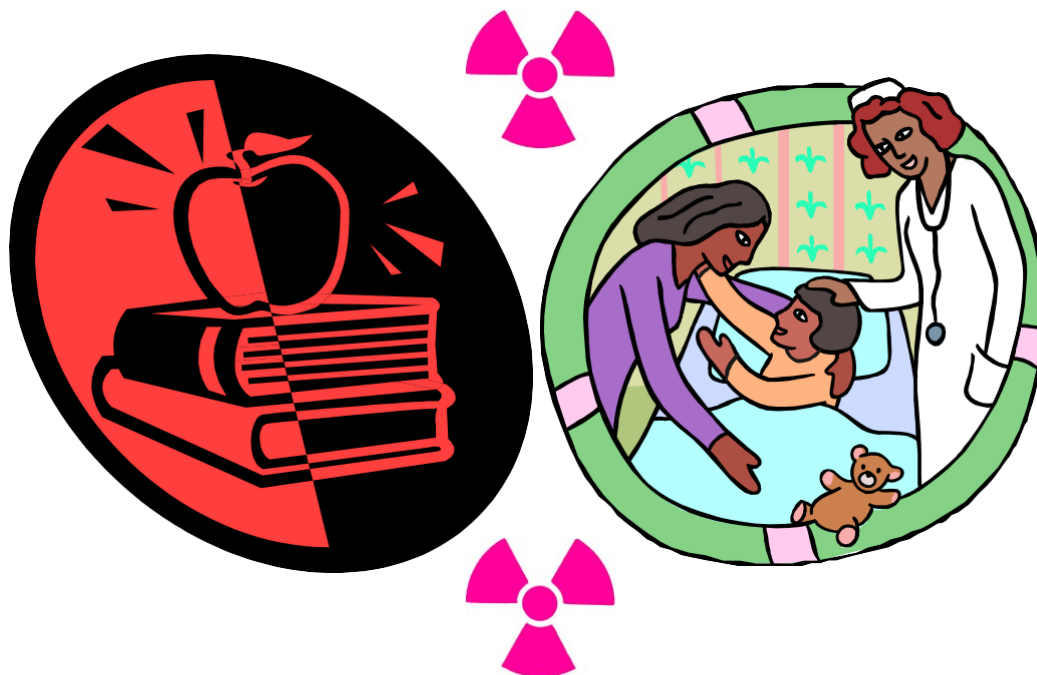


# HEALTH CARE PROVIDER RADIATION SAFETY TRAINING AND REFERENCE MANUAL



October 1993  
(Revised 2001, 2002, 2006, 2007, 2012)

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# TRAINING GOALS AND OBJECTIVES

## Goals

1. To ensure health care providers have a basic understanding of radiation safety principles.
2. To enable health care providers to deliver quality care to patients receiving radiation therapy.
3. To minimize radiation exposure and contamination of patients, visitors, and health care providers.

## Objectives

By the completion of the training program, the participant will be able to:

1. List three (3) specific mechanisms for minimizing radiation exposure.
2. State the regulatory limits for radiation exposure.
3. Explain the "ALARA" principle.
4. Verbalize general procedures used in the care of a patient receiving radiation therapy (e.g., radiopharmaceutical therapy and brachytherapy).
5. Identify common brachytherapy sources.

# GENERAL RADIATION SAFETY INFORMATION

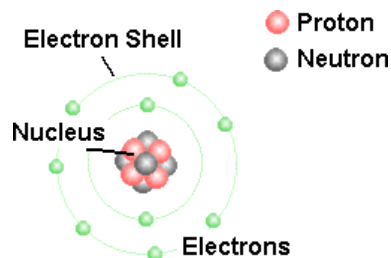
## Emergency Contacts

Department	Daytime Number	Pager number
Radiation Safety Office (RSOf)	513-558-4110	513-249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
Radiation Oncology	513-584-4775	513-590-5555 (Digital) after hours resident on-call (or call University Hospital at 513-584-7243 and request the physician on-call for Radiation Oncology)
CCHMC Nuclear Medicine	513-636-6390	513-303-2078 (Digital) Nuclear Medicine on-call technologist, 513-736-5732 Nuclear Medicine Manager, 513-736-9192 for physician on-call for Nuclear Medicine

## THE ATOM AND RADIOACTIVE DECAY

**The Atom:** All matter is made of atoms. In a simple picture an atom can be imagined as a heavy, compact, positively charged nucleus surrounded by light, negatively charged electrons orbiting in distinct electron shells. The size of the atomic nucleus is about 10,000 times smaller than the atom as a whole.

The nucleus of an atom consists of protons and neutrons held together by nuclear forces. Protons and neutrons have about the same mass and each is approximately 2000 times heavier than an electron. A proton carries a positive electrical charge equal in magnitude to the negative electrical charge carried by an electron. A neutron is electrically neutral.



The number of protons in a nucleus determines the chemical element of the atom and its atomic number, designated as  $Z$ . The total number of protons and neutrons in a nucleus is the mass number of the atom, designated as  $A$ . The standard notation used to represent a nuclide is  ${}^A_Z X$ , where  $X$  is the symbol of the element (Note: general practice is to drop the atomic number  $Z$  since each element has a unique number of protons).

Elements with the same atomic number, but different mass numbers are referred to as isotopes. Isotopes that are unstable are called radioisotopes. Radioactive phosphorus is commonly used in research and is written as the symbol P, implying an atomic number of 15. The atomic mass numbers are indicated as either  ${}^{32}\text{P}$  or  ${}^{33}\text{P}$  for its radioisotopes (Note: when discussing like elements the reference is to “isotopes.” When discussing different elements the reference is to “nuclides.” Therefore  ${}^{32}\text{P}$  or  ${}^{33}\text{P}$  are *radioisotopes* of phosphorus and  ${}^{32}\text{P}$  or  ${}^{14}\text{C}$  two different *radionuclides*).

**Radioactivity:** Radioactivity may be defined as a spontaneous process in which an atom with an unstable nucleus undergoes transformation to a more stable atom by energy emission in the form of radiation. The released energy can be in the form of a particle with kinetic energy, a photon of electromagnetic energy, or a combination of both. The original nucleus prior to the transformation is called the “parent” and the resulting nucleus after transformation is called the “progeny”. A given transformation, i.e., one parent/progeny transition, is termed a “radioactive decay” or disintegration.

**Alpha decay:** (Note: alpha emitting radionuclides are rarely used in medicine.) Relatively heavy radionuclides decay by alpha emission. An alpha particle is essentially an energetic helium nucleus consisting of two protons and two neutrons with an electrical charge of +2. An alpha particle is designated by the symbol  $\alpha$ . A nucleus emitting an alpha particle reduces its atomic number  $Z$  by 2 and mass number  $A$  by 4.



**Beta decay:** Beta decay will result in the emission of a particle from the nucleus that has the same charge and mass as an electron. Nuclei with an excess of neutrons decay by emission of a

beta particle. The result is a neutron transforming into a proton, and the atomic number  $Z$  increasing by 1 while the mass number  $A$  remains the same. The beta particle is designated by the symbol  $\beta^-$  (beta) or  $\beta^+$  (positron). Beta decay results in particles being emitted in continuous spectrum of energies, up to a maximum energy ( $E_{\max}$ ) level for any given radionuclide. The average energy emitted,  $E_{\text{avg}}$  is equal to  $1/3 E_{\max}$ .



**Photon emission:** There are two major types of photon emissions, gamma ray and x-ray. Photon emissions are a type of electromagnetic radiation that travels at the speed of light and acts like small packets of energy called photons. A gamma ray is the same as an x-ray except for two distinguishing characteristics: 1) Gamma rays originate in the nucleus while x-rays originate in the electron shells of an atom and 2) Gamma rays are usually of a higher energy (MeV range) than x-rays (keV range). Gamma rays are emitted from a nucleus that is in an excited state, usually after a decay reaction has taken place. Many, but not all, nuclear decay reactions result in a gamma ray emission. The gamma ray is designated by the symbol  $\gamma$ .



## **RADIATION THERAPY**

Radiation therapy kills cancer cells with a radiation source. The radiation can be delivered by an implant of encapsulated radioactive material near the cancer cells---a procedure called brachytherapy (BRAY-kee-THAIR-uh-pee) or by a beam of radiation from an external machine (teletherapy). The radiation can also be delivered through the use of a radioactive compound called a radiopharmaceutical that is administered either orally or intravenously.

Almost all cells in the body renew themselves by periodically dividing to make a new copy. In cancer, this process gets out of control, spawning an endless series of copies that eventually displace normal tissue. Because radiation is especially damaging to cells at the moment of division and cancer cells divide more frequently than healthy cells, radiation can kill cancer while sparing most of the surrounding normal tissue. Radiation therapy is used to improve control of local disease, treat areas at high risk for recurrence of the cancer, preserve vital organ function and/or minimize normal surrounding tissue damage.

**Teletherapy:** Teletherapy or “external radiation therapy” involves radiation dose being administered to a patient using a machine. The patient sits or lies on a couch and an external source of radiation is pointed at a particular part of the body. The radiation dose is administered remotely and caregivers are not in the room when the dose is administered.

**Brachytherapy:** Brachytherapy has been used since the early 1900s and continues to be used alone or in combination with external radiation therapy, surgery, chemotherapy, and/or hyperthermia for the treatment of cancer. Brachytherapy is also referred to as internal radiation therapy or implant therapy. It is defined as the method of therapy in which the radioactive source is placed on or within the tumor. This placement can be temporary or permanent. Methods used to provide a therapeutic dose of radiation therapy by brachytherapy include interstitial implants, intracavitary implants, and topical implants. For interstitial implants, the radioactive source is directly implanted into the tumor. For intracavitary implants, the radioactive source is placed directly into the body cavity and held in place by an applicator. Topical implants are placed directly on the tumor and include eye implants. Brachytherapy sources are sealed (encapsulated) sources in the form of a needle, tube, seed or wire.

**Radiopharmaceuticals:** Radiopharmaceuticals are given systemically for therapy. The radiopharmaceutical is an unsealed radioactive drug and is administered orally or intravenously.



## RADIATION TERMS AND UNITS

There are a number of terms and/or units uniquely applied to radiation and radiation safety. The most common terms used when dealing with radiation therapy patients are contamination, decontamination, exposure, half-life and pig. The most common units used when dealing with radiation therapy patients include the rem and the curie. Additional radiation terms and units are listed in appendix A.

**Contamination:** Contamination is the deposition of unwanted radioactive material on the surfaces of structures, areas, objects or personnel.

**Decontamination:** Decontamination is the reduction or removal of radioactive material from a structure, surface, area, object or person. Decontamination may be accomplished by treating (e.g., cleaning) the area, removing the contaminated area and disposing as radioactive waste, or allowing the radioactive material to decay.

**Exposure:** Radiation is energy and is emitted from all radioactive materials. Exposure means being exposed to ionizing radiation or radioactive material.

**Half-life:** Half-life is the time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

**Pig:** A pig is a container (usually lead) used to ship or store radioactive material. The container provides protection to a person handling the container from the radioactive material within the container.

**Rem:** Rem is a unit of radiation dose. The most common used subdivision is the millirem, which is 1/1000 of a rem.

**Curie:** The curie is a unit of radioactivity or amount. A curie equals  $3.7 \times 10^{10}$  disintegrations per second. The most common used subdivisions are the millicurie, which is 1/1000 of a curie and the microcurie, which is 1/1000000 of a curie.

## ALARA AND RADIATION PROTECTION TECHNIQUES

Radiation safety is primarily the use of techniques to keep radiation exposure and dose **as low as is reasonably achievable (ALARA)**. The principles of *time*, *distance*, and *shielding* are used to keep radiation exposure and dose ALARA. When providing care to a radiation therapy patient the principles are most effective for gamma-emitting radionuclides since the patient's body provides shielding for beta-emitting radionuclides. In addition to the application of time, distance and shielding, the use of personnel protective equipment also assists in keeping radiation exposure and dose ALARA.

**Time:** Radiation dose is a function of the time spent near a radiation source. The shorter the time someone is near a radiation source, the smaller the radiation dose. Time spent with a radiation therapy patient should be limited to the time necessary to provide appropriate care. Unless special arrangements are made, visitation time is limited to the visitor stay time posted on the patient's door. To keep doses ALARA, **minimize time**.

**Distance:** In radiation safety, distance is applied to the amount of space between an individual and the radiation source. Increasing the distance from a radiation source significantly decreases radiation exposure. The radiation exposure decreases proportionally with the distance change, up to the square of the distance change. Therefore moving from one foot away to three feet away decreases radiation exposure up to nine times. To maximize distance from the radiation source stand several feet away from the patient while providing indirect care and/or work/provide direct care from the opposite side of the bed of the implant site. To keep doses ALARA, **maximize distance**.

**Shielding:** The use of shielding is applied when a protective material is placed between the radiation source and an individual. Lead is the most frequently used material for shielding. The thickness of the lead and the energy of the photon emitted by the radiation source determine the degree of protection. A lead shield can be cumbersome when performing procedures and can increase the amount of time spent with the patient. A lead shield in the room should be used as a reminder to limit time and increase distance. Since beta particles have mass and will travel only a short distance in tissue, the patient's body serves as a very effective shield resulting in shielding as much as 100% of the beta radiation emitted. Types of shielding that may be encountered when dealing with the patients undergoing radiation therapy include the patient's body, a lead shield positioned in room or a lead-lined eye shield. To keep doses ALARA, **shielding should be placed between an individual and the radiation source**.

**Personnel protective equipment:** In addition to the basic principles of time, distance and shielding, the use of personnel protective equipment is important when unsealed radioactive material, such as a radiopharmaceutical is involved. When unsealed radioactive material is involved, wearing personnel protective equipment, such as gloves, shoe covers and laboratory coats, significantly reduces the spread of contamination and the deposition of contamination on a caregiver's skin. To keep doses ALARA, **use personnel protective equipment as applicable**.

## RISKS

The biological effects of low level radiation, i.e., acute whole body doses up to 10 rem or substantially larger doses received over an extended period of time, are not directly known. The biological effects are assumed using the "linear no threshold" theory. This theory assumes that a linear relationship exists from high dose levels all the way down to a zero dose level and that even very small amounts of radiation can cause biological damage detrimental to the individual. Other theories hold that below some threshold value, possibly 10 rem there is no biological damage the human body cannot repair. Finally, some individuals believe there is a positive (hormetic) effect at low dose levels that may help the body fight cancer. However, until more positive proof is provided, government agencies continue to regulate worker and public doses based on the most conservative "linear-no threshold" theory.

What risks may be involved in caring for a radiation therapy patient under radiation precautions? Regulatory agencies set radiation dose limits based upon acceptable risk estimates. The regulators have set dose limits for radiation workers and the general public. A radiation worker may receive a dose (average over the whole body) of 5 rem (5000 millirem) per year. A member of the public may receive a dose of 0.1 rem (100 millirem). A member of the public may also receive 0.5 rem (500 millirem) from a patient who has a radiation source implant or been administered a radiopharmaceutical. These doses are in addition to the average natural background dose of 0.3 rem (300 millirem), the average man-made "background" dose of 0.025 rem (25 millirem) and the average dose of 0.3 rem (300 millirem) from medical procedures.

These regulatory limits make working with radiation a "safe" industry, when compared to other work related risks. A one rem lifetime radiation dose using the "linear-no-threshold" theory is estimated to increase the chances of dying from cancer by  $4 \times 10^{-4}$ . Twenty percent of adults in the United States will die from cancer from smoking, food, alcohol, drugs, air pollutants, and inherited traits. To put this into a proper perspective, in any group of 10,000 workers, it can be estimated that 2,000 will die from cancer without any occupational radiation exposure. If each of these 10,000 workers receives one rem of occupational radiation dose, using the "linear-no- threshold" model it is estimated that an additional four will die from delayed cancer. The one- rem figure is used because the majority of radiation workers receive one rem or less of occupational radiation dose in their lifetimes.

Health Care radiation workers within the University of Cincinnati Radiation Control and Safety Program average well below 100 millirem per year. A detailed explanation of risks from occupational radiation exposure can be found in U.S. Nuclear Regulatory Commission (NRC) REGULATORY GUIDE 8.29 INSTRUCTION CONCERNING RISKS FROM OCCUPATIONAL RADIATION EXPOSURE. Copies are available on the NRC's website ([www.nrc.gov](http://www.nrc.gov)) or from the Radiation Safety Office (558-4110).

## PRENATAL RADIATION RISKS AND DECLARING A PREGNANCY

Faster dividing cells and less differentiated cells, including the embryo/fetus, are known to be more sensitive to radiation. Because the embryo/fetus is more radiosensitive than an adult, the occupational total effective dose equivalent limit for a radiation worker during a declared pregnancy is set at 1/10<sup>th</sup> (0.5 rem) the normal adult occupational limit. This limit is only in effect if the female chooses to "declare" her pregnancy in writing. Detailed information is found in U.S. Nuclear Regulatory Commission (NRC) REGULATORY GUIDE 8.13 INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE. Copies are available on the NRC website ([www.nrc.gov](http://www.nrc.gov)) or from the Radiation Safety Office (558-4110).

Declaring a pregnancy is optional. If an individual does not declare their pregnancy their radiation dose limits are the standard dose limits for an adult radiation worker.

### Declaring a pregnancy:

- Health Care radiation workers wishing to declare their pregnancy should notify their supervisor and must notify the Radiation Safety Office *in writing* if pregnancy is suspected or confirmed. RS Form 33 "Declaration of Pregnancy" is available on the Radiation Safety Office website ([www.uc.edu/radsafety](http://www.uc.edu/radsafety)).
- The maximum radiation exposure to declared pregnant personnel is **0.5 rem (500 mrem)** during the pregnancy. Once the pregnancy is declared to the Radiation Safety Office an assessment will be made.
- If it is determined it is likely that caring for certain types of radiation patients could result in a dose greater than the maximum allowed, the Radiation Safety Officer will inform the individual and their supervisor. The Radiation Safety Officer will discuss work assignment modification with the supervisor to ensure the dose is maintained below the regulatory limit.
- Throughout the individual's declared pregnancy, work assignments related to the care of patients receiving radiopharmaceuticals and/or brachytherapy are evaluated and monitored by the manager/designate and radiation safety.

Health Care radiation workers who have questions and/or want to discuss a specific situation are encouraged to contact the Radiation Safety Officer (558-4110). This includes Health Care radiation workers who may be pregnant, are unsure about declaring a pregnancy or have radiation risks concerns regarding getting pregnant.

## RADIATION DETECTION EQUIPMENT

Radiation itself cannot be directly detected by the human body. It cannot be detected by sight, smell or touch. However, some material interactions can be detected. The type of radiation detection equipment encountered when providing care to a radiation therapy patient are the survey meter, the whole body dosimeter and the personnel dosimeter monitor (PDM).

**Survey meter:** The survey meter is a portable radiation detection instrument specially adapted for inspecting an area to establish the existence and amount of radioactive material present. Survey meters are simple instruments that give an indication of the amount of radiation that is present at a specific time. Survey meters detect ionizing radiation using ionization. During ionization an electron is detached from an atom, free to move and will continue to move if a supply of energy is available to keep it moving. This flow of electrons is called electric current. The survey meter detects varying flows of electrical current due to varying amounts of ionizing radiation present. Survey meters are portable and allow immediate radiation protection decisions to be made on location. For example, survey meters allow for contamination to be readily detected and cleaned up before it is spread. The types of survey meters used include the Geiger-Mueller (GM) survey meter, the ion chamber and the sodium iodide (NaI) survey meter. The survey meter most frequently provided for Health Care radiation workers to perform surveys of themselves after providing care to a radiopharmaceutical patient is the GM survey meter.



**Whole body dosimeter:** The whole body dosimeter is an after the fact dosimeter. The whole body dosimeter provides a record of the amount of whole body radiation exposure the wearer received. Each whole body dosimeter is assigned to a specific individual. The specific individual must wear the dosimeter when exposed to radiation, such as providing care to a radiation therapy patient. It is important to notify the RSO if immediately if your whole body dosimeter is lost or damaged, so a replacement dosimeter can be issued. The whole body dosimeter is worn at the area on the trunk of the body which is expected to receive the highest exposure to radiation by the person to whom it is issued. The whole body dosimeter is not to be worn during non-occupational exposure and must be stored in a protected, low-background location. The type of whole body dosimeter used under the University of Cincinnati Radiation Control and Safety Program is the Luxel® dosimeter. The Luxel® dosimeter is an optically stimulated luminescent (OSL) dosimeter. When exposed to radiation some of the energy from the radiation is “trapped” in the OSL. The energy is released as detectable light using a laser beam. The radiation dose to the dosimeter (and the individual wearing the dosimeter) is determined from the amount of light emitted.



**Personnel dosimeter monitor (PDM):** The PDM is not as sensitive or as accurate as the whole body dosimeter; however, it does provide a more immediate assessment of the radiation dose received by an individual. The PDM should either be zeroed or read prior to entering a radiation therapy patient’s room. The PDM should be read upon exiting the radiation therapy patient’s room. The difference in readings is a good estimation of the radiation dose received. If a PDM is used, the PDM must be worn in conjunction with a whole body dosimeter.

## GENERAL APPLICATION INFORMATION

1. The following procedures are always followed unless otherwise directed.
  - a. Maintain dose ALARA. Avoid unnecessary contact and maximize distance from the patient and/or implant site whenever possible.
  - b. The patient's chart and/or door signage will list details of the radiation therapy.
  - c. Limit visitors to non-pregnant individuals who are 18 years of age or older. Visitors should remain at least six (6) feet from the patient or behind the 2 mR/hr line.
  - d. Care is needed when handling dressing or linen changes:
    - i. Brachytherapy implants - observe soiled dressings and linens for dislodged seeds.
    - ii. Collect soiled dressings and linens in labeled container for survey by Radiation Safety Office staff.
  - e. Only Radiation Safety Office staff is authorized to remove signs and postings.
2. Regulations allow some deviation when a regulatory requirement may impair the health of a patient. The Authorized User physician in consultation with the Radiation Safety Officer may authorize a deviation on a case-by-case basis. If a deviation is approved specific instructions will be provided.
3. A radiation therapy patient who has been released from radiological precautions may be required to remain in the hospital for other medical reasons. In these cases, an instruction sheet containing information similar to home instructions shall be placed in the patient's chart by the Radiation Safety Office. However, no specialized radiological precautions remain in place.
4. Some radiation therapy patients may contain implants that present little radiation risk to workers and visitors, but must remain hospitalized for regulatory reasons. For these patients the visitor stay time will be listed as unlimited. In addition, the patient's food may be delivered by dietary personnel as noted by the Radiation Safety Office posting a sign on the patient's door stating, "TRAY PASSERS MAY ENTER."
5. If the room of a radiation therapy patient requires cleaning while under radiation precautions and a trained Health Care radiation worker cannot perform the task, arrangements must be made to have a Radiation Safety Office staff member supervise the cleaning. This supervision will include observing the housekeeping staff member clean the room and surveying all materials taken from the room.
6. Dosimeters are to be worn by Health Care radiation workers providing care to patient's under radiation precautions. The dosimeter should be worn at an area on the trunk of the body that is expected to receive the highest exposure.
  - a. All Health Care radiation workers monitored for radiation exposure are notified if they come within ALARA investigational limits (i.e., 10%/30% of regulatory limits).
  - b. Annually (~April/May), a report of the previous year's dosimetry results are distributed with the applicable month's dosimeters. Any Health Care radiation worker wanting more frequent information should call the Radiation Safety Office.

# **RADIONUCLIDE SPECIFIC INFORMATION**

(Isotope Fact Sheets for each of the radionuclides  
are also available on  
the Radiation Safety Office website  
at [www.uc.edu/radsfaety](http://www.uc.edu/radsfaety))

## IODINE – 125

### I-125

#### General Information

I-125 is a low-energy gamma-emitting radionuclide that may be used for brachytherapy or radiopharmaceutical therapy.

Because of the lower energy of the gamma ray emission from I-125, the patient's body provides shielding, and other shielding is very effective in reducing radiation exposure rates.

I-When I-125 is used in brachytherapy, it is sealed sources (encapsulated radioactive material). Because the radioactive source is sealed, body secretions are not radioactive. It is used in the treatment of tumors as a temporary or permanent implant. Tumors may include brain, breast, prostate, eye or any soft tissue. The sealed sources are generally "seeds". Seeds may have the appearance of a wire or a small tomato seed. (Larger picture in Appendix B) The length of therapy for temporary implant generally ranges from 2 to 7 days.



When I-125 is used in a radiopharmaceutical body secretions are likely radioactive. The radiopharmaceutical is often I-125 tagged to a monoclonal-antibody for treatment of cancer. The radiopharmaceutical may be administered orally or intravenously.

#### General Safety Considerations

1. Due to the low energy of the gamma radiation emitted, radiation exposure is generally minimal, but maximize distance whenever possible.
2. In some cases lead shielding such as lead skullcaps, limb covering or eye patches may be used. If lead shielding is used, the shielding should be placed between implant site and caregiver.
3. The patient's chart and/or door signage will contain start time of radiation treatment, total amount of activity implanted and the anticipated stop time.
4. No unauthorized or non-essential personnel should enter the room. Personnel who have not received radiation safety training must follow visitor guidelines.
5. Health Care radiation workers shall wear dosimeters when providing care to radiation patients being treated with I-125 and when working in the patient's room.
6. Additional requirement if brachytherapy: Dressings should be observed for dislodged sources (seeds). If a seed is found, **do not touch seed(s) with hands**; lift with tongs and put in lead container ("pig"). Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
7. Additional requirement if radiopharmaceutical: All items handled by the patient are potentially radioactive. Consequently, all waste and materials handled by the patient or used in the patient's room should be handled as radioactive until determined otherwise.
8. Additional requirement if radiopharmaceutical: Double gloves, gown and double shoe covers must be worn upon entering the room or when attending the patient.



**IODINE – 125**  
**I-125**

Health Care Radiation Worker Provider Instructions – Summary  
(temporary brachytherapy)

1. **Patient care must not be compromised because of potential radiation exposure.** To keep dose ALARA, avoid unnecessary contact, maximize distance from the implant site, perform duties with lead shielding in place (e.g., eye or limb shield) and use the posted exposure rates on PATIENT EXPOSURE SURVEY FOR CAREGIVER GUIDANCE (Form 50A).
2. Patient will likely be required to stay in his/her room and may be required to stay in his/her bed.
3. Visitors are limited to non-pregnant individuals 18 years or older. Visitors should remain at least six (6) feet from the patient or behind the 2 mR/hr line. Visitors not designated as an Familiar Adult Caregiver (FAC) **must** comply with "stay time" posted on the door.
4. Dressing or linen changes should be observed for dislodged seeds and must be collected in the labeled containers for survey by Radiation Safety staff.
5. Dislodged Source: (I-125 seeds resemble a small tomato seed or may be strung along a wire (silver colored))
  - a. If a seed is found, place in lead container (“pig”) or cup of water using tongs. **Do not touch source with hands.**
  - b. Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
  - c. Do not remove anything from the room.
  - d. Remain close by, but away from the radiation source. Restrict access to the patient's room until Radiation Safety Office staff arrives.
6. Health Care radiation workers should always wear a personal dosimeter when providing direct care to the patient or in the patient’s room. The dosimeter should be worn at an area on the trunk of the body that is expected to receive the highest exposure.
7. In the event of a medical emergency or cardiac arrest, follow hospital guidelines for contacting arrest team. Contact the Radiation Safety Office and Radiation Oncology STAT!
8. If the patient expires, contact the Radiation Safety Office and Radiation Oncology STAT!
9. For radiation safety questions contact the Radiation Safety Office.

Department	Daytime Number	Pager number
Radiation Safety Office (RSOf)	513-558-4110	513-249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
CCHMC Nuclear Medicine	513-636-6390	513-303-2078 (Digital) Nuclear Medicine on-call technologist, 513-736-5732 Nuclear Medicine Manager, 513-736-9192 for physician on-call for Nuclear Medicine.

## IODINE – 125

### I-125

#### Health Care Radiation Worker Instructions – Summary (radiopharmaceutical therapy)

1. Persons entering the patient's room shall wear gowns, double gloves, and double shoe coverings. Follow posted instructions to remove gowns, gloves and shoe covers immediately upon leaving the patient's room. Dispose of gowns, gloves, and shoe coverings in container provided inside the patient's room.
2. **Patient care must not be compromised because of potential radiation exposure.** Avoid unnecessary direct patient contact, and maximize distance whenever possible. To minimize radiation exposure use time, distance and shielding.
3. The patient is required to remain in his/her room.
4. Visitors are limited to non-pregnant individuals 18 years or older. They should remain at least six (6) feet from the patient. Visitors **must** comply with "stay time" posted on the door.
5. All materials handled or used in the patient's room are potentially radioactive. This material includes food items, disposable trays, plates, cups, and eating utensils. Disposable items must be used for all meals. All materials must be collected in containers provided by the Radiation Safety Office. The Radiation Safety Office will survey and dispose of the items daily.
6. Health Care radiation workers shall always wear a personal dosimeter when providing direct care to the patient or when in the patient's room. The dosimeter should be worn under the protective gown at an area on the trunk of the body that is expected to receive the highest exposure.
7. In the event of a medical emergency or cardiac arrest, follow hospital guidelines for contacting arrest team. Contact the Radiation Safety Office and Nuclear Medicine STAT!
8. In the event of urine, emesis, or any body fluid spills, or patient death, contact Radiation Safety and Nuclear Medicine STAT!
9. For any non-patient related radiation safety questions contact the Radiation Safety Office.

<b>Department</b>	<b>Daytime Number</b>	<b>Pager number</b>
Radiation Safety Office (RSOf)	513-558-4110	513-249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
CCHMC Nuclear Medicine	513-636-6390	513-303-2078 (Digital) Nuclear Medicine on-call technologist, 513-736-5732 Nuclear Medicine Manager, 513-736-9192 for physician on-call for Nuclear Medicine.

**IODINE – 125**  
**I-125**

Example Nursing Care Plan  
(temporary brachytherapy implant)

Nursing Diagnosis: Knowledge deficit: Related to radiation safety precautions for patients receiving I-125 brachytherapy and/or parent of patient receiving temporary brachytherapy implant.

Focus: Information

Outcome: Parent/patient will verbalize understanding of radiation safety precautions.

Nursing Orders:

1. Instruct parent/patient that patient will be confined to his/her room approximately 2-7 days, as specified by the treatment time.
2. Inform parent/patient that all used linen will be temporarily stored until checked (daily) by a member of the Radiation Safety staff.
3. Instruct parent/patient that patient will not be radioactive once the implant is removed and that body secretions are not radioactive.
4. Inform parent/patient that health care providers will limit the time they spend in the room to only that necessary for good patient care (i.e., limited to treatments associated with his/her medical condition). Encourage self-care and, if applicable assistance from the Familiar Adult Caregiver (FAC).

=====

Nursing Diagnosis: Knowledge deficit: Related to radiation safety precautions for visitors of patients receiving I-125 temporary brachytherapy implant.

Focus: Information

Outcome: Parent/patient will verbalize understanding of visitor precautions.

Nursing Orders:

1. Instruct parent/patient and visitor about dose minimization precautions.
  - a. Visitation time for any single visitor not designated as a FAC is limited to the "stay time" listed on the door sign.
  - b. Visitors should maximize their distance from the patient. (Minimum distance of 6 feet or behind the 2 mR/hr line)
  - c. Visitors should remain only in the designated areas.
2. Instruct parent/patient about visitor restrictions.
  - a. No pregnant person or a person who suspects she is

pregnant may visit the patient.

- b. No person under the age of 18 may visit the patient.
- 3. Instruct parent/patient that visitors are not permitted if an implant is missing or becomes dislodged.

=====

Nursing Diagnosis: Potential for anxiety: Related to social isolation.  
Focus: Coping  
Outcome: Minimize isolation anxiety.  
Nursing Orders: 1. Reassure parent/patient that the patient will not be abandoned. Reinforce reasons for time limitations for health care providers and visitors (i.e., maintaining radiation dose ALARA).  
2. Assure call light within reach and operable.  
3. Frequent observation of patient by health care provider, with maximization of distance.  
4. Encourage diversionary activities, e.g., television, radio, cards, magazines, books, and games.  
5. If available, use camera and/or two-way communication system.

Nursing Diagnosis: Discharge Planning.  
Focus: Information  
Outcome: Parent/patient will verbalize understanding of discharge instructions and the need for follow-up care with the physician.  
Nursing Orders: 1. Inform the parent/patient that the patient is not radioactive once the radiation implants are removed.  
2. Instruct parent/patient per physician orders.

=====

Nursing Diagnosis: Discharge Planning.  
Focus: Information  
Outcome: Nurse will understand special discharge instructions.  
Nursing Orders: 1. Room cannot be released to Housekeeping for post discharge cleaning until approved by the Radiation Safety Office.  
2. Only Radiation Safety Office staff may remove the "Caution Radioactive Material" sign from the door.

## **IODINE – 131**

### **I-131**

#### **General Information**

I-131 is a high-energy gamma-emitting radionuclide used for radiopharmaceutical therapy. I-131 also emits high energy betas that provide much of the therapeutic dose.

I-131 is used in the treatment of hyperactive thyroid, thyroid ablation (destruction) thyroid cancer and neuroblastoma.

The radiopharmaceutical (drug that includes the I-131 in its molecular structure) is an unsealed radioactive material and is not reusable.

The radiopharmaceutical or the radioactive iodine is excreted primarily by the kidneys; but also may be excreted in perspiration, nasal secretion and stool, and may be present in emesis.

I-131 may be administered by mouth in liquid form or capsules. I-131 may also be administered intravenously either by manual injection or by utilization of an injection pump.

#### **General Safety Considerations**

1. All items handled by the patient are potentially radioactive. Consequently, all waste and materials handled by the patient or used in the patient's room should be handled as radioactive until determined otherwise.
2. Double gloves, gown and double shoe covers must be worn upon entering the room or when attending the patient.
3. Maximize distance whenever possible.
4. The chart and/or door signage will identify the radionuclide and total activity administered.
5. No unauthorized or non-essential personnel should enter the room. Personnel who have not received radiation safety training for caregivers must follow visitor guidelines.
6. Health Care radiation workers shall wear dosimeters when providing care to radiation patients being treated with I-131 and when working in the patient's room.
7. Nurses must survey themselves when exiting the room of a patient undergoing radiotherapy utilizing I-131.

**IODINE – 131**  
**I-131**

Health Care Radiation Worker Instructions – Summary  
(radiopharmaceutical therapy)

1. Persons entering the patient's room shall wear gowns, double gloves, and double shoe coverings. Follow posted instructions to remove gowns, gloves and shoe covers immediately upon leaving the patient's room. Dispose of gowns, gloves, and shoe coverings in container provided by the Radiation Safety Office.
2. **Patient care must not be compromised because of potential radiation exposure.** Avoid unnecessary direct patient contact, and maximize distance whenever possible. To minimize radiation exposure, apply time, distance and shielding.
3. The patient is required to remain in his/her room.
4. Visitors are limited to non-pregnant individuals 18 years or older. They should remain at least six (6) feet from the patient. Visitors who are not a Familiar Adult Caregiver **must** comply with "stay time" posted on the door.
5. All materials handled or used in the patient's room are potentially radioactive. This material includes food items, trays, plates, cups, and eating utensils. Disposable items must be used for all meals. All materials must be collected in containers provided by the Radiation Safety Office. The Radiation Safety Office will survey and dispose of the items daily.
6. Health Care radiation workers shall always wear a personal dosimeter when providing direct care to the patient or when in the patient's room. The dosimeter should be worn under the protective gown at an area on the trunk of the body expected to receive the highest exposure.
7. In addition to the personal dosimeter, Health Care radiation workers are required to wear a PDM. The PDM must be worn underneath the gown.
8. In the event of a medical emergency or cardiac arrest, follow hospital guidelines for contacting arrest team. Contact the Radiation Safety Office and Nuclear Medicine STAT!
9. In the event of urine, emesis, or any body fluid spills, or patient death, contact Radiation Safety and Nuclear Medicine STAT!
10. For any non-patient related radiation safety questions, contact the Radiation Safety Office.

<b>Department</b>	<b>Daytime Number</b>	<b>Pager number</b>
Radiation Safety Office (RSOf)	513-558-4110	513-249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
CCHMC Nuclear Medicine	513-636-6390	513-303-2078 (Digital) Nuclear Medicine on-call technologist, 513-736-5732 Nuclear Medicine Manager, 513-736-9192 for physician on-call for Nuclear Medicine.

**IODINE - 131**  
**I-131**

Example Nursing Care Plan  
(sodium iodide therapy)

Nursing Diagnosis:	Knowledge deficit: Related to radiation safety precautions for patients receiving I-131.
Focus:	Information
Outcome:	Parent/patient will verbalize understanding of radiation safety precautions.
Nursing Orders:	<ol style="list-style-type: none"><li>1. Inform parent/patient that the patient will be confined to his/her room approximately 1 to 3 days depending on the amount of I-131 administered. Most patients receiving sodium iodine I-131 treatment, who must stay in the hospital require less than 1 full day of hospitalization. (The radioactive iodine is excreted through the urine, perspiration, nasal secretions and stool, and may be present in emesis.)</li><li>2. Inform parent/patient that disposable trays and utensils will be used. The trays and utensils will be held with other trash until surveyed (daily) by Radiation Safety Office staff.</li><li>3. Inform parent/patient that the floor covering and plastic wrap on switches and other equipment will allow a more efficient cleanup of the room when the patient is discharged.</li><li>4. Inform parent/patient that all used linen will be temporarily stored until checked (daily) by a member of the Radiation Safety Office staff.</li><li>5. Encourage parent/patient to bring minimal personal belongings into the patient's room due to any item which comes in contact with the patient may contain radioactive secretions. Any items that contain radioactive secretions must be disposed of by or held by the Radiation Safety Office until it no longer contains the radiation, which generally takes about 3 months.</li><li>6. Inform parent/patient that health care providers will limit the time they spend in the room to only that necessary for good patient care, (i.e., limited to treatments associated with his/her medical condition). Encourage self-care. Encourage Familiar Adult Caregiver assistance.</li><li>7. Instruct parent/patient to notify the nurse immediately if vomiting, incontinence or any body fluid spill occurs. <b><u>All items which may have come in contact with the patient, including personal items, must be cleared by the Radiation Safety Office prior to removal from the patient's room.</u></b></li></ol>

=====

Nursing Diagnosis: Knowledge deficit: Related to radiation safety precautions for visitors of patients receiving I-131.

Focus: Information

Outcome: Patient, parent of patient and/or visitor(s) will verbalize understanding of precautions to be followed while visitor(s) is in the patient's room.

Nursing Orders:

1. Instruct parent/patient/visitor(s) about dose minimization precautions:
  - a. Except for Familiar Adult Caregivers, visitation time for any single visitor is limited to the "stay time" listed on the door sign.
  - b. Visitors should maximize their distance from the patient (Minimum distance of 6 feet or behind the 2 mR/hr line.)
  - c. Visitors should remain only in the designated areas.
2. Instruct parent/patient/visitor(s) regarding visitation restrictions:
  - a. No pregnant person or a person who suspects she is pregnant may visit the patient.
  - b. No person under the age of 18 may visit the patient.
3. Instruct parent/patient/visitor(s) that visitor(s) are restricted from applying cosmetics, consuming food or drink while in the room and taking any food or drink from the room for their consumption.
4. Instruct parent/patient that visitor(s) are restricted from removing any items from the room.
5. Instruct parent/patient/visitor(s) that visitors must put on a gown, two (2) sets of shoe covers and two (2) sets of gloves before entering the room and that they must use the posted procedure to survey themselves and properly dispose of gown, shoe covers and gloves immediately upon leaving the room.

=====

Nursing Diagnosis: Alteration in Nutrition: less than body requirements related to nausea and vomiting.

Focus: Nutritional

Outcome: Patient will have adequate nutrition intake and control of nausea and vomiting.

Nursing Orders:

1. To reduce nausea during I-131 therapy; NPO for 2 hours before I-131 administration:



- a. Offer frequent mouth care.
  - b. Instruct parent/patient, patient needs to remain in an upright position.
2. If patient begins to feel nauseated, encourage deep breathing and voluntary swallowing.
  3. Anti-emetics, per physician's order.
  4. Encourage use of lemon slices, hard candy, or gum at bedside to increase salivation (for consumption by patient only).

=====

Nursing Diagnosis: Alteration in bowel elimination: Related to evacuation of radioactive material.

Focus: Elimination

Outcome: At least a daily bowel movement.

Nursing Orders: 1. Inquire and document amount and frequency of bowel movement.

2. If necessary, administer laxative per physician's order.

=====

Nursing Diagnosis: Potential for anxiety: Related to social isolation.

Focus: Coping

Outcome: Patient will experience isolation anxiety.

Nursing Orders: 1. Reassure parent/patient the patient will not be abandoned. Reinforce reasons for time limitations for health care providers and visitors (i.e., maintaining radiation dose ALARA).

2. Assure call light within reach and operable.

3. Frequent observation of patient by health care provider, with maximization of distance. Use of 2-way communication and camera to monitor patient.

4. Encourage diversionary activities, e.g., television, radio. (Reminder: before the patient leaves room all personal items such as cards, magazines, books and games must be discarded in a waste container in the room, or must be monitored by the Radiation Safety Office.)

5. Sedation of patient per physician's orders, as needed.

=====

Nursing Diagnosis: Discharge Planning.

Focus: Information

Outcome: Parent/patient will verbalize understanding of discharge instructions and the need for follow-up care.

- Nursing Orders:
1. Remind parent/patient of home instructions received from the Nuclear Medicine physician. A sample "Home Precautions" for I-131 sodium iodine therapy patients is included in this manual for information purposes only. The official instructions are provided to the parent/patient by Nuclear Medicine staff.
  2. Provide information about follow-up appointment.
  3. Patient will continue on medication until directed by physician.
  4. Inform the parent/patient, the patient cannot be discharged until the physician has approved discharge and the Radiation Safety Office has monitored and determined that the radiation levels are such that they may be discharged.

=====

Nursing Diagnosis: Discharge Planning.

Focus: Information

Outcome: Nurse will understand special post discharge instructions.

- Nursing Order:
1. Room cannot be released to Housekeeping for post discharge cleaning until approved by the Radiation Safety Office.
  2. Only the Radiation Safety Office staff may remove any posted "Caution Radioactive Material" sign on door or in room.

**SAMPLE HOME PRECAUTIONS**  
**(sodium iodide therapy)**  
Home Instructions  
I-131-Therapy

RADIOISOTOPE LABORATORY  
Children's Hospital Medical Center

Home Precautions to be taken by patient  
after receiving a therapeutic dose of radioiodine (I-131)

1. Sleep alone for two weeks.
2. Drink plenty of liquids during the daytime for the first two days after the therapy. Try to urinate frequently.
3. Whenever possible use separate toilet facilities, that is, a toilet not used by other members of the family (for two weeks).
4. Use care so that the area around the toilet is not soiled with urine (for two weeks).
5. Wash hands well after using toilet.
6. Bed linens, towels and clothing need no special precautions, except when there are young children in the family, in which case your linen and clothing should be washed separately with soap or detergent, after the other clothing has been washed (for two weeks). The tub or washing machine should be rinsed once (that is, run an extra rinse cycle on the machine after linen and clothing have been removed).
7. Limit the periods of time during which you are less than 3 feet from small children.
8. Wash out bathtub with soap or cleanser after tub or shower bath (for seven days).
9. You may eat 3 hours after treatment and your diet need not alter in any way.
10. Use stringent contraceptive measure to avoid pregnancy during the three (3) months after treatment. Do not breast feed during this time.
11. Do not travel by airplane or mass transportation for the first day.
12. Do not take prolonged auto trip with others for 2 days.
13. If any questions arise regarding these instructions, or any "radiation" questions, we can be reached at (513) 636-6390 (workdays), (513) 636-4200 (evenings/weekends). Ask for the Nuclear Medicine doctor on call.
14. If medical questions arise, please call the Endocrinology doctor on call (513) 636-4744, (workdays), or (513) 636-4200 (evenings/weekends).

**IODINE – 131**  
**I-131**

Example Nursing Care Plan  
(MIBG therapy)

Nursing Diagnosis: Patient planning  
Focus: Additional room set up for patients receiving I-131 MIBG.  
Outcome: Set-up of patient room shall be assured.  
Nursing Orders: 1. Review room and ensure all room preparations have been completed. A sample checklist is included in this manual for information purposes only. The official checklist is to be obtained from the MIBG standard operating procedure manual.

=====

Nursing Diagnosis: Knowledge deficit: Related to additional radiation safety precautions for patients receiving I-131 MIBG.  
Focus: Information  
Outcome: Parent/patient will verbalize understanding of radiation safety precautions.

Nursing Orders:

1. Inform parent/patient that patient may be confined to his/her room approximately 3 to 5 days depending on the amount of I- 131 MIBG administered and patient's individual uptake and excretion.
2. Inform parent/patients that the patient will have a Foley Catheter placed and it will remain in place for 3 to 4 days. (The radioactive iodine is primarily excreted through the urine. Small quantities also maybe in perspiration, nasal secretions stool, and emesis.)
3. Inform parent/patient that patient will have 2 peripheral IV's placed and one of them will be used to administer the I-131 MIBG. Once the I-131 MIBG has been administered both of the peripheral IV's may be able to be removed (ask physician).
4. Inform parent/patient that disposable trays and utensils will be used. The trays and utensils will be held with other trash until surveyed (daily) by Radiation Safety Office staff.
5. Inform parent/patient that the floor covering and plastic wrap on switches and other equipment will allow a more efficient cleanup of the room when the patient is discharged.
6. Inform parent/patient that all used linen will be temporarily stored until checked (daily) by a member of the Radiation Safety Office staff.
7. Inform parent/patient that health care providers will limit the time they spend in the room to only that necessary for good patient care, (i.e., limited to treatments associated with his/her medical condition). Encourage self-care.

8. Instruct parent/patient to notify the nurse immediately if vomiting, incontinence or any body fluid spill occurs. **All items which may have come in contact with the patient, including personal items, must be cleared by Radiation Safety Office staff prior to removal from the patient's room.**

9. Assure the Familiar Adult Caregiver (FAC) has received training from the Radiation Safety Office. Review with the FAC the orientation checklist. (A sample checklist is included in this manual. The sample is for information purposes only. The official checklist must be obtained from the MIBG standard operating procedure manual.)

**SAMPLE**  
**MIBG Room Set-Up for Nursing**

**Before patient is admitted**

- Make up Bed: A bottom plastic mattress cover followed by a fitted sheet. Place four chux on top of the sheet to cover the entire length of the mattress. Place a second fitted sheet over the chux. Follow this until you have four sets of fitted sheets and chux. You can place a draw sheet over the top layer of chux for patient comfort.
- Confirm everything is wrapped in plastic. Visually check plastic to ensure there are no rips or openings.
- Confirm lead shields are in place as per room set up, and are outlined with tape.
- Confirm Lead Box for Foley bag is near patient bed on side closest to the bathroom. Confirm Tubing to toilet is secured to floor, and has been run along wall.
- Confirm Child Life personnel have set up room with appropriate play items, video games, movies, etc.
- Set up correct sized BP cuff, O<sub>2</sub> sat probes, electrodes with lead wires, and temperature cards near patient bed. Place disposable stethoscope inside room near patient bed.
- Place IV infusion pumps (double Alaris and syringe pump) and pole in room outside of the lead shield. Extra long extension tubing is required for patient hook up to IV fluids
- Position cardiac monitor screen for visualization by nurses from antechamber.
- Confirm that emergency bag is in room outside of lead shields.
- Confirm that there are flow meters and Christmas trees with oxygen set up on left side of head wall. Test that oxygen functions correctly.
- Set up suction on left side of head wall. Check that it functions correctly.
- Confirm garbage (waste) and linen containers are labeled and in room.
- Confirm that toilet flushes and there is no overflow. Confirm the toilet has been wrapped in plastic, and lid is present. Confirm water shut off valve is labeled
- Camera and TV: Make sure that the camera and TV are working. Make sure there is a sign on patient's TV with channel number (94) for nursing station camera.
- Ensure bed controls are locked (at foot of bed control panel) so patient is not able to move bed up and down. It is ok for patient to move head of bed up and down. The control panel will be covered with plastic.
- Confirm there are several Patient Belonging's bags, labels, and a pen for personnel to bag and label items brought into room to have Radiation Safety survey and return back to them.
- Pen and pieces of paper to remain in room for nursing to use, if needed.

**In Antechamber:**

- Boxes of gloves (sizes M, L, XL)
- Box of Booties
- Disposable Gowns
- Chemo Spill Kit
- Lap top computer attached to ceiling mounted radiation monitor by cable (confirm cable is plugged into housing and unit is functional).

- Radiation Safety Manual
- MIBG Procedures Manual
- At least two 1-liter regular Foley bags and appropriate sized Foley catheters
- Personal dose monitors, aka “Chirpies”

### **After Patient is Admitted Evening Before Infusion**

- Notify Child Life of patient arrival.
- Start IV Fluids as ordered through CVC using direct technique (physician’s order should be placed to OK direct hookup for more than 3 days). Use long extension tubing with enough slack to reach over the lead shield.
- Assist with patient bath.
- Check Foley. Make sure it is not leaking. Keep Foley set up a “closed” system. Run urine pump and make sure it is functioning. After turning on pump, ensure there are no leaks in tubing that runs from Foley box to toilet.
- Change CVC (central venous catheter) dressing. Change CVC caps if due during MIBG admission. If patient has a port make sure all ports are accessed.
- Reinforce patient/family teaching. Complete parent orientation checklist.
- Arrange patient items in reach of patient.
- Check and clarify orders.
- Give medications as ordered. Make sure to give loading doses of Potassium Iodine (KI) and Potassium Perchlorate (KCL04)
- Assess patient’s PIVs (Peripheral IVs). Make sure they both flush easily. Flush and saline lock PIVs every 8 hours.

### **Day of Infusion**

A Nuclear Medicine technologist does the infusion. It is a 2 hour infusion. Attending physician needs to be present for the infusion. Nursing is responsible for the following:

- Make sure orders have “OK to give” and are signed. Make sure they have been checked by two RN’s.
- Make sure IVF have been started and the Potassium Iodine (KI) and Potassium Perchlorate (KCL04) loading doses have been given.
- Before infusion, verify CVC dressing and caps (if needed) were changed the previous evening. If they have not been changed, change them before infusion is scheduled to start.
- Set up supplies for infusion near patient’s bed.
- Double check that Foley is not leaking, and run urine pump to ensure it is functional.
- Lightly re-tape both PIVs for easy removal after MIBG infusion is complete.

### **Someone from Nuclear Med will call about 30 min prior to MIBG infusion to notify RN when they are coming to do infusion.**

- Have FACs don gloves, gown, and booties per entering procedure, if not already done.
- Connect the patient to the heart monitor, the BP cuff, and the pulse ox probe. The patient will need to be on monitors for the entire two hour infusion. Set the monitor to take vitals

every 15 minutes and then you can read it off the monitor from the antechamber. Turn off alarms.

- Zofran needs to be given per order 15 minutes prior to infusion. If patient is to receive a sedative prior to infusion, this also needs to be given.
- Flush both PIV's and ensure they are still useable. Start 500 ml bag NS flush line for MIBG infusion through left hand PIV (if left PIV blows, it is ok to use right hand PIV). Use Alaris tubing with several extension tubing. Set NS line to KVO.
- Make sure Nuclear Medicine requisition is signed by MD. When dose arrives, verbally check dose from orders with Nuclear Medicine technologist before infusion. It is ok to have a +/- 10% difference in dose due to drawing up procedures (similar concept to factor products).

SAMPLE



**SAMPLE**  
**MIBG Familiar Adult Caregiver Orientation**

Familiar Adult Caregiver (FAC) refers to parents or caregivers that will be staying in the child's room during hospitalization. If possible, at least two FACs will be available during the patient's hospitalization for MIBG treatment. The FAC's will be trained by the Radiation Safety Office a day or two prior to admission. This checklist is a "refresher" going over what parents have already been taught. If nursing has concerns regarding parent readiness, please contact attending MD.

- Ensure all FACs are present during orientation.
- Orient FACs to A5S per normal admission procedure.
- Remind FACs how to enter room.
- Remind FACs how to exit room.
- Remind FACs on how to use dosimeter badge and personal dose monitor (chirpie).
- Point out proper trash cans for FACs to use.
- Point out linen hamper for FACs to use.
- Show FACs sign for TV channel (94) and location of camera.
- Show FACs sign for nursing station telephone number and instruct them to call if remote nursing light doesn't work.
- Instruct FACs that any personal items must remain in plastic. If items are not wrapped in plastic (toddler/infant toys), remind FACs personal items may be held by radiation safety for three months.
- Remind FACs once MIBG has been given, patient must remain in bed inside lead shields at all times. This includes bed changes, eating, using a bedpan etc.
- Instruct FACs how to remove layer of linen from bed. Remind FACs patient will be in bed during linen change.
- Remind FACs one of them must be in room with child at all times. Remind FACs to notify RN if they need to leave room and someone is not at child's bedside.
- Instruct FACs to have visitors check with RN before entering room. Visitors will need to have RN help them enter and exit room. Instruct FACs to have visitors "call out" to RN before exiting room to have RN help with exiting procedures.
- Remind FACs visitors have a time limit on their visits each day.
- Remind FACs he/she is not allowed to eat in room, use patient's toilet or shower in patient's bathroom. Remind them visitors are also not permitted to do the same.
- Show FACs how to cleanse exposed Foley catheter area using comfort care wipe. Instruct FACs this needs to be done twice a day.

## IRIDIUM – 192

### Ir-192

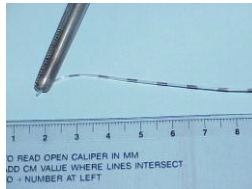
#### General Information

Ir-192 is a high-energy gamma-emitting radionuclide.

Ir-192 is used as sealed sources (encapsulated radioactive material). Because the radioactive source is sealed, body secretions are not radioactive.

Ir-192 is used as a temporary implant in the treatment of tumors. Tumors treated include brain, neck, tongue, breast, vaginal, uterine, cervical and other soft tissue.

Ir-192 sealed sources are generally a string of "seeds". Ir-192 seed strings have the appearance of a wire. (Larger picture in Appendix B)



Length of therapy generally ranges from 2 to 7 days.

#### General Safety Considerations

1. Due to the energy of the gamma radiation emitted maximize distance whenever possible.
2. Lead shielding should be used. Shielding should be placed between implant site and caregiver.
3. Dressings should be observed for dislodged seeds. If a seed or implant becomes dislodged **do not touch with hands**. Lift with tongs and place the string of seeds in the provided lead container ("pig"). Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
4. The chart and/or patient door signage will contain start time of radiation therapy, total amount of activity, and the anticipated stop time.
5. No unauthorized or non-essential personnel should enter the room. Personnel who have not received radiation safety training for caregivers must follow visitor guidelines.
6. Health Care radiation workers shall wear dosimeters when providing care to radiation patients with Ir-192 implants and when working in the patient's room.

**IRIDIUM - 192**  
**Ir-192**

Health Care Radiation Worker Instructions – Summary  
(temporary brachytherapy)

1. **Patient care must not be compromised because of potential radiation exposure.** To keep dose ALARA, avoid unnecessary contact, maximize distance from the implant site, perform duties behind a lead shield whenever possible and use the posted PATIENT EXPOSURE SURVEY FOR CAREGIVER GUIDANCE (Form 50A).
2. Patients are required to stay in his/her room and depending on implant site may be required to stay in his/her bed.
3. Visitors are limited to non-pregnant individuals 18 years or older. Visitors should remain at least six (6) feet from the patient or behind the 2 mR/hr line. Visitors, who are not a Familiar Adult Caregiver (FAC), **must** comply with posted "stay time."
4. Dressing or linen change should be observed for dislodged seeds and must be collected in the labeled containers for survey by the Radiation Safety Office staff.
5. Dislodged Source: (sources resemble wire (silver or colored.))
  - a. Place suspected source in lead container ("pig") using tongs. **Do not touch source with hands.**
  - b. Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
  - c. Do not remove anything from the room.
  - d. Remain close by, but away from source. Restrict access to the patient's room until Radiation Safety Office staff arrives.
6. Health Care radiation workers should always wear a personal dosimeter when providing direct care to the patient or in the patient's room. The dosimeter should be worn at an area on the trunk of the body that is expected to receive the highest exposure.
7. In the event of a medical emergency or cardiac arrest, follow hospital guidelines for contacting arrest team. Contact the Radiation Safety Office and Radiation Oncology STAT!
8. If the patient expires, contact the Radiation Safety Office and Radiation Oncology STAT!
9. For radiation safety questions contact the Radiation Safety Office.

Department	Daytime Number	Pager number
Radiation Safety Office (RSOf)	513-558-4110	513- 249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
Radiation Oncology	513-584-4775	513-590-5555 (Digital) after hours resident on-call (or call University Hospital at 513-584-7243 and request the physician on-call for Radiation Oncology)

**IRIDIUM 192**  
**Ir-192**

Example Nursing Care Plan  
(brachytherapy – soft tissue)

Nursing Diagnosis: Knowledge deficit: Related to radiation safety precautions for patients receiving Ir-192 brachytherapy.

Focus: Information

Outcome: Parent/patient will verbalize understanding of radiation safety precautions.

- Nursing Orders:
1. Instruct parent/patient that the patient will be confined to his/her room and may be restricted to his/her bed for approximately 2 to 3 days.
  2. Inform parent/patient that all used linen will be temporarily stored until checked (daily) by a member of the Radiation Safety Office staff.
  3. Instruct parent/patient that the patient will not be radioactive once the implant is removed and that body secretions are not radioactive.
  4. Inform parent/patient that health care providers will limit the time they spend in the room to only that necessary for good patient care, (i.e., limited to treatments associated with his/her medical condition). Encourage self-care. Encourage assistance by Familiar Adult Caregivers (FAC), if applicable.

=====

Nursing Diagnosis: Knowledge deficit: Related to radiation safety precautions for visitors of patients receiving Ir-192 brachytherapy.

Focus: Information

Outcome: Parent/patient will verbalize understanding of visitor precautions.

- Nursing Orders:
1. Instruct parent/patient and visitor about dose minimization precautions:
    - a. Visitation time for any single visitor is limited to "stay time" listed on the door sign.
    - b. Visitors should maximize their distance from the patient. (Minimum distance of 6 feet or stay behind the 2 mR/hr line.)
    - c. Visitor should remain only in the areas designated.
  2. Instruct parent/patient about visitor restrictions:
    - a. No pregnant person or a person who suspects she is

pregnant may visit the patient.

- b. No person under the age of 18 may visit the patient.
- 3. Instruct parent/patient that no visitors are permitted if an implant is missing or dislodged.

=====

Nursing Diagnosis: Potential for anxiety: Related to social isolation.  
Focus: Coping  
Outcome: Minimize isolation anxiety.  
Nursing Orders: 1. Reassure parent/patient that the patient will not be abandoned. Reinforce reasons for time limitations for health care providers and visitors (i.e., maintaining radiation dose ALARA).  
2. Assure call light is within reach and operable.  
3. Frequent observation of patient by health care provider, with maximization of distance. If available, use camera and/or two-way communication system.  
4. Encourage diversionary activities, e.g., television, radio, cards, magazines, books, and games.

=====

Nursing Diagnosis: Alteration in safety: Related to implant position and potential dislocation of implant.  
Focus: Health Promotion  
Outcome: Implant position will not be altered.  
Nursing Orders: 1. Check the position of applicator and packing every shift.  
2. DO NOT REMOVE PACKING, APPLICATOR, OR CATHETERS. If packing, applicator or catheter is dislodged, contact Radiation Safety and Radiation Oncology STAT!

<b>Department</b>	<b>Daytime Number</b>	<b>Pager number</b>
Radiation Safety Office (RSOf)	513-558-4110	513-249-6812 (Digital) On-call RSOf technician (use all 10 digits when dialing)
Radiation Oncology	513-584-4775	513-590-5555 (Digital) after hours resident on-call (or call University Hospital at 513-584-7243 and request the physician on-call for Radiation Oncology)



=====

Nursing Diagnosis: Discharge Planning.  
Focus: Information  
Outcome: Parent/patient will verbalize understanding of discharge instructions and the need for follow-up care with the physician.  
Nursing Orders: 1. Inform the parent/patient that the patient is not radioactive once the radiation implants are removed.  
2. Instruct parent/patient per physician orders.

=====

Nursing Diagnosis: Discharge Planning.  
Focus: Information  
Outcome: Nurse will understand special discharge instructions.  
Nursing Orders: 1. Room cannot be released to Housekeeping for post discharge cleaning until approved by the Radiation Safety Office.  
2. Only Radiation Safety Office staff may remove the "Caution Radioactive Material" sign from the door.

## PALLADIUM - 103 Pd-103

### General Information

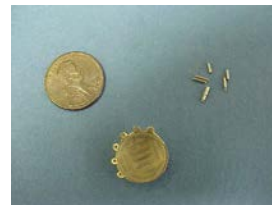
Pd-103 is a low-energy gamma-emitting radionuclide that may be used for brachytherapy.

Pd-103 is used as sealed sources (encapsulated radioactive material). Because the radioactive source is sealed body secretions are not radioactive.

Pd-103 is used in the treatment of tumors as a permanent implant and may be used for temporary implants. The most common tumors are prostate cancer, but Pd-013 may be used for any soft tissue.

Pd-103 sealed sources are generally “seeds”. Pd-103 seeds will have the appearance of a small tomato seed. (Larger picture in Appendix B)

Because of the lower energy of the gamma ray emission the patient’s body provides shielding and other shielding is very effective in reducing radiation exposure rates.



### General Safety Consideration

1. Due to the low energy of the gamma, radiation emitted radiation exposure is generally minimal, but maximize distance whenever possible.
2. In some cases lead shielding may be used. If lead shielding is used the shielding should be placed between the implant site and caregiver.
3. If a seed/implant is dislodged **do not touch with hands**. Lift with tongs and put in provided lead container (“pig”) or a cup of water. Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
4. The patient’s chart and/or door signage will contain the radionuclide and total activity administered.
5. No unauthorized or non-essential personnel should enter the room. Personnel who have not received radiation safety training for caregiver must follow visitor guidelines.
6. Health Care radiation workers shall wear dosimeters when providing care to radiation patients with Pd-103 implants and when working in the patient’s room.



**PALLADIUM - 103**  
**Pd-103**

Health Care Radiation Worker Instructions – Summary  
(temporary brachytherapy)

1. **Patient care must not be compromised because of potential radiation exposure.** To keep dose ALARA, avoid unnecessary contact, maximize distance from the implant site and perform duties behind any provided lead shield and use the posted PATIENT EXPOSURE SURVEY FOR CAREGIVER GUIDANCE (Form 50A).
2. Patients will likely be required to stay in his/her room and may be required to stay in his/her bed.
3. Visitors are limited to non-pregnant individuals 18 years or older. Visitors should remain at least six (6) feet from the patient or behind the 2 mR/hr line. Visitors not designated as a Familiar Adult Caregiver (FAC) **must** comply with “stay time” posted on the door.
4. Dressing or linen changes should be observed for dislodged seeds and must be collected in the labeled containers for survey by Radiation Safety staff.
5. Dislodged Source: (Pd-103 seeds resemble small, tomato seeds.)
  - a. If a seed is found, place in lead container (“pig”) or cup of water using tongs. **Do not touch source with hands.**
  - b. Note time discovered. Contact the Radiation Safety Office and Radiation Oncology STAT!
  - c. Do not remove anything from the room.
  - d. Remain close by, but away from source. Restrict access to the patient's room until the Radiation Safety Office staff arrives.
6. Health Care radiation workers should always wear a personal dosimeter when providing direct care to the patient or in the patient’s room. The dosimeter should be worn at an area on the trunk of the body that is expected to receive the highest exposure.
7. In the event of a medical emergency or cardiac arrest, follow hospital guidelines for contacting arrest team. Contact the Radiation Safety Office and Radiation Oncology STAT!
8. If patient expires, contact the Radiation Safety Office and Radiation Oncology STAT!
9. For radiation safety questions, contact the Radiation Safety Office (558-4110).

Department	Daytime Number	Pager number
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## **PHOSPHORUS – 32**

### **P-32**

#### **General Information**

P-32 only emits a beta particle. The patient's body is an effective shield.

P-32, in the form of NaPO<sub>4</sub> (sodium phosphate) is administered by means of intravenous injection as a palliative agent to alleviate severe pain caused by extensive osseous metastasis or polycythemia vera.

P-32 used in the form of chromic phosphate is administered by catheter into intrathoracic, intra-abdominal or intracerebral cavities for treatment of cancers.

P-32 is used as an unsealed radioactive material and is not reusable.

Patients receiving radiation therapy using P-32 are most often not required to be housed under radiation precautions.

#### **General Safety Considerations**

1. In most cases the patient is released from all radiological precautions immediately after treatment.
2. If the patient is hospitalized or is under radiation precautions, caregivers should use "universal precautions" to minimize dose.

**STRONTIUM – 89**  
**Sr-89**

**General Information**

Sr-89 only emits a beta particle. The patient's body is an effective shield.

Sr-89 is used in the treatment of cancers that have metastasized to bone.

Sr-89 is used as an unsealed radioactive material and is not reusable.

Sr-89 is administered in a liquid form and generally by injection.

**General Safety Considerations**

1. The patient is released from all radiological precautions immediately after treatment.
2. If the patient is hospitalized or is under radiation precautions, caregivers should use "universal precautions" to minimize dose.

## **YITRIUM – 90 Y-90**

### **General Information**

Y-90 only emits a beta particle. The patient's body is an effective shield.

Y-90 in the form of microspheres is used for the treatment of liver cancers. The microspheres are suspended in liquid and delivered like an unsealed radioactive material. Y-90 microspheres are not reusable.

Patients receiving radiation therapy using Y-90 are most often not required to be housed under radiation precautions.

### **General Safety Considerations**

1. In most cases the patient is released from all radiological precautions immediately after treatment.
2. If the patient is hospitalized or is under radiation precautions, caregivers should use "universal precautions" to minimize dose. Some free Y-90 may be released in the urine. Any diapers changed during hospitalization should be collected in the patient's bathroom and disposed through the Radiation Safety Office.

## **Appendix A**

# **GLOSSARY OF RADIATION SAFETY TERMS**

## **GLOSSARY OF RADIATION SAFETY TERMS**

### **ABLATION**

The functional destruction of an organ through surgery or exposure to large doses of radiation.

### **ABSORBED DOSE**

The energy deposited by ionizing radiation per unit mass of irradiated material. The units of absorbed dose are the rad and the gray (Gy).

### **ACTIVITY**

The rate of disintegration (transformation) or decay of radioactive material. The units of activity are the curie (Ci) and the Becquerel (Bq).

### **ALARA**

“ALARA” is an acronym for “As Low As is Reasonably Achievable”. ALARA refers to an operating philosophy in which every reasonable effort is taken to maintain occupational exposures to radiation as far below regulatory limits as is practical.

### **ATTENUATION**

The process by which a beam of radiation is reduced in intensity when passing through some material. It is the combination of absorption and scattering processes, and leads to a decrease in flux density of the beam when projected through matter. Shielding attenuates radiation.

### **BACKGROUND RADIATION**

Background radiation arises from cosmic rays and natural radioactivity in the body, soil and building materials. Natural background radiation in the Cincinnati area results in a radiation dose to persons living in the Cincinnati area of approximately 300 mrem per year.

### **BETA PARTICLE**

Charged particle emitted from the nucleus of an atom, with a mass and charge equal in magnitude to that of the electron. (Body tissue attenuates most beta particles; therefore, patients receiving treatment with a beta-emitting radionuclide are generally immediately released from radiological controls.)

### **BIOASSAY**

A bioassay is an evaluation of the amount (if any) of radioactivity taken into the body. Bioassays may be direct (such as thyroid and whole body counts) or indirect (such as urinalysis).

### **BRACHYTHERAPY**

A method of radiation therapy in which sealed sources are utilized to deliver a radiation dose at a distance of up to a few centimeters, by surface, intracavitary, or interstitial application.

### **CONTAMINATION**

The deposition of radioactive material in any place where it is not desired, and particularly where its presence might be harmful. Contamination may be fixed, removable (smearable) or airborne.

## CURIE

The special unit of activity. One Curie equals  $3.7 \times 10^{10}$  nuclear transformations/disintegrations per second (dpm). (Abbreviated Ci). Fractions of the Curie are in common usage.

millicurie: Abbreviated mCi. One-thousandth of a Curie ( $3.7 \times 10^7$  dpm).

microcurie: Abbreviated  $\mu$ Ci. One-millionth of a Curie ( $3.7 \times 10^4$  dpm).

## DECAY, RADIOACTIVE

Disintegration of the nucleus of an unstable nuclide by spontaneous emission of charged particles and/or photons.

## DECONTAMINATION

Decontamination refers to the reduction or removal of radioactive contamination from any given surface (for example, floors, tools, clothing and skin).

## DETECTOR, RADIATION

A material or device that is sensitive to radiation and can produce a response signal suitable for measurement or analysis. An instrument used to determine the presence, and sometimes the amount, of radiation. Examples include Geiger-Mueller (GM) survey meters and ion chambers.

## DOSE

A generic term denoting the quantity of radiation or energy absorbed. For special purposes, it must be appropriately qualified. If unqualified, it refers to absorbed dose.

## DOSE, EXTERNAL

That portion of the dose received from radiation sources outside the body.

## DOSE, INTERNAL

That portion of the dose received from radioactive material taken into the body.

## DOSE RATE

Absorbed dose delivered per unit time.

## DOSIMETER

A dosimeter is an instrument used to detect and measure accumulated radiation exposure. "Personal" or "personnel" dosimeters refer to those of small size worn by an individual to determine the exposure received during the time it is worn. The dosimeters most often used at UC are Luxel® OSL (optically stimulated luminescence) dosimeters and TLDs (thermo-luminescent dosimeters).

## EXPOSURE

Being exposed to ionizing radiation or to radioactive material. The special unit of exposure is the Roentgen.

## GAMMA RAY

High-energy, short wavelength electromagnetic radiation (a packet of energy) emitted from the nucleus of an atom. Gamma rays are very penetrating and are best stopped or shielded with a

dense material, such as lead. Gamma rays are similar to x-rays, but are usually more energetic.

#### HALF-LIFE, BIOLOGICAL

The time in which half the quantity of a material in a compartment, in an organ or in the whole body is eliminated by biological process.

#### HALF-LIFE, EFFECTIVE

The time required for a radionuclide contained in the body to reduce its activity by half as a combined result of radioactive decay and biological elimination.

#### HALF-LIFE, RADIOACTIVE

Time required for a radioactive substance to lose 50 percent of its activity by decay. Each radionuclide has a unique half-life.

#### HALF VALUE LAYER (HVL)

The thickness of any given absorber that will reduce the intensity of a beam of radiation to one-half its original value.

#### INGESTION

Ingestion (of radioactivity) refers to the entry of radioactive material into the body through the mouth.

#### INHALATION

Inhalation (of radioactivity) refers to the entry of radioactive material into the body through the breathing of airborne radioactive matter.

#### IONIZING RADIATION

Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions in matter.

#### MIBG

The acronym for meta-iodobenzylguanidine. I-131 labeled meta-iodobenzylguanidine is a radiopharmaceutical used in the treatment of neuroblastoma.

#### MONITORING

"Area monitoring" refers to periodic or continuous determinations of the amount of radiation or radioactive contamination present in an area. "Personnel monitoring" refers to the determination of radiation exposures to individuals, as with the use of personal dosimeters.

#### PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) is worn by individuals to prevent radioactive contamination of their bodies or personal clothing. PPE includes disposable coveralls and gowns, gloves, shoe covers, and safety goggles.

#### PIG

A container (usually lead) used to ship or store radioactive material. The walls provide a shield



and protect the person handling the container from radiation.

### RADIOISOTOPE/RADIONUCLIDE

An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation. When discussing like elements, radioisotopes is used (i.e.,  $^{32}\text{P}$  and  $^{33}\text{P}$ ). When discussing different elements, radionuclide is used (i.e.,  $^{32}\text{P}$  and  $^{14}\text{C}$ ).

### RADIOPHARMACEUTICAL

A radiolabeled drug. A chemical compound tagged with a radionuclide and prepared in a form suitable for human-use.

### RADIOACTIVITY

Radioactivity is a natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei as particles or photons and thus change (or decay) to atoms of a different element or to a lower energy state of the original element.

### RESTRICTED AREA

A restricted area is any area in a radiation facility (including all UC-related hospitals and research laboratories) to which access is controlled for the purposes of protecting individuals from exposure to radiation and radioactive material. Restricted areas must be posted with appropriate warning signs, and must be secured (locked) when unattended.

### SEALED SOURCE

A sealed source is any radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent the release or dispersal of the material under the most severe conditions encountered in normal use or handling. Sealed sources may be used in research, training, and industrial applications, as well as for diagnostic and therapeutic medical use.

### SHIELDING

Any material or obstruction that absorbs radiation and thus tends to protect personnel from the effects of ionizing radiation.

### STAY TIME, RADIATION SAFETY

A calculated time used in estimating a possible radiation exposure or dose. The actual dose, which is received, can be different as other radiation dose modifiers, such as distance and shielding, are not considered in the calculation. (Stay times posted on a patient's door is a limit for visitors and non-radiation workers, such as Housekeeping, and assures the dose is maintained less than regulatory limits for members of the public.)

### SURVEY METER

Any portable radiation detection instrument especially adapted for inspecting an area to establish the existence and amount of radiation present.

### SURVEY, RADIOLOGICAL

The evaluation of the radiological conditions and potential hazards incident to the use or presence of radioactive material or other sources of radiation.

## THERAPY

Medical treatment of a disease.

- Brachytherapy: Therapy at short distance. The treatment of disease with sealed radioactive sources placed near, or inserted directly into the diseased area.
- Radiation Therapy: Treatment of disease with any type of radiation.

## WIPE SURVEY

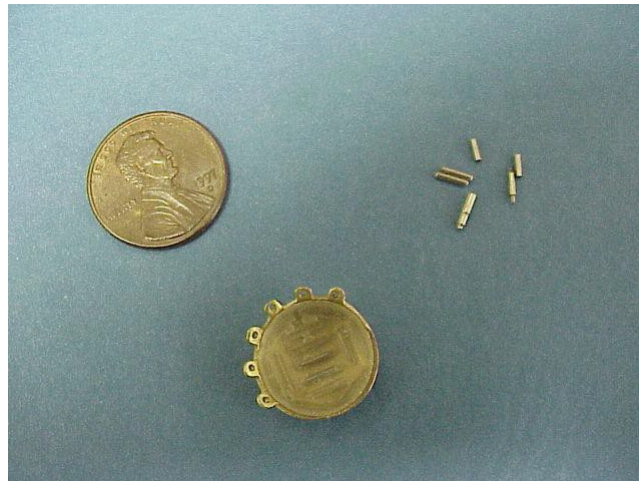
A sample made for the purpose of determining the presence of removable radioactive contamination on a surface. It is done by wiping, with slight pressure, a piece of soft filter paper over a representative type of surface area and analyzing the wipe for radioactivity.

## X-RAYS

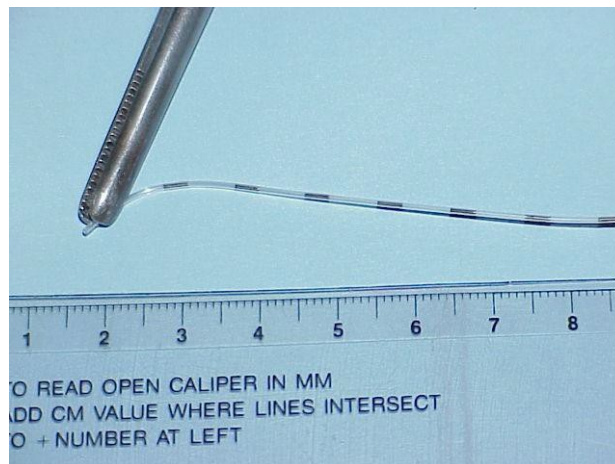
X-rays are penetrating electromagnetic radiations (photons) that are usually produced mechanically by bombarding a metallic target with fast electrons. X-ray machines DO NOT contain radioactive material and no x-ray radiation is produced unless the device is activated.

# **Appendix B**

## **Pictures of Common Brachytherapy Sources**



**Iodine-125 (I-125) seeds with eye plaque (Penny shown for scale)**



**Iridium-192 (Ir-192) seeds in nylon ribbon. (Ruler shown for scale)**

# **Appendix C**

## **Guidelines for Patient Medical Emergency or Death**

## **GUIDELINES FOR PATIENT MEDICAL EMERGENCY OR DEATH**

### **PATIENT MEDICAL EMERGENCY or DEATH**

1. Insure the Radiation Safety Office and Authorized User physician are immediately informed.
2. If untrained and/or unmonitored personnel respond to the patient's room, determine who was present, what their location was, and how much time was spent in the room so dose estimates can be made.
3. If the patient is excreting radioactivity (e.g.,  $^{131}\text{I}$  therapy), Radiation Safety Office personnel must verify that contamination is not spread out of the area and will check involved personnel for contamination.
4. Room release surveys must be performed on that room. Insure the room is isolated until Radiation Safety personnel perform a release survey.

### **ADDITIONAL ACTIONS if PATIENT DEATH**

Brachytherapy - temporary implant: The sources will be removed by Radiation Oncology staff, and a source removal confirmation survey will be performed by Radiation Safety Office personnel.

Brachytherapy - permanent implant: Radiation Safety Office personnel will perform a release survey.

- If an autopsy or cremation is planned for the patient, additional action, such as removal of sources may be necessary (e.g.,  $^{125}\text{I}$  seeds removed, if cremated;  $^{103}\text{Pd}$  or  $^{125}\text{I}$  seeds removed if autopsy to include area of implant).

Radiopharmaceuticals: Radiation Safety Office personnel will perform a dose rate survey.

- Take safety precautions to ensure persons who handle the body are not contaminated. (i.e., ensure “universal precautions” are used)
- Additional action/precautions as determined by the Radiation Safety Officer may be required due to the dose rate and/or body preparation procedures.

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Radiation Oncology	513-584-4775	513-590-5555 (Digital) after hours resident on-call (or call University Hospital at 513-584-7243 and request the physician on-call for Radiation Oncology)
CCHMC Nuclear Medicine	513-636-6390	513-303-2078 (Digital) Nuclear Medicine on-call technologist, 513-736-5732 Nuclear Medicine Manager, 513-736-9192 for physician on-call for Nuclear Medicine.