

# GUIDANCE MATERIAL FOR TRANSPORTING PERSONS SUBJECTED TO RADIOACTIVE MATERIAL INTAKE

Developed in coordination with the  
International Atomic Energy Agency (IAEA)

## Transport of persons for medical treatment

For many years there has been an exemption in the dangerous goods regulations relating to the carriage of a person who contains radioactive material as a result of medical diagnosis or treatment. In 2009, it was noted that this exemption did not apply to cases where the radioactive material in the person was not as a result of medical diagnosis or treatment (e.g. accidental intake). This anomaly is rectified in the latest edition of the regulations. One significant difference is that, in these new scenarios, there is a low risk of some external contamination of the patients. This guidance is intended to be sufficiently generic to allow it to be used for initial urgent transport of a first responder from the incident scene (normally by road) and also for later urgent transport for specialist treatment (normally by air). It will be usual for a casualty to be decontaminated as soon as practicable, however this may be after removal to a safe location by road transport, or by dedicated air ambulance. Patients who are externally contaminated are very unlikely to travel by international commercial air transport.

The Technical Instructions are not presently intended to be applied to movements of a person for medical treatment in case the person has been subjected to the accidental intake of radioactive material or the external contamination from radioactive material. Some adjustment is therefore required.

The appropriate authorities of the States of Operator, Origin, Transit and Destination should be notified of the proposed transport of a person contaminated with radioactive material. Normally, a person being transported for urgent medical treatment will be accompanied by an appropriate medical professional. The responsible medical professional should give advice on radiological safety (if not, locally available appropriate expertise is likely to be available at the destination). Levels of radioactive material in a person who is being flown for medical treatment will be self-limiting to some degree, however the degree to which material internal to the patient can affect others is easy to measure. If the dose rate at 50 cm from the patient exceeds 25 microSv per hour then any adjacent seats should only be occupied by informed and willing carers and it would be sensible for the carer to carry a dosimeter badge. Where there is loose contamination, surgical gloves should be worn. If the dose rate at 50 cm from the patient exceeds 100 microSv per hour then expert advice on radiological protection should be sought and followed.

Radioactive material external to the body is more difficult to deal with. Generally, the principles applied to any medical treatment in terms of cleanliness apply equally to contaminated casualties. Skin decontamination of persons should be considered prior to their transport when the associated delay is estimated to have no health impact. The degree to which contamination is removable from the skin needs to be considered. The method of determining this is to wipe the skin and then measure the amount of radioactive material that is removed on the swab. The goal is to remove any easily removable contamination, or to cover areas where this is not possible such that any contamination cannot spread. Particularly difficult areas are open wounds. Guidance is provided in IAEA documents on contamination monitoring and skin decontamination, and is summarized in the following table.

<b>Monitoring for and dealing with skin contamination</b>
Perform a radiological survey.
Decontaminate the skin with soap using warm water. Do not scrub too vigorously.
Handle any unknown metal objects with a hemostat or forceps.
Save samples and label them (smears of contamination, nasal smear, extracted tooth, hair and nails, purged bone pieces, etc.).
If a wound is contaminated, survey, rinse, debride only for surgical reasons.
If contamination persists, consider covering the area (taking into account that contamination may be fixed to the skin or internal).
Perform a final radiological survey (by first responder monitor/radiological assessor).
Transfer the decontaminated patient to the clean area. Use clean gloves to move the patient to a clean stretcher and exit the contaminated area.
Control the spread of contamination.
Survey staff for possible contamination; remove contaminated clothing and shower before exiting contaminated area.
Survey medical equipment for contamination and decontaminate as required before removing it from the contaminated area.

### **Criteria for determining if decontamination is warranted**

There are two sets of limits established in dangerous goods regulations relating specifically to contamination.

Contamination level below which the object should not be considered as radioactive:

- < 0.4 Bq/cm<sup>2</sup> beta/gamma emitters
- < 0.04 Bq/cm<sup>2</sup> for alpha emitters

Cleanliness limit for packages for transport:

- < 4.0 Bq/cm<sup>2</sup> beta/gamma emitters
- < 0.4 Bq/cm<sup>2</sup> for alpha emitters
- < 5 micro Sv/h at the surface

Contamination limits are specified as being the average over 300 cm<sup>2</sup> and should be measured by an appropriately trained person. The cleanliness limits are set considering both worker and public exposure. Even taking into account the most restrictive conditions, these limits are very unlikely to result in exposures close to dose limits to any member of the public. These levels will apply to the conveyance following transport of a patient.

## First responders

IAEA advice to first responders, who may need to be transported away from the radiation source, gives the following limits:

- 1 micro Sv/h at 10 cm
- 10 000 Bq/cm<sup>2</sup> beta/gamma emitters
- 1 000 Bq/cm<sup>2</sup> for alpha emitters

Only one ambient dose rate criterion of 1 micro Sv/h is provided for assessing the first responder. This criterion can only be used to assess skin/clothing contamination from strong gamma emitters. The ambient dose rate criteria were established at levels for strong gamma emitters that can be easily detected under emergency conditions but still correspond to contamination levels more than 100 times below those at which deterministic health effects would be expected.

Criteria in terms of concentrations (Bq/cm<sup>2</sup>) are provided for use by the radiological assessor for assessment of all types of radioactive materials. The criteria were established at levels which are below those at which contaminated people would experience deterministic health effects warranting medical treatment or follow-up. These limits demonstrate how restrictive the limits for packages are (over 1 000 times lower).

The following were considered in developing the first responder criteria:

- all the important isotopes;
- all members of the public, including children and pregnant women;
- inadvertent ingestion of contamination from the skin;
- external dose from skin contamination;
- skin contamination as an indicator of inhalation dose; and
- personal protective equipment (PPE) for carers not being used.

Generally conservative assumptions were used in the calculations (e.g. it is assumed that the skin contamination is undiminished for four days). For inhalation it was assumed that the skin contamination may have resulted from an airborne cloud and thus is an indicator of inhalation dose.

## Conditions for carriage of patients

Overall, a prudent approach is to use the more limiting criteria resulting in the following three cases based on the dose rate at 0.5 m (the approximate distance between two seated individuals). The following scenarios take into account a long-haul flight and a dose constraint of 0.3 mSv (i.e. no member of the public should get more than one-third of the public dose limit from this activity, and no special precautions should be required other than those listed below). This low constraint ensures safety of all concerned.

### CASE 1

Dose rate at 0.5 m  $>100$  microSv per hour – seek advice from radiological protection expert on separation from other people.

Beta/gamma contamination  $>4.0$  Bq/cm<sup>2</sup>, or Alpha emitters  $>0.4$  Bq/cm<sup>2</sup> – decontaminate or cover the affected area (to reduce any alpha emission, but more importantly prevent the spread of radioactive material).

### CASE 2

Dose rate at 0.5 m  $>25$  microSv per hour – adjacent seats should only be occupied by informed and willing carers.

Beta/gamma contamination  $>4.0$  Bq/cm<sup>2</sup>, or Alpha emitters  $>0.4$  Bq/cm<sup>2</sup> – decontaminate or cover the affected area.

### CASE 3

Dose rate at 0.5 m  $<25$  microSv per hour – no restriction on use of adjacent seats.

Where possible use 1 micro Sv/h at 10 cm, or 5 micro Sv/h at contact (ability to use these values will depend on dose from the patient at 0.5 m).

Beta/gamma contamination  $>4.0$  Bq/cm<sup>2</sup>, or Alpha emitters  $>0.4$  Bq/cm<sup>2</sup> – decontaminate or cover the affected area. If monitoring for contamination is impracticable (e.g. at an ongoing major incident), then consider taking simple precautions such as use of disposable covers, and clean (using routine cleaning methods) the conveyance before next use.

Spread of contamination to the conveyance in significant levels is very unlikely and can be further limited by following this guidance. Generally, it will be accurate to say that the risk to other passengers and workers, even in the most extreme circumstances, will be low compared to the risk to the casualty if they are not treated. Simple precautions such as the patient changing into clean clothes shortly before boarding or placing a sheet (e.g. a typical bed sheet) over the patient's seat can produce even greater protection with little cost.

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