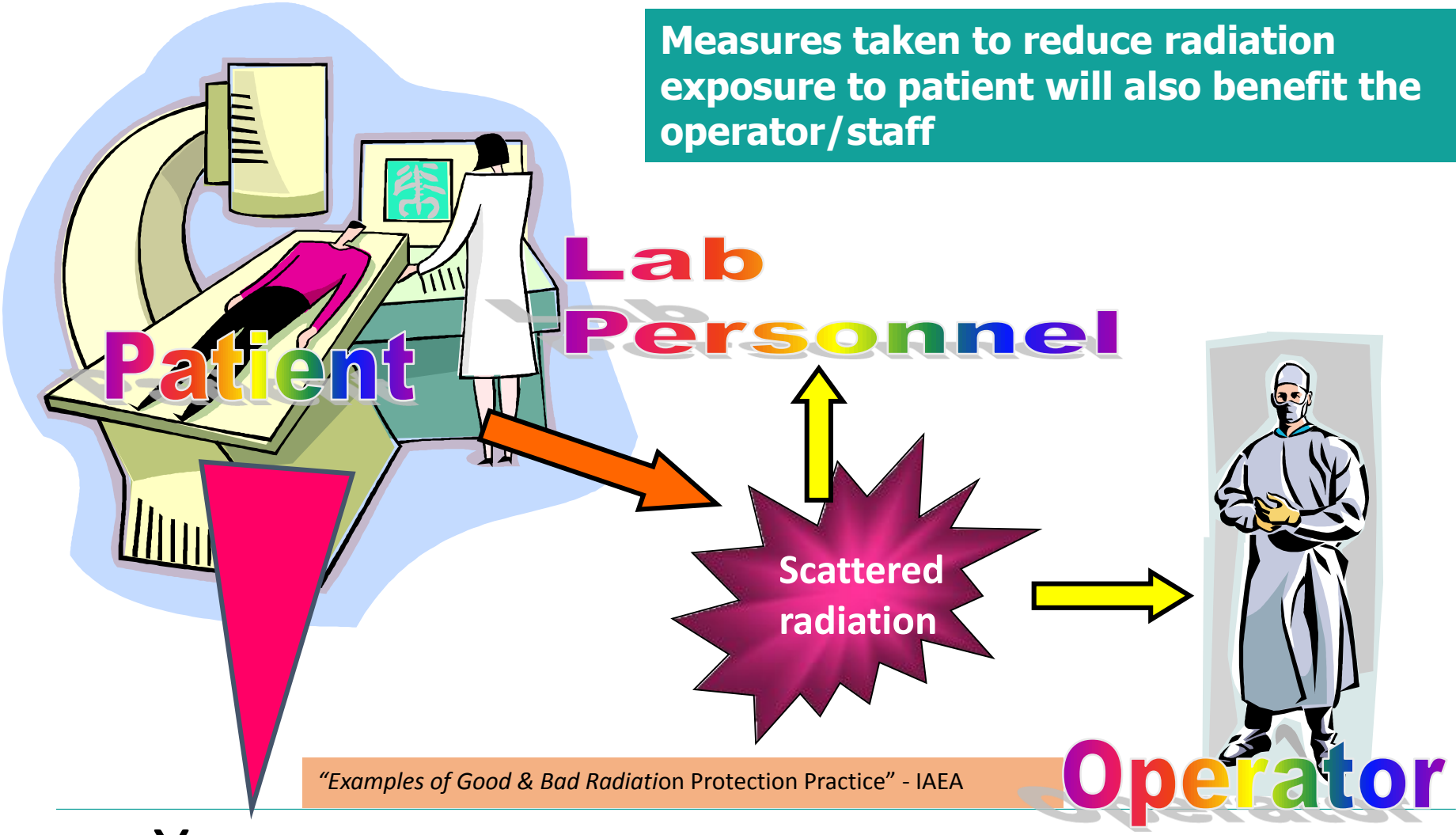
- Real time monitoring of the radiation dose to the staff is a very effective learning tool in an IR laboratory
- The staff gets immediate feedback about
  - How they are using the extra protective shielding
  - The relation between the distance to the radiation source and dose
  - How the different angulations influences the direction of scattered radiation
  - How imaging series and fluoroscopy influences the dose rate differently and how changes in framerate and pulse rate effects the scattered dose



Images from Raysafe.com

In general

Measures taken to reduce radiation exposure to patient will also benefit the operator/staff



"Examples of Good & Bad Radiation Protection Practice" - IAEA