The use of personal protective equipment in nuclear medicine

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Which PPE to use in a nuclear medicine department?

Different opinions, different guidelines
Technologists in NM belong to the highest exposed workers in hospital practice

1 – 5 mSv/12 months
Occupational exposure in nuclear medicine

≠ Exposure situations
- Unpacking and storage
- Activity measurements
- Preparation, administration and imaging
- Care of the radioactive patient
- Handling waste
- Incidents

≠ Exposure pathways
- External exposure
- External contamination
- Internal contamination/exposure
Different types of radiation and energies

Radiology: low energy scattered X-rays

Nuclear medicine: different types of radiation with a wide range of energies

≠ Types of radiation
  -> Photons, electrons, positrons
≠ Energies
  -> 6keV (Fe-55) -> 1116 keV (Zn-65)
≠ Radionuclides
  -> Tc-99m, F-18, Ge-68, I-131, .....
Keeping occupational exposure as low as reasonably achievable

By combination of different tools

- Shielding
- Personal protective equipment
- Exposure control procedures
In NM shielding the source is more efficient for dose reduction
What about the use of a lead apron?

ALARA? **Reasonably?**

1° **The use of PPEs may not hamper the work**
   - Prolong the exposure time?
   - Increase the risk on radioactive contamination?

2° **Can cause physical stress (back, neck, knees)**
   - Balance benefit/cost (to the technologist)?

3° **Gives only limited dose reduction**
The attenuation rates of lead aprons are in general measured for X-ray energies

70 - 120 kVp X-rays
- 99 - 88% dose reduction with 0.5mm PbEq-apron

$^{99m}$Tc – $\gamma$ 140keV
- 78% dose reduction with 0.5mm PbEq-apron
- 35- 40% attenuation for composite lead aprons

$^{18}$F – $\beta$ 634keV, $\gamma$ 511keV
- <10% dose reduction with 0.5mm PbEq-apron
Shielding the sources

Lead glass shielding used during preparation
- > 90% dose reduction

Syringe shields used during administration
- > 90% dose reduction
  - > personal protective equipment?
Syringe shields as PPE?

**Measuring campaign on hand contamination**
- 10 months survey, 560 inspections

**Results**
- 40 measured contaminations
- For 12 (31%) of the detected contaminations the technologist was not aware
- Cross contamination through the use of syringe shields

>> **Introducing personal syringe shields**
The use of shielding in NM - summary

In nuclear medicine shielding the source is more efficient than shielding the worker

For each manipulation the proper shielding must be present, they can be workplace related or personal

When (lead) aprons are available in a nuclear medicine department know that:
- Lead free aprons may not be appropriate for shielding gamma emission
- 0.25 or 0.5 mm PbEq aprons provide a modest amount of radiation protection
- They create a false feeling of safety which can result in longer exposure times
To prevent personal contamination

Most common, the use of disposable gloves

Apply rules of good practice to prevent cross contamination
- Regular change of gloves
  - with every manipulation/patient
  - with every presumption of contamination
  - when leaving the controlled area/room

Depending on the method of administration other disposables are necessary to prevent contamination
Ex: Lung ventilation/perfusion procedures

Administration
- Injection
- Inhalation <<<

Tracers
- Inert gas $^{133}$Xe, $^{81m}$Kr
- Aerosol $^{99m}$Tc-DTPA
- Technegas <<<
Technegas

- $^{99m}$Tc-labeled solid graphite particles
- submicron diameter (0.005 – 0.2 µm)
- argon carrier gas

*Increased risk for contamination*
- Opening the gas preparation door
- Dysfunctioning valve inside apparatus
- Leakage in case of uncoöperative patient
- Patient with productive cough during administration
The use of additional disposables was introduced to prevent personal contamination
- Gloves
- Mouth mask
- Hair cap
- Disposable over-apron

Technegas administration:
In 24% of cases activity was detectable on staff (hair and nose)
Ref: Lloyd JJ, Nuclear Medicine Communications, June 1994
High risk on contamination when not using the proper PPE

Disposable gloves, cap, mask and apron must be worn

Lead apron can reduce the external exposure ($^{99m}$Tc) but must be covered by a disposable apron

Contamination check up must be performed after each administration
Thank you for your attention