# RADIATION PROTECTION OF WORKERS

# Nuclear Medicine

IAEA

Nuclear medicine is a special field of medicine in which radioactive material is used to diagnose (detect) and treat medical disorders. One can receive a radiation dose from exposure to nuclear medicine sources from outside the body (external exposure) or if the radioactive material enters the body (internal exposure).

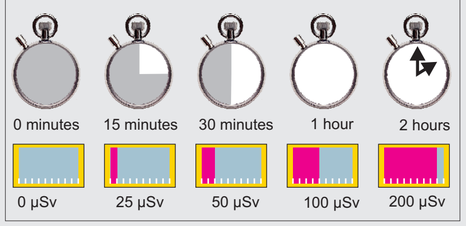
## EXTERNAL EXPOSURE

External exposures to staff can occur:

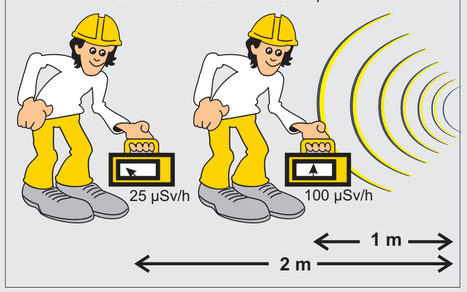
- ☑ From any exposure to a significant quantity of unshielded radioactive material.
- ☑ When working with vials, syringes or transport boxes containing radioactive material.
- ☑ During contact with a patient after radio-pharmaceutical administration, e.g. after radioiodine therapy.

External exposures can be controlled by consideration of time, distance and shielding.

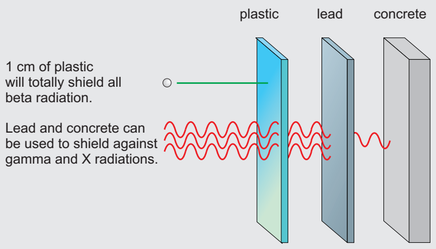
**Time** To reduce radiation doses, the time spent in radiation areas must be kept as short as possible. The longer the time spent in an area, the higher the dose received.
In an area where the dose rate is 100 µSv/h, the dose received will be:




**Distance** If the dose rate at 1 m from a source is 100 µSv/h, the dose rate at 2 m will be 25 µSv/h.




**Shielding** Shielding material must be appropriate for the type of radiation. For example:




## INTERNAL EXPOSURE

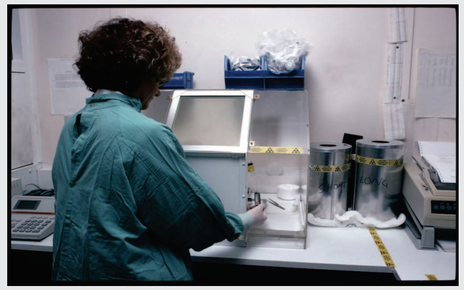
Radioactive material can enter the body by inhalation, ingestion and by absorption through intact or damaged areas of the skin. The presence of radioactive contamination presents an internal exposure risk to staff for each of these exposure routes.

**CONTAMINATION**
There may be contamination:

- ☑ Where splashes or spills have occurred.
- ☑ On laboratory surfaces.
- ☑ Through the sweat, saliva and excreta of patients.

Where there is contamination, you should:

- ☑ Wear protective clothing.
- ☑ Wear latex gloves.
- ☑ Wear overshoes.
- ☑ Cover cuts and wounds.
- ☑ Do not eat, drink, smoke or apply cosmetics.
- ☑ Clean up spills, even minor splashes, as soon as practicable.
- ☑ Not touch things unnecessarily.
- ☑ Wash your hands immediately.

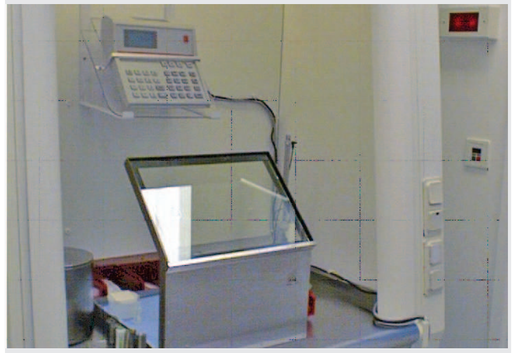


## PROCEDURES

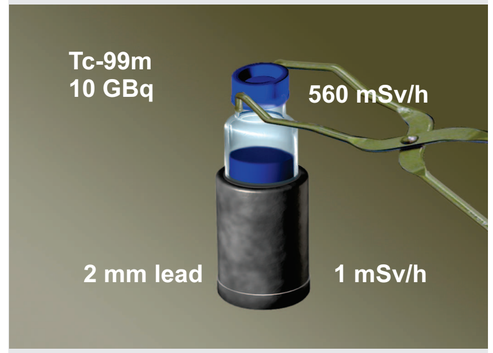
**SHIELDING**

Use syringe shields for the preparation and administration of radiopharmaceuticals.

Leaded shields can help to reduce dose rates.



Use tongs to handle sources.




**WASTE**

Waste must be disposed of in a strictly controlled and prescribed way.

**RADIOIODINE THERAPY**

The activities in radioiodine therapy are so large that the external exposure from the patient becomes signficant.

- ☑ Whenever hospitalization is required, the patient must stay in a designated, shielded and isolated room. Waste from the toilet and sink will be radioactive and must be carefully managed.
- ☑ The area around the patient's toilet should be covered in absorbent paper to contain any contamination.
- ☑ Staff must have extra training.
- ☑ Staff must wear protective clothing, limit their time in the room, and whenever possible, keep a shield between them and the patient.
- ☑ Staff must wear personal dosimeters.
- ☑ After the patient leaves, the room must be thoroughly cleaned and monitored. The room must be confirmed as being safe for use by the Radiation Protection Officer before being used again.
- ☑ Clothes and materials handled by the patient must be handled separately and decontaminated.

**Radiation doses to staff must be kept:**

**As Low As Reasonably Achievable: ALARA**

**Dosimeters**: Finger dose monitoring may be appropriate for those dispensing or injecting radiopharmaceuticals. **Dosimeters do not provide protection from exposure to ionizing radiation. They are a means of assessing the dose the wearer has received**.

## MONITORING

Keep checking for contamination!

Always monitor:

- ☑ The nuclear medicine laboratory, especially at the end of any period of work.
- ☑ The hands and shoes of staff whenever leaving the laboratory.
- ☑ Equipment that has been used and cleaned.
- ☑ The radioactive material store.

Contaminated areas must be cleaned up carefully and surveyed again.

## ☑ If contamination is present

- ☑ Do not touch anything.
- ☑ A contaminated person should contact the Radiation Protection Officer.

Others must:

- ☑ Keep away from other contaminated areas, unless an injured person needs help.

## ☑ Remember

- ☑ Always wear the assigned dosimeters according to the instructions.
- ☑ A female worker should, on becoming aware that she is pregnant, notify the employer in order that her working conditions may be modified if necessary.
- ☑ Avoid contamination.
- ☑ Use a contamination survey meter.
- ☑ Clean up spills as soon as practicable, following instructions or local rules.
- ☑ Take extra precautions when looking after patients treated with high activity radiopharmaceuticals.

## DOSE AND EFFECTS

**Units of dose**

The unit of absorbed dose is the gray (Gy).

The unit used to quantify the dose in radiation protection is the sievert (Sv).

One millisievert (mSv) is 1/1000 of a sievert.

- ▶ Annual doses from natural background radiation vary on average between 1 mSv and 5 mSv worldwide.

One microsievert (µSv) is 1/1000 of a millisievert.

- ▶ The typical dose from a chest X ray is 20 µSv.

**Dose rate**

Dose rate is the dose received in a given time.
The unit used is microsieverts per hour (µSv/h).

- ▶ If a person spends two hours in an area where the dose rate is 10 µSv/h, then they will receive a dose of 20 µSv.

**Health effects of radiation exposure**
In nuclear medicine, there is hardly any chance of deterministic effects rising among staff unless the hand or skin is heavily contaminated.

**AS LOW AS REASONABLY ACHIEVABLE (ALARA)**

Use of the ALARA principle and the regular monitoring of personal dose can minimize the risk of stochastic effects arising.