

SESLHD PROCEDURE COVER SHEET



Health
South Eastern Sydney
Local Health District

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FUNCTIONAL GROUP(S)	Radiation Safety
KEY TERMS	Radiation safety; death; radioactive corpse
SUMMARY	Procedure for the handling, investigation and reporting of radiation incidents

COMPLIANCE WITH THIS DOCUMENT IS MANDATORY

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1. POLICY STATEMENT

The South Eastern Sydney Local Health District (SESLHD) is committed, through a risk management approach, to protecting employees, contractors, students, volunteers, patients, members of the public and the environment from unnecessary exposure to radiation arising from systems and processes which use radiation apparatus and radioactive substances, whilst maintaining optimum diagnostic and therapeutic quality, therapeutic efficacy and patient care.

This document provides the procedure to be carried out on the death of a patient being treated with radioactive materials.

2. BACKGROUND

If a patient dies during treatment with radioactive materials (including radioactive applicators or radioactive implants in situ) certain procedures may be required in order to minimise occupational and public exposure.

It should be emphasised that this document applies only to death of patients being treated with *therapeutic* isotopes. If a patient dies shortly after undergoing a *diagnostic* nuclear medicine procedure, no special handling or post mortem precautions are required.

3. RESPONSIBILITIES

In the event of the death of a patient with radioactive material above the relevant activity exemption level in situ:

3.1 Medical Radiation Practitioner (MRP)

The treating Medical Radiation Practitioner, in consultation with a *Qualified Medical Physicist* and *Radiation Safety Officer*, will ensure that:

- the radiation exposure of any person handling the body is minimised;
- each temporarily implanted sealed source or radioactive applicator is removed; and
- consideration is given as to whether a permanent radioactive implant or tissue containing unsealed radioactive material is to be excised;

3.2 Qualified Medical Physicist (QMP)

The appropriately specialised Qualified Medical Physicist will, at the request of the MRP or RSO:

- calculate and document the level of activity of a permanent implant or unsealed radioactive material remaining in the body.

3.3 Radiation Safety Officer (RSO)

The Radiation Safety Officer will, where a permanent implant or unsealed radioactive material remains in the body:

- provide written instructions regarding handling and safety to each person who handles the body; and
- release the body for autopsy, embalming or cremation when safe to do so.

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4. PROCEDURE

4.1 Procedure for the handling of radioactive bodies on the wards

The RSO and the department supervising the patient's treatment must be notified as soon as possible after death. The hospital switchboard has an after-hours number for the RSO and other Medical Physicists who may deputise for them.

All such patients will have a separate yellow radiation-hazard wrist band (see [SESLHDPR/539 Radiation Safety in Ward Areas](#)) in addition to the regular identification wrist band. This band identifies that a significant quantity of radioactive material is present within the patient. This yellow wrist band is not to be removed on death.

Only a minimum of laying out procedures should be attempted (e.g. replacement of false teeth) and the sheet in which the body is wrapped should be labelled with a yellow "radioactive material" label, used in conjunction with the routine mortuary labels indicated in the Nursing Procedures Manual, which will be available in the ward. The label should be clearly visible to all those handling the body.

The body should be removed from the ward as soon as possible after death, and placed, if possible, in the centre section of the body storage refrigerator. This is to minimise potential radiation exposure to staff who may be working in the mortuary. No attempt should be made to remove any of the radioactive material before this is done.

If death occurs within 24 hours of the administration of an anaesthetic, normal Coroner's case procedures should be followed, with the addition that permission is to be obtained from the Coroner to remove any radioactive material from the body.

4.2 Procedures for the handling of radioactive bodies in the mortuary.

Exposure of individuals to radiation emitted by therapeutic radioactive materials retained in or on a corpse can be reduced by adopting the following precautions:

- remove the radioactive materials as soon as safely possible;
- work expeditiously to reduce the time of exposure;
- work at a distance from the radioactive material rather than working unnecessarily close to it; and
- work, where necessary, behind adequate shielding.

The RSO must be consulted to perform a risk assessment on the radiation-related problems likely to be met in performing an autopsy or disposing of the body.

Note: additional Transport Code requirements may apply if a body is to be transported (See [SESLHDPR/534 Transport of Radioactive Substances procedure](#)).

4.3 Death of patient undergoing Nuclear Medicine Therapy using Unsealed Radioactive Sources

If a patient dies during treatment with an unsealed radioactive source, the Nuclear Medicine Practitioner concerned should ensure, after consultation with the Nuclear Medicine Physicist, that the radiation exposure of any persons handling the body is minimised.

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At the time of death, the body should be clearly labelled with the radionuclide, chemical form and estimated residual activity. The body should be handled as little as possible, using strict procedures for prevention of contamination with body fluids, until the Nuclear Medicine Physicist has been contacted

Body fluids may be radioactive and catheterisation of the cadaver should only be performed under the direct supervision of the Nuclear Medicine Physicist.

The following table (based on Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2008) displays maximum activities proposed for autopsy, embalming, burial or cremation of the body of a patient who has died during treatment with unsealed radioactive substances:

	Half life (days)	Indicative maximum activity administered (MBq)	Autopsy/ Embalming (MBq)	Burial (MBq)	Cremation (MBq)
³² P	14.3	200	100	2000	30
⁸⁹ Sr	50.7	200	50	2000	20
⁹⁰ Y	2.7	2000	200	2000	70
¹³¹ I	8.0	10 000	10	400	400
¹⁷⁷ Lu	6.7	8000	100	4000	800

Note: Samarium-153, an alternative to strontium-89 for the palliation of malignant bone disease, is not included in this table as the short half life of 1.95 days allows significant reduction in residual activity after a few days delay.

All corpses released for autopsy, embalming, cremation or burial above these limits should have a label attached, identifying the radionuclide and its activity at the time of release, together with a release statement signed by the RSO.

4.3.1 Precautions for Autopsy

If an autopsy is required, consideration should be given as to whether a CT examination would be a sufficient alternative.

When a corpse contains less radioactive material than the activities shown in the table above, procedures for personal protection normally observed during an autopsy will provide adequate protection against external radiation exposure or contamination with radioactive material.

If a corpse contains activity exceeding the levels shown above and autopsy cannot be postponed for a suitable period for radioactive decay, the pathologist should be informed of the radiation levels likely to be encountered and of the hazards involved. The methods employed and the precautions adopted should be chosen accordingly in consultation with a Nuclear Medicine Physicist and the RSO.

If it is known that the radioactive material used for treatment will have been selectively absorbed in a particular organ (e.g. iodine-131 in the thyroid) then the organ should be excised and removed from the work area before the autopsy examination proceeds. It may later be disposed of with the body after consultation with the RSO.

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If it is known that radioactive material will be distributed in particular body fluids, e.g. iodine-131 or strontium-89 in the bladder, these should be drained off, using suitable equipment, before the examination proceeds. In general, these fluids may be safely disposed of via the sewerage system. The equipment should later be decontaminated by thorough rinsing in a detergent solution followed by washing in running water.

Other practical measures for autopsy may include:

- Assessment of need, timing, shielding, rotation of staff;
- Issue of electronic personal dosimeters (see SESLHDPR 543);
- Wearing of full protection including splash goggles and heavy duty gloves;
- Monitor equipment, staff and room for radioactive contamination at end of autopsy;
- Remove radioactive waste for safe disposal per RSO instruction.

4.4 Death of a Patient Undergoing Treatment with Brachytherapy Sources In Situ

Brachytherapy radioactive implantation may be administered:

Temporarily:

- as inpatient treatment, where the sources are removed before the patient is discharged from the hospital or clinic (e.g. caesium-137 tube applicator, iridium-192 wire implant)
- to patients who are discharged but return subsequently for removal of the sources (e.g. iodine-125 seed eye attachment).

Permanently:

- to patients who are subsequently discharged with the sources permanently in situ (e.g. iodine-125 seed prostate implant).

In all cases, written information should be provided by the Radiation Oncology Practitioner or Physicist in the patient's medical notes, and, as relevant, to the ward staff, the family or carer, and the patient's general practitioner.

This information should include the appropriate actions and contact person (treating Radiation Oncology Practitioner, Radiation Oncology Physicist and RSO) in the event of death of the patient, and should state the relevant date until which the radiation safety precautions apply.

If the patient dies within this time with radioactive sources in situ, this information ensures the notification to the Radiation Oncology Practitioner and other relevant staff at the hospital which administered the treatment.

4.4.1 Procedures for temporary applicators / implants

A temporary applicator/implant, i.e. one which was designed to be removed after a pre-set time (such as caesium-137 tubes, iridium-192 wire, or iodine-125 seed eye attachment), should be removed (surgically if required) from the body by an authorised person as soon as possible after death to avoid unnecessary exposure of further persons.

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Provision should be made for an appropriately shielded container to be available prior to the planned or premature removal of the applicator/implant.

4.4.2 Procedures for permanent applicators / implants

General Radiation Safety Considerations for Post-mortem and Funeral Personnel

The extent of exposure to attending persons will depend on the type of radiation (penetrating or non-penetrating), the amount of activity remaining, the site of the implant and the management of the body (post-mortem, embalming, cremation, burial or entombment).

If a permanent implant remains sufficiently radioactive to be a radiation hazard, radiation safety instructions should be provided to post mortem and funeral personnel by the Radiation Safety Officer of the hospital or clinic which administered the implant so that appropriate care can be taken when dealing with the body. As a rule of thumb, this should occur if the ambient dose equivalent rate is greater than 25 µSv/hour at one metre from the body.

In the case of iodine-125 seed implants, studies have shown that, for the commonly administered activity range, the ambient dose equivalent rate at a distance of one metre from the implant at time of administration is usually less than 25 µSv/hour. Consequently, it is unlikely that morticians or embalmers would be exposed to significant doses during these processes when the implant is seeded iodine-125.

Precautions for Cremation

Encapsulated radioactive sources can survive the cremation process and could therefore be present in the cremated remains and/or the working area of the crematorium personnel.

It is therefore desirable that these sources do not enter the cremation process if their activity, in aggregate is above the relevant radioactive substances exemption levels of the National Directory for Radiation Protection (NDRP). These levels are as shown in the following table, (ARPANSA 2008a):

Cremation: Permanent sealed source implants which will persist with the cremated bone and remains.

Radionuclide, physical half-life and physical form	Treatment and administered activity	Exemption levels Exempt Activity; Exempt Activity Concentration as per the NDRP (IAEA 1996 sup by NRPB R306 1999)	Time from implant administration until activity decreases to the Exempt Activity	NFA after the following time from implant administration
iodine-125 59.9 d titanium encapsulated seeds mp ~1700°C	Prostate implant 0.9 – 1.5 GBq typically ~1.2 GBq (implant) 10 – 12 MBq (individual seed)	1 MBq; 1 MBq/kg	20 months (implant) 7 months (individual seed)	1 year* within this time, excision of the implant should be carried out before the body of the deceased is released for cremation

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Radionuclide, physical half-life and physical form	Treatment and administered activity	Exemption levels Exempt Activity; Exempt Activity Concentration as per the NDRP (IAEA 1996 sup by NRPB R306 1999)	Time from implant administration until activity decreases to the Exempt Activity	NFA after the following time from implant administration
gold-198 2.7 d platinum encapsulated seeds mp ~1770°C	Interstitial implant Up to 6 GBq (implant) Up to 185 MBq (individual seed)	1 MBq; 0.1 MBq/kg	34 days (implant) 20 days (individual seed)	1 month**

* After 1 year from date of implant:

- individual seeds will typically be about 0.17 MBq, well below the Exempt Activity for iodine-125 of 1 MBq; and
- any small collection of seeds in at least 2 kg cremains should meet the Exempt Activity Concentration for iodine-125 of 1 MBq/kg, assuming that only some of the seeds will end up in the collected cremains and the remainder will drop out into cremation furnace and cremulator (processing machine).

** Gold seed implants not currently done in most jurisdictions; included here to illustrate the principle and for future reference if applicable.

If the NDRP exemption levels are likely to be exceeded, cremation should only be permitted if the implant tissue (or most of it) is first excised from the body. This would normally be done by a pathologist under the direct supervision of a Radiation Oncology Physicist to ensure appropriate radiation safety precautions for the pathologist.

The excised tissue should be treated as radioactive waste. In particular, iodine-125 seeds (titanium encapsulated) have been shown to survive the cremation process, and it is recommended that cremation is not carried out within one year following insertion of an iodine-125 seed prostate implant of typical individual source and implant activities unless the implant tissue is first excised.

Precautions for Burial

Permanently implanted sources are not normally an impediment to burial or entombment since once the body is buried or entombed the sources are well shielded.

5. DOCUMENTATION

- Release form

6. AUDIT

The following documentation should be available for audit:

- Calculations of residual activity from permanent implants or unsealed sources remaining in bodies.
- Release statements signed by the RSO for embalming, cremation or burial.

7. REFERENCES

- ARPANSA Statement on Safe Handling of Deceased Persons Recently Treated with Radioactive Material (ARPANSA 2020)
- ARPANSA Radiation Protection Series C-1 *Code for Radiation Protection in Planned Exposure Situations* 2020.
- ARPANSA Radiation Protection Series C-5 *Code for Radiation Protection in Medical Exposure* 2019.
- ARPANSA Radiation Protection Series C-6 *Code for Disposal of Radioactive Waste by the User* 2018
- ARPANSA Radiation Protection Series No. 14.2 *Safety Guide for Radiation Protection in Nuclear Medicine* (ARPANSA 2008)
- ARPANSA Radiation Protection Series No. 14.3 *Safety Guide for Radiation Protection in Radiotherapy* (ARPANSA 2008a)
- International Commission on Radiological Protection (ICRP) Publication 72 *Age-dependent Doses to the Members of the Public from Intake of Radionuclides - Part 5 Compilation of Ingestion and Inhalation Coefficients*
- SESLHDPR/534 Transport of Radioactive Substances procedure
- SESLHDPR/539 Radiation Safety in Ward Areas
- SESLHDPR/543 Personal monitoring

8. VERSION AND APPROVAL HISTORY

Date	Version	Version and approval notes
July 2010	Draft	Radiation Safety Officer in conjunction with the Area Radiation Safety Committee
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