

How to Optimize Radiation Protection During Complex Peripheral

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Leipzig Interventional Course LINC'11

Introduction

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- Modern angiography systems allow virtually unlimited exposure and comprise Rotational angiography with cone beam CT capabilities.

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- Some interventionists claim that:
 - "There is no real danger and it is all about statistics".
- In fact, there is a danger and not only about chances for malignant tumors, but also a real damage to the operator's skin and eyes.

Noninvasive Imaging

- CTA almost instantly provides an accurate diagnosis, an access map and measurement tool in most of the cases
 - Does save valuable time and personnel exposure
- MRA should be preferred when possible.
- Use a special monitor in the CathLab to view images from the PACS system in real time

Multicenter Randomized Controlled Trial of the Costs and
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Peripheral Arterial Disease: The DIPAD Trial

Ouwendijk R. et al. AJR:190, May 2008

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- OBJECTIVE. To compare the costs and effects of three noninvasive imaging tests (Duplex US, CTA and MRA) as the initial imaging test in the diagnostic workup of patients with PAD.
- CONCLUSION. The results suggest that both CTA and MRA are clinically more useful than duplex US and that CTA leads to cost savings compared with both MRA and duplex US in the initial imaging evaluation of PAD.



Knowing is not enough, we must apply.
Willing is not enough, we must do.

Johann Goethe 1765

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We, as image guided interventionists are obligated to practice radiation protection principles at least as good and safe as we perform the interventions.

Factors that Can Assist in Appropriate Radiation Management of the Patient

- Obtain a thorough medical history to determine if the patient has had any previous radiation related procedures such as:
 - radiation therapy
 - previous fluoroscopically guided interventional procedure.
- If a previous radiation history exists:
 - examine the patient for signs of skin changes related to radiation exposure
 - plan to avoid further irradiation of any such area, if possible.
- Review the patients medical history for conditions that might increase radiation sensitivity.

Factors that Can Assist in Appropriate Radiation Management of the Patient

- Consider including the potential for skin injury in the patient consent:
 - especially if the patient is large
 - if the procedure could be prolonged,
 - counsel the patient about these and other risk factors specific to the patient (e.g., weakened skin from previous procedure, obesity, collagen vascular disease or diabetes, etc.);
- After the procedure ask the patients to examine themselves for several weeks for any skin changes or hair loss at the area of beam entry and to report any changes to you.



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Top Stories

Protecting Those Who Heal

IAEA Raises Awareness of Radiation Risks Among Heart Doctors

Staff Report

29 August 2008

Patients are not the only ones at risk during cardiac procedures. Doctors performing heart surgery also face health risks, namely to their eyes.

The IAEA is helping to raise awareness of threats, through training in radiation protection related to medical uses of X-ray imaging systems.

The issue of radiation protection for medical personnel is particularly acute in the case of lengthy angioplasty and other cardiac interventions performed under X-ray fluoroscopic guidance. The procedure can cause extensive radiation exposure to cardiologists that could lead to cataracts, alongside other longer term health risks. Fluoroscopy provides X-ray images of a patient that physicians can view on a display screen or monitor in real time.



The IAEA is organizing a study to test the eyes of interventional cardiologists participating in a regional cardiology conference organized by SOLACI in Bogota, Colombia, in September. (Photo: Morguefile)

[Story Resources](#)

Factors affecting staff doses

- The main source of radiation for the staff in a fluoroscopy room is the patient (scattered radiation).
- The scattered radiation is not uniform around the patient.
- The level of dose rate around the patient is a complex function of a great number of factors.



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- They are operator independent and represent any possible active consented protection.
- Are of no use if they are not utilized in daily practice.

“Active” Radiation Protection

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- Image guided interventionists are obligated to be protected from Ionizing Radiation using:
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 - dose reduction methods,
 - adjust our behavior to the hostile setting of the angiography system.

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 - adjust our behavior to the hostile setting of the angiography system.
- The “active methods” allow proper performance of the interventional procedures with the lowest radiation exposure for patients and staff.

Avoid Back Pains

- There is a proven correlation between wearing a protective apron and development of cervical and /or Low Back Pains.
- Measures to reduce possible damage:
 - Use light apron (rear earth elements with high lead equivalence)
 - Various hanging and supporting devices are available
 - Maintain your spine in neutral position and avoid sharp movement
 - Intermittently bend one knee during prolonged standing

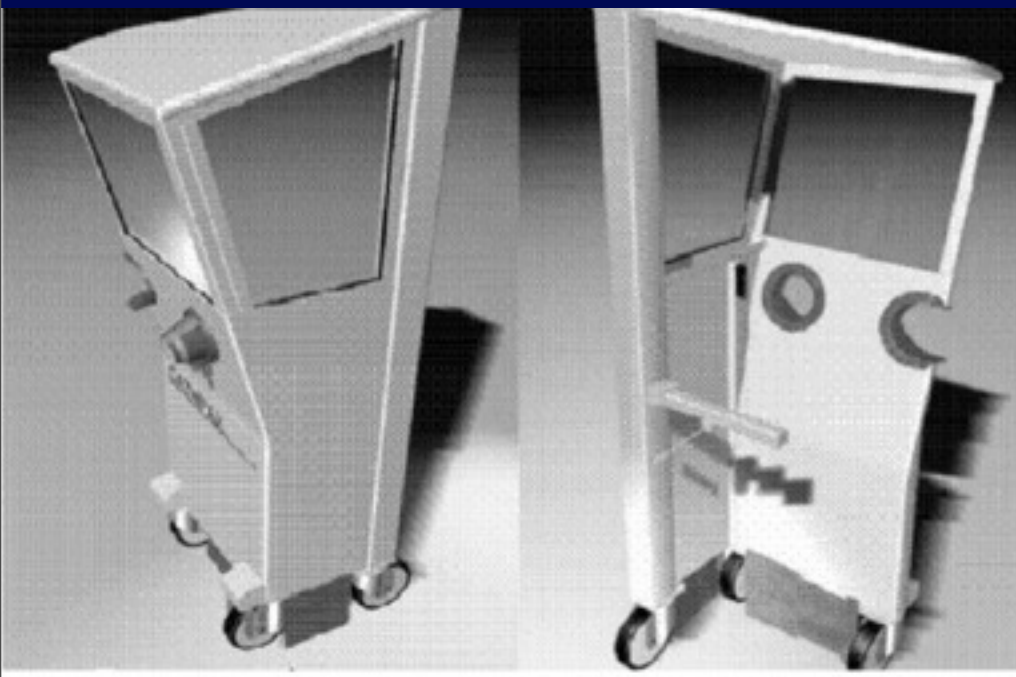
Lead Apron

- 15 pound lead apron:
 - puts approximately **300 pounds per square inch** of initial pressure on the intervertebral disc
 - this pressure is aggravated by:
 - improper table height,
 - fluoroscopy monitor height and position
 - On-table control panel position

Radiation Protection Cabin

Dragusin O. Evaluation of a radiation protection cabin for invasive EP procedures (European Heart Journal (2007) 28, 183–189)

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Fluoroscopy Monitors



Desirable

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Desirable



Wrong, but realistic

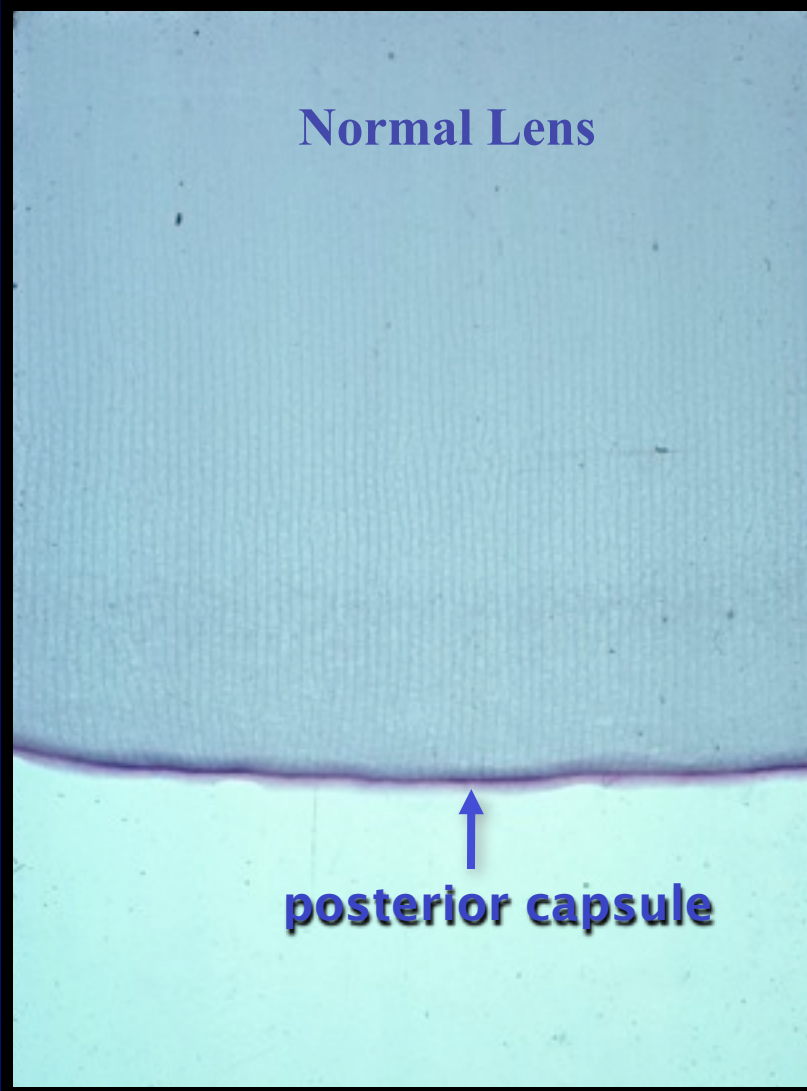


“Radiation Cataract Risk in Interventional Cardiology Personnel”

E. Vano, et al (Accepted May 2010)

During two regional SOLACI Congresses (Sept 2008 and April 2009) 116 exposed and 93 similarly aged non-exposed individuals were examined. Posterior subcapsular opacities typically associated with ionizing radiation exposure were found in **38% of interventional cardiologists and 21% of nurses and technicians** as compared to **12% of unexposed controls**. Cumulative median values of lens doses were estimated at 6.0 Sv for cardiologists and 1.5 Sv for associated medical personnel.

Posterior Lens





"Risk for radiation induced cataract for staff in interventional cardiology: Is there reason for concern?"

O Ciraj-Bjelac, MM Rehani, KH Sim, HB Liew, E Vano, NJ Kleiman
Accepted on May 2010

During a regional cardiology congress in Malaysia (April 2009), the prevalence of radiation associated posterior lens opacities was **52% for interventional cardiologists, 45% for nurses** and **9% for controls**. Estimated mean cumulative ocular doses were 3.7 Gy for cardiologists and 1.8 Gy for nurses. A strong dose-response relationship was found between occupational exposure and the prevalence of radiation-associated posterior lens changes.

Personnel protection from Scatter Radiation using RADPAD® Shield

- Proven to reduce exposure to scatter radiation from 50% to 95%.
- Available in four different levels of protection.
- Lead free; sterile; disposable.

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“Radiation is the only proven cause of brain tumors.”

-DeAngelis, LM, New England Journal of Medicine, 2001



Real Time Monitoring of Occupational Dose



Electronic dosimeter

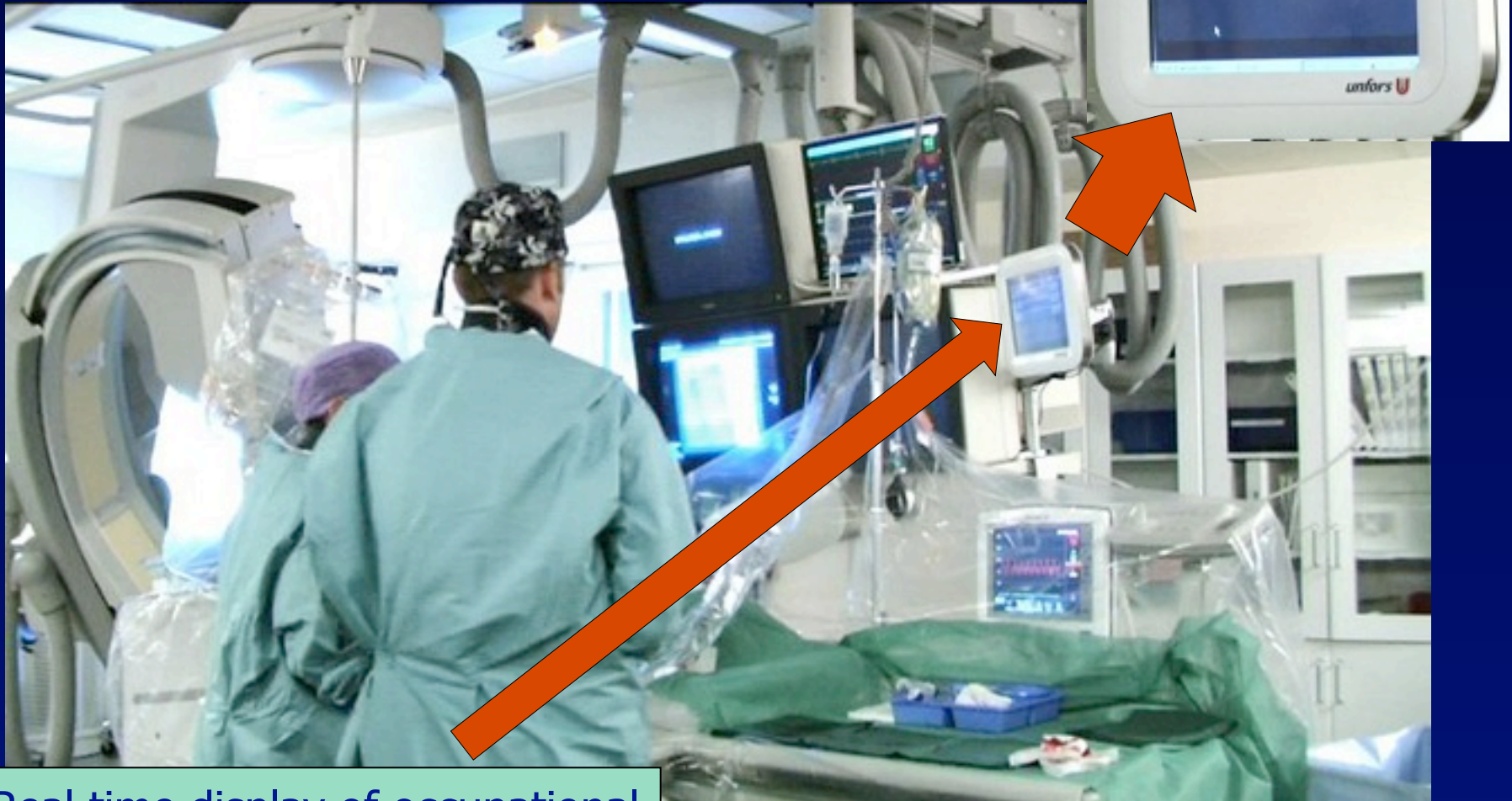


Screen displaying personal doses in the interventional suite

Courtesy E. Vano

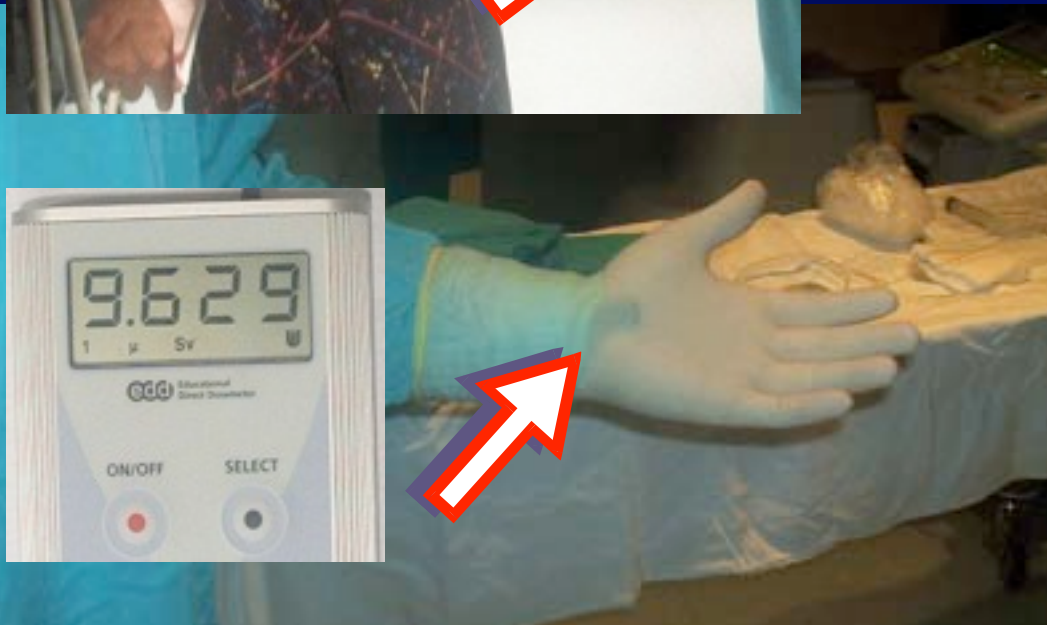
Occupational doses are displayed in real time in the CathLab

Sahlgrenska University Hospital (Gothenburg)



Real time display of occupational dose for each operator

Courtesy E. Vano



Electronic dosimeters.
Measure per procedure
occupational dose
(optimization)
E. Vano



E. Vano

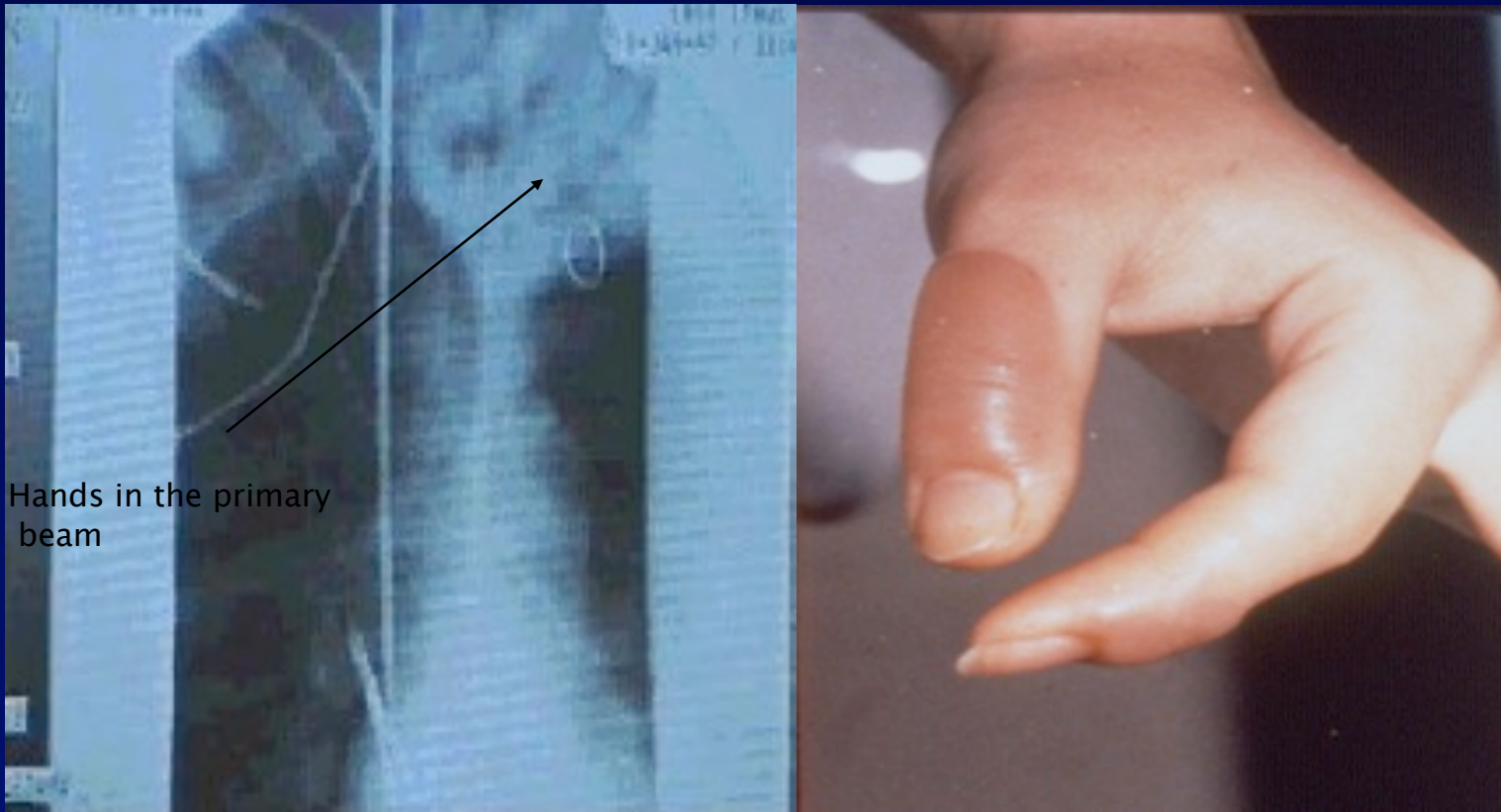


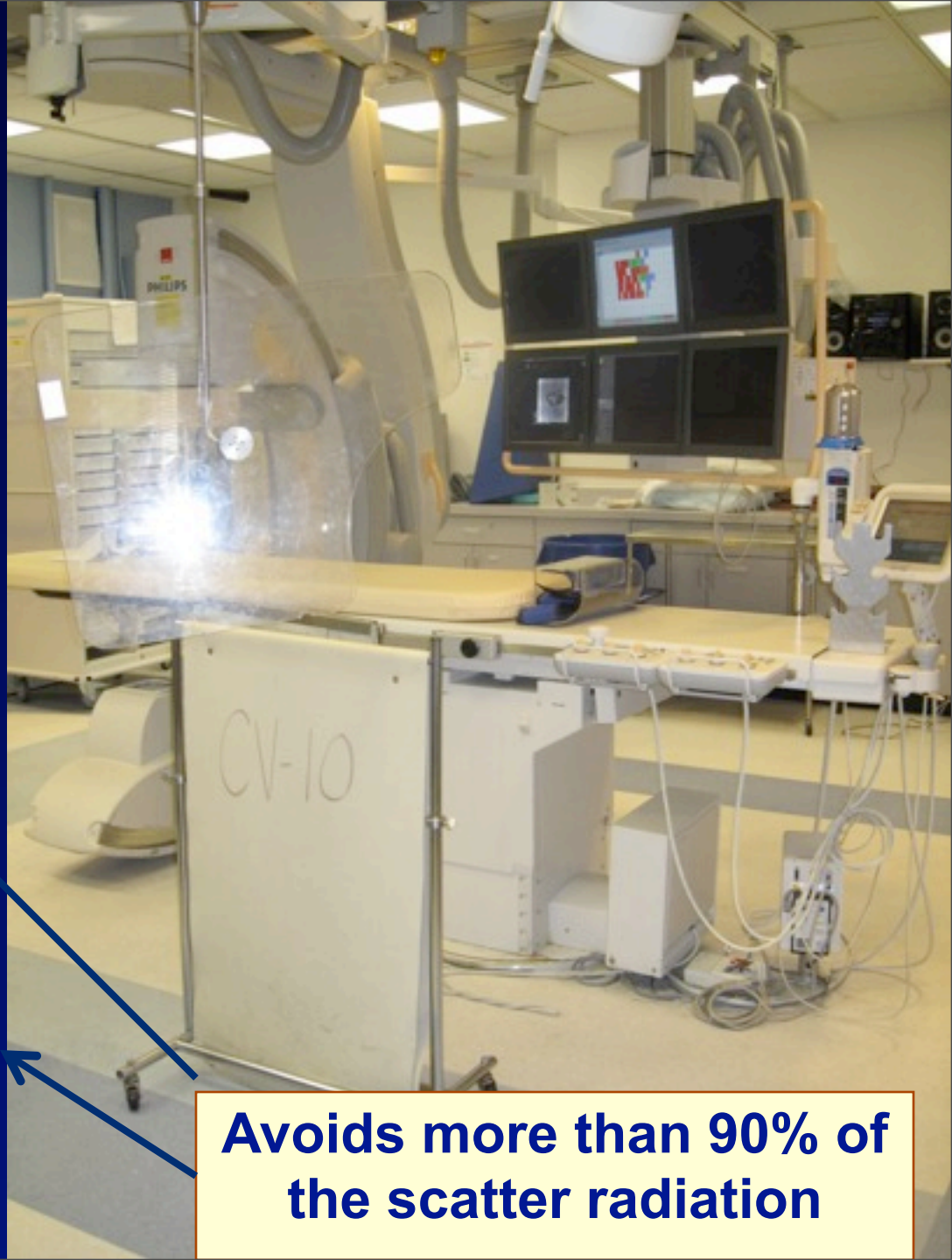
Your hands are sometimes very close to the direct X-ray beam and exceptionally inside the radiation field.



Your hands are sometimes very close to the direct X-ray beam and exceptionally inside the radiation field.
Do you know your radiation doses in these cases?

Personnel Radiodermatitis (Hands in the Primary Beam)





**Avoids more than 90% of
the scatter radiation**



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- Follow the 4!

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- Important variations in patient and staff dose values occur in interventional suites.
- The very new technology is not a guarantee to work with low radiation risk.
- Image Guided Interventionist has to have:
 - good training in Radiation Protection,
 - deep knowledge of your X-ray system,
 - effectiveness of the different passive and active RP methods and tools,
 - be aware of the typical exposures for the available operational modes.

Future Trends

- Real time dosimetry of the Operator.
- Medical Simulation training of the staff.
- Routine planning of interventions using noninvasive imaging.
- Radiation protection measures should become an essential part of any procedure.



Thank You!



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- Use appropriate collimation.
- Recognise that magnification usually increases patient skin dose (also with flat detectors).

Essential Passive RP Techniques

- Obtain the needed diagnostic information but not the best information
 - reduce fluoroscopy time,
 - use low dose fluoroscopy modes,
 - reduce the number of DSA series,
 - reduce the number of images in the series,
 - avoid the most irradiating C-arm angulations.
- Image detector should always be close to the patient.

Essential Passive RP Techniques

- X-ray focus should not be close to the skin of the patient.
- Use the feedback on the values of patient and staff doses after comparison with available references values indicative of good practice.
- Require reports on the constancy checks of your X-ray system and on your patient and staff dosimetry database.

**Always think
ALARA**