Ask EuroSafe Imaging
Tips & Tricks

Interventional Radiology Working Group

Protective Garments

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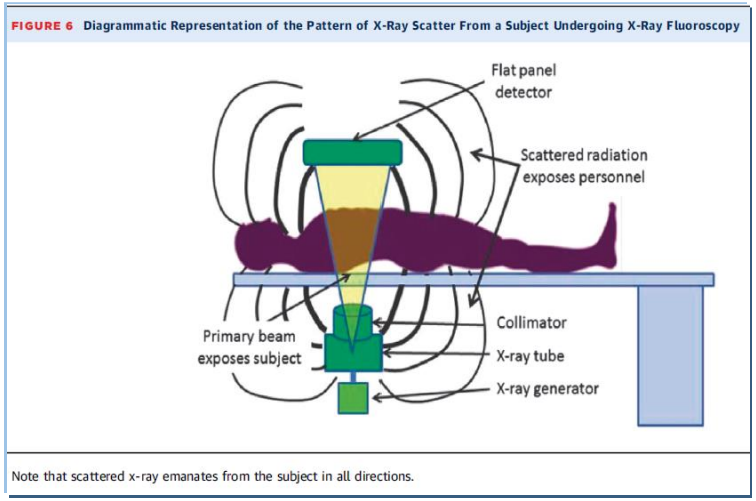
Background

- Occupational exposure to Interventional Radiologists (IR) and other staff is strongly regulated and monitored in the EU.
- Surprisingly, labeling and testing of the protective aprons are loosely regulated.
- IR's are not familiar with the apron qualities and testing methods.

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.

Optimization of Protection in IR



JACC, 2018 Hirshfeld et al.

Self Protection
The Lead/Rubber Aprons

- Usually contain the equivalent of:
  - 0.25 mm, 0.35 mm, or 0.5 mm of lead
- Some designs have an overlap at the front to provide protection of 0.5 mm lead equivalence with 0.25 mm lead equivalence on the back
- Transmission is typically between 0.5% and 5% in the range of 70 kV to 100 kV

The Truth about "Lightweight" Aprons

- Unclear and misleading labels might specify lead equivalencies corresponding to overlap zone
  - creates confusion and makes some of us to believe that the entire apron is twice its real thickness
- Weight reductions with "equivalent protection" are not achieved for Non Lead apparel
  - Only heavy materials attenuate similarly to Lead (Pb)
  - Trust no one and do not be charmed by colors and engravings
  - Do not hesitate to demand results of independent evaluations and consult your medical physicist

Alternative Metal Based Light-Weight Aprons

- Contain composite layers of high atomic number elements instead of lead
  - i.e. tin or bismuth
- Their lead equivalence depends on the standard method used to measure it
- For some beam energies lead-free materials may offer lower protection
  - i.e. less effective for voltages above 100 kV

Lightweight or "Lead-Free" Aprons

- Provide a reasonable alternative where weight reduction is required to alleviate back or neck problems.
  - They have different x-ray transmission from ones containing lead for different x-ray spectra.
  - A study concluded that some aprons provide less lead equivalent thickness than what is stated on the lead aprons and their manufacturing certificates.

  (Papadopoulos et al., 2009)
- Users and patients wearing lead-free x-ray protective clothing might unknowingly be exposed to a greater dose than generally assumed.

Lightweight or "Lead-Free" Aprons

- Manufacturers often characterise their attenuation properties in terms of "lead equivalence"
  - e.g. "0.5 mm lead equivalent"
- These data without further qualification can be misleading
  - since photon attenuation varies significantly over the photon energy spectrum, and
  - largest variations occur in the diagnostic imaging range.

  (Finnerty et al., 2005; Schlattl et al., 2007; Eder et al., 2010)
- Make sure that your protection apparel complies with current EU standards: **IEC 61331-1 2014**

Take home points

- Trust no one, but your medical physicist in choosing protective garments.
- Demand conformity with the IEC 61331-1 2014 or equivalent standards.
- Do not buy or wear an apron just because it feels light-weight
  - mainly, if you use it frequently and if you are required to be close to the patient during fluoroscopy.
- Removable protective sleeves avoid exposure of the chest
  - essential for female breast protection!
- Store the apron properly without bending or folding.

(Should we keep the lead in the aprons? Bartal, Sailer, Vano. Techniques in Vascular and Interventional Radiology, 2018)