University of Virginia

Radiation Safety Manual

FOR NURSING STAFF

Rev. January 2016

A downloadable version of this manual is available at the following UVa website:
http://ehs.virginia.edu/ehs/ehs.rs/rs.pregnancy.html

We wish to acknowledge the University of North Carolina Health Care System
for allowing the use of their manual (www.ehs.unc.edu/radiation/manual) for the creation
of this document

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Radioactivity and Radiation

All matter in our environment is made of atoms. Most atoms we encounter on Earth are stable. Some atoms, however, are unstable, giving off energy in the form of radiation in order to reach a stable state. These atoms are said to be **radioactive**. An example is the radionuclide, Carbon-14, produced in the atmosphere when cosmic rays interact with stable nitrogen atoms. When a Carbon-14 atom undergoes radioactive decay, it gives off radiation in the form of a beta particle and then becomes a stable nitrogen atom once again. The existence of Carbon-14 in all living things enables archaeologists to date ancient artifacts.

There are small amounts of naturally occurring radioactive substances in soil, rocks, plants, animals, and in our own bodies, all of which give off radiation. Large amounts of radiation are present in outer space and a small portion of this radiation penetrates the atmosphere. This low level of naturally occurring radiation is known as **background** radiation.

Radiation can only be detected by specially designed instruments. Radiation may pass through an object, or it may be absorbed and cause changes at the site of absorption. Radiation is known to cause cancer and birth defects in animals and humans. The **risk of radiation damage is related to the amount of radiation** absorbed by an individual. With the amounts of radiation encountered by employees of the UVa Health System, the risk is very small.

Radiation exposure can have many benefits for individuals and society. Medical imaging exams that involve radiation are beneficial for determining whether organs are functioning properly, bones are broken and providing information for cancer therapy. **Low levels** of radiation exposure are used for most medical exams involving radiation, although when we are using radiation to treat a disease (e.g., cancer), we use very high doses to actually kill the cancer cells. Like so many things in our society that have benefits, some also have risks. For instance, aspirin is extremely effective in many indications but, taken in large quantities,can be harmful and even cause death. With radiation it is similar—the small radiation doses used to conduct medical exams carry little or no risk, while exposure to high levels may cause observable health effects.[1]

1 Health Physics Society document "Radiation Benefit and Risk Assessment" http://hps.org/physicians/documents/

Radiation Protection at UVa Health System

To minimize the biological effects of radiation, special rules and regulations are set forth for individuals occupationally exposed to radiation. The amount of radiation received by persons exposed occupationally should not exceed the dose limits specified in the 10 CFR Part 20 of the Code of Federal Regulations, the Virginia State Regulations For Protection Against Radiation and the UVa Radiation Safety Guide.

There is, in general, minimal external radiation hazard to hospital personnel from procedures involving radiation. Depending on your specific job duties, you may or may not be classified as a "radiation worker" and may or may not be required to wear personnel monitoring devices. All X-ray equipment operators are considered "radiation workers" and most require personnel monitoring. The need for personnel monitoring is determined by the likelihood of receiving exposures in excess of certain regulatory limits and by the recommendations of groups such as JCAHO (Joint Commission on Accreditation of Healthcare Organizations). Adherence to guidelines contained in this manual will help all X-ray equipment operators and radiology staff members keep their exposures as low as reasonably achievable (ALARA). For most other health system staff members, it should reduce radiation exposures to levels allowable for individual members of the general public, or in some cases, to levels indistinguishable from natural background.

Radiation protection support services are provided for UVa Health System by the UVa Environmenal Health and Safety Office (EHS). These services include the oversight and administration of the personnel monitoring program, area surveys and in-service training of hospital workers. X-ray equipment inspections are performed by staff in Radiological Physics. Questions regarding the radiation protection program should be directed to the Radiation Safety Officer (RSO) at 982-4911. Radiation Safety can be reached after normal working hours at pager 923-5047.

Medical Radiation Sources

Sources of radiation are used at UVa for diagnosis, therapy and research. The most likely places to find radiation sources are in Radiology, Nuclear Medicine, Nuclear Cardiology, Radiation Oncology and certain hospital laboratories. However, mobile radiographic and fluoroscopic units are used frequently throughout the hospital, and many nuclear medicine patients retain radiopharmaceuticals for days or weeks after their procedures are complete. It has also become more common for specialty departments (such as GI Procedures, Urology, OR, etc.) to possess and operate their own diagnostic X-ray equipment. Thus, radiation may be encountered virtually anywhere within the health care system.

Radiation Producing Equipment

In *diagnostic radiography*, X-rays are produced when high-energy electrons collide with a metal target in an X-ray tube. X-rays are produced only when the machine is activated. The patient does not become radioactive from exposure to X-rays.

In *diagnostic fluoroscopy*, X-ray images are viewed on a video monitor rather than on film. Fluoroscopy procedures are the largest source of occupational radiation exposure in medicine. Fluoroscopy is used to study moving structures, and to assess positioning during surgical and radiographic procedures. The portable fluoroscopy unit is often referred to as a "c-arm." All X-ray machines are "registered" with the state radiation protection regulatory agency, the Virginia Department of Health's Radiological Health Program.

In *radiation therapy*, linear accelerators (powerful electron and X-ray beam machines) are used for the treatment of cancer. The energy of the X-ray radiation produced by these units is 10 to 100 times that of a diagnostic X-ray machine. Linear accelerators may treat with either X-rays or electrons. Registration and operation of linear accelerators is regulated by the State Radiological Health Program.

Radioactive Materials

Radionuclides like Tc-99m, F-18, I-131, P-32, Ir-192, Cs-137, I-125 and Y-90, are frequently used in hospitals. For example, I-131 is used as a diagnostic aid in the evaluation of thyroid function and also as a therapeutic agent in the treatment of thyroid disease. It can be expected that in the future many new uses for radioactive materials will be found in medicine. Most of these radioactive materials are used under a broadscope byproduct material license issued to UVa by the State Radiological Health Program through an agreement with the U.S. Nuclear Regulatory Commission. The UVa Radiation Safety Committee oversees and approves all use of radioactive materials at the institution as required by the license agreement. The Radiation Safety section of the Environmental Health and Safety Office acts as an "agent" for this committee, managing the radiation protection program.

Diagnostic Radiopharmaceuticals – Some of the radionuclides used in the Nuclear Medicine and Nuclear Cardiology departments for diagnostic procedures emit gamma rays, which are a penetrating radiation, like X-rays. It is this penetrating quality that allows images of internal structures to be obtained. These radionuclides remain in the patient after the study is over, but have short half-lives, so the patient and the people around him or her are not exposed for a long period of time. A half-life is the time it takes to reduce the radioactivity of a substance by half. Diagnostic radiopharmaceuticals have half-lives from six hours to eight days. Short half-life

nuclides may be intensely radioactive, but for a short period of time. After about 10 half-lives, the radioactivity is reduced to near background levels.

Although radiation exposures may arise from the radiation emitted by radionuclides in patients, by accidental contamination of skin with radioactive materials, or by accidental ingestion of these materials (possibly through smoking or eating when hands are contaminated), there is, in general, no radiation hazard to hospital staff from these sources in patients who have received **diagnostic** or tracer doses of radioactive materials.

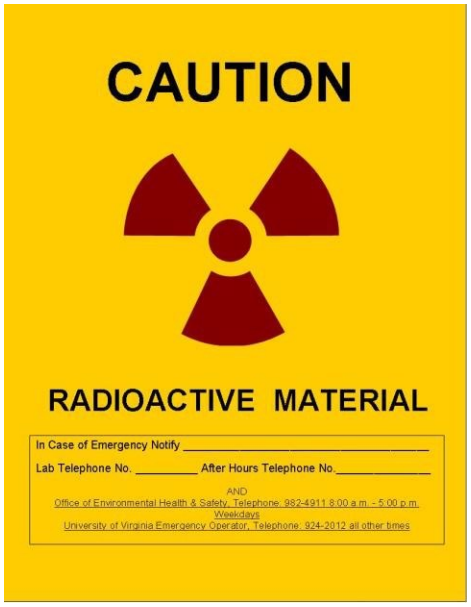
Potential radiation doses due to nuclear medicine procedures have been widely studied. The general conclusion has been that there is no need for additional restrictions when the patient leaves the Nuclear Medicine Department. Radiation doses and dose rates form patients who have undergone diagnostic nuclear medicine procedures have been measured. Based on such measurements, physicians, scientists and regulators have unanimously concluded that such radiation doses from patients are extremely small and do not warrant an undue concern or any radiation precautions. Pregnant caregivers should not feel at risk and no protective lead is necessary. No special precautions are needed in caring for them and no restrictions on patient activities or contact with other people is required. The probability for nursing staff receiving doses higher than dose limits for the public in a single session or working day is negligible. To exceed the limits would require being in close contact with the radioactive patient for several hours following each administration. You should contact Radiation Safety at 2-4911 if you are **routinely** exposed to radioactive patients so that your potential dose can be evaluated.

Therapeutic Radionuclides - When **therapeutic** radiopharmaceuticals or sealed sources are used, relatively large doses are involved. The patient can become a significant source of radiation exposure to staff, family and visitors. When procedures require that radiation precautions be put into effect, a **radiation sign** and a precaution sheet will be posted on or near the door to the patient's room.

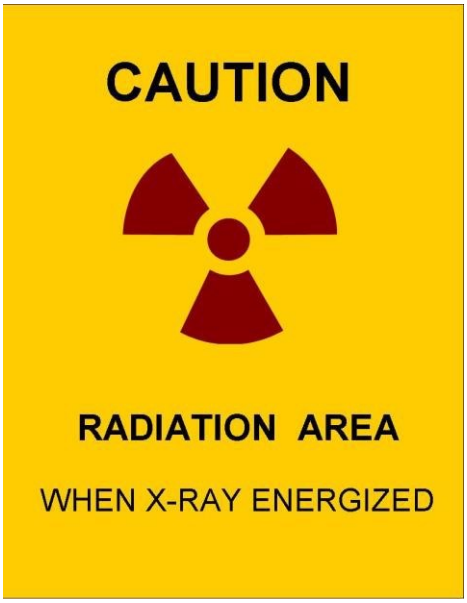
Laboratory Use of Radionuclides - Research and medical laboratories often use radionuclides that emit beta particles and low-energy gamma rays. Beta particles are not nearly as penetrating as gamma rays or X-rays. Weak and moderate energy betas will not even penetrate the skin. The most important safety precaution for most of these radionuclides is to keep the material from contaminating the skin thereby avoiding the possibility of ingestion or absorption.

Because radiation cannot be seen or felt, the 3-blade **radiation symbol** shown below is used to alert you to the presence of radiation and/or radioactive material.

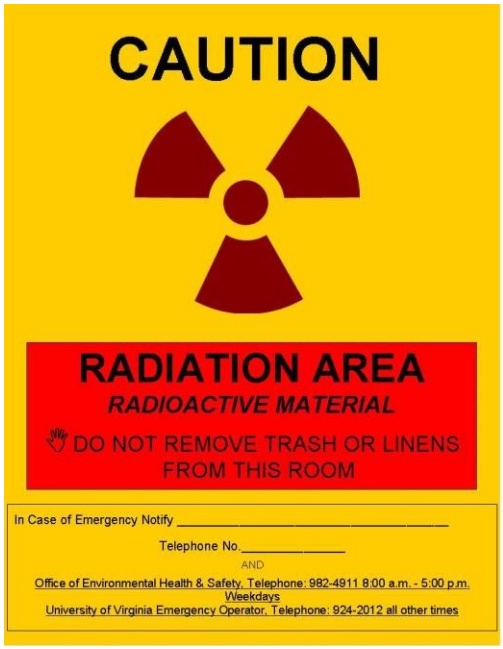
Containers of radioactive material and rooms where radioactive materials are stored or used, are posted with the following label, which when in use is magenta or black with a yellow background:



Rooms or areas where radiation-producing equipment is used are posted with the following sign, also magenta or black with a yellow background:



Rooms where significant radiation exposure can occur from radioactive sealed sources in patients undergoing brachytherapy, or from patients receiving radiopharmaceutical therapy are posted with a "Caution – RADIATION ISOLATION" sign like below. Radiation safety precautions are provided on these signs and include caregiver and visitor instructions, stay times, and Radiation Safety emergency contact information.



Basic Radiation Safety Procedures

The radiation protection program is guided by the concept of keeping radiation exposure As Low As Reasonably Achievable (**ALARA**). The ALARA concept is based on the assumption that any radiation dose, no matter how small, can have some adverse effect. At UVa, radiation exposure of all individuals routinely working with sources of radiation is monitored with a Luxel® OSL (Optically Stimulated Luminescence) dosimeter. The dosimeters are changed out and analyzed on a monthly or quarterly frequency. Action levels have been set by the Radiation Safety Committee at 10% of the regulatory limits. These levels trigger investigations to determine if the exposures were actually as low as reasonably achievable. If not, recommendations are made to ensure that future exposures are ALARA. Under the ALARA program, every reasonable means of lowering exposure is used. Radiation exposure can be minimized by utilizing three basic principles:

1. **Time:** Shorter exposure time means a lower dose.
2. **Distance:** Doubling the distance from a radiation source means one-fourth the dose rate. Tripling the distance gives one-ninth the dose rate.
3. **Shielding:** The use of appropriate shielding greatly reduces the dose rate. Wearing a lead apron when performing a fluoroscopy procedure is one example. The shield material used and its thickness depend on the type and strength of the source of radiation.

Remember that radiation cannot be seen or felt, but can be detected with radiation survey meters.

Radioactive Spills: When a spill of radioactive material is encountered, **do not clean it up**. **Isolate the area and notify the Radiation Safety Officer**. Remember that small droplets may have splashed away from the spill. If liquid is running, try to contain it with a paper towel or other absorbent material, taking care not to contaminate yourself. All persons involved in a spill should be monitored for contamination before they are released.

Loose sources or seeds: If a radioactive source or seed has become dislodged from the patient, **do not touch the source!** Remove all unnecessary personnel, and call Radiation Safety and Radiation Oncology. Try to get the source to the corner of the room via remote handling tool, yardstick, etc. **Isolate the area and notify the Radiation Safety Officer.**

Dose Limits/Monitoring Requirements

A radiation worker is required to be monitored if he/she is **likely** to receive in excess of 10% of the regulatory dose limits. Those dose limits are:

Whole Body:	5 rem/year
Skin/Extremities:	50 rem/year
Lens of Eye:	15 rem/year
Fetus:	500 **milli**rem/gestation (9 months)

NOTE: 1 rem = 1,000 millirem

The average annual dose of a UVa Health System radiation worker is **about 100 millirem** (millirem or rem is a measure of radiation dose in the human body).

Per regulations, an individual member of the public is allowed only 100 millirem per year from all licensed and registered radiation activities. Keep in mind, however, that the average U.S. citizen receives about 360 millirem of radiation each year from "background" radiation sources and medical procedures. (That's the equivalent of about 36 chest X-rays!)

Typical Exposure Levels During X-ray Examinations

An individual located four feet from the patient's bed at the time that a radiographic exposure using a 14 x 17 image receptor is made, may typically receive about 0.010 millirem. To receive 500 millirem, one would have to remain at that distance for 50,000 X-ray exposures. An individual located four feet from a patient undergoing fluoroscopy may typically receive about 0.50 millirems per minute while the machine is "on". To receive 500 millirem, one would have to be in the location for 15-20 hours with the machine operating. Since radiation decreases rapidly with distance, the further one is from the patient during the actual X-ray examination, the smaller the exposure.

Radiation and Risk

Effects of large doses of radiation are well-documented and understood from the study of groups including atomic bomb survivors, radiation accident victims, radiation therapy patients, and early radiation researchers. The effects of the very low doses of radiation expected among workers in the hospital setting are difficult to observe and, therefore, are not as well understood. When a large dose of radiation is increased to an even larger dose, the adverse effects become greater or more prevalent. This dose vs. effect relationship can be thought of as linear, with confirmed and documented effects beginning at a certain "threshold" level of radiation dose.

But since this "threshold" level is far greater than any allowable occupational dose, how is the risk of occupational radiation exposure assessed? Although the effects of very low doses of radiation are not truly known, health physicists "extend" what is known about the health effects of higher doses of radiation down to "zero" dose. In other words, any radiation dose is assumed to have some effect. Most scientists believe that this is a conservative model of the risk. With the amounts of radiation encountered by employees in the UVa Health System, the risk is very small.

Consider that for very low doses of radiation the effect of most concern is cancer. If every member of a population of 1 million were to receive 10 millirem of radiation (average film chest X-ray), it is possible that 5 additional cancer deaths would be observed. Remember however, that out of this population of 1 million, about 200,000 (20%) will die of cancer, making these few additional cancer deaths statistically impossible to detect. Additionally, according to the Biological Effects of Ionizing Radiation (BEIR) committee, the risk of cancer death is 0.08% per rem for doses received rapidly (acute) and might be 2 times (0.04% per rem) less than that for doses received over a long period of time (chronic).

It's important to keep in mind that all activities carry some element of risk. For example, flying in an airplane, driving a car, smoking cigarettes, eating certain foods, and drinking alcoholic beverages are everyday activities that carry some risk. Many of us are willing to accept the risk from these activities.

Fetal Protection Policy

Recent studies have shown that the risk of childhood leukemia and other cancers increases if the mother experienced a **significant** radiation exposure during pregnancy. The National Academy of Sciences has reported that the incidence of leukemia among children from birth to 10 years of age could rise from 3.7 cases in 10,000 children to 5.6 cases in 10,000 children if the children were exposed to 1 rem (1000 millirems) of radiation before birth. The Academy has also estimated that an equal number of other types of cancers could result from this level of radiation. Although other studies have shown a much smaller effect from radiation, each woman should be aware of any possible risk so that she can take steps she thinks are appropriate to protect her offspring.

UVa has adopted a policy to protect the fetus/embryo of pregnant employees exposed to ionizing radiation in their work. Radiation protection regulations limit the occupational dose to pregnant women to 500 millirems over the course of the pregnancy if the worker declares her pregnancy in writing to the employer. This

value is one-tenth of the permissible annual exposure established for adults. To help put this in perspective, the average annual dose from natural radiation sources is approximately 360 millirem.

If an employee decides to declare her pregnancy, she should notify her supervisor and contact the EHS Radiation Safety Office to discuss possible precautions to limit radiation exposure. Declaration of Pregnancy forms are available from Radiation Safety, 982-4911. The Radiation Safety Officer will review work assignments and radiation exposure history, and may recommend limitations in work assignment if necessary. Dosimeters will be assigned, with radiation exposures to be reviewed monthly. If radioactive materials are used, the employee may also be placed on a periodic bioassay program.

Guidelines for Nursing Personnel
Working with Brachytherapy (Implant) Patients

In *brachytherapy,* small, sealed sources of radiation (typically Cs-137 or Ir-192), are positioned near the patient's cancer site using special, surgically-implanted catheters. While these catheters are implanted in the operating room, the radiation sources themselves are inserted into these catheters in the patient's room. Radiation exposure is the primary concern when working with brachytherapy patients. Exposure levels at the patient's bedside can be as high as 50 to 100 millirem/hour. **Contamination is not of concern as the radiation sources are "sealed."** No radioactivity is retained inside the patient once these sources are removed. Cs-137 sources are nickel-coated, approximately 20 mm long and 3 mm wide, and sometimes have an eyelet on one end that is color-coded. Ir-192 "seeds" are stainless steel encapsulated, only 3 mm long and 0.2 mm wide, and come in nylon strands with up to 12 seeds spaced typically 1 cm apart.

The following guidelines should be observed when working with brachytherapy patients:

- Individuals that provide routine care for these patients will typically be issued a radiation dosimeter.
- Always wear your personnel monitoring badge (dosimeter) when attending the patient. Wear the badge between your waist and collar and make sure that the badge worn is the one issued in your name for the current monitoring period. Do not share badges with other workers. Do not take your badge home with you. When you are not wearing your dosimeter, store it in a controlled area away from all radiation sources.
- Provide all necessary care, but try to minimize time spent with the radioactive patient. Try to work behind mobile shields whenever possible, and work no closer to patient than necessary.
- Observe **nursing stay times** and instructions on the "Caution Radiation" signs and instruction sheets posted by the door to the patient's room. Read and observe any Radiation Safety instructions written in the patient's chart.
- If you are the primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:
- Other hospital staff members are allowed in patient room if stay times and other instructions are observed. (Exception: Personnel who do not routinely work with radiation therapy patients may not be required to wear a personnel monitoring device. Contact Radiation Safety with questions.)
- Visitors are permitted provided the visitor stay times and instructions are followed as posted by the room doorway. Visitor stay times are dependent upon the activity of the implant and generally are posted for a visitor distance of 2 meters or greater from the patient. The mobile shields should not be moved by visitor(s). Visitors under 18 and pregnant visitors are not permitted.
- Housekeeping and Dietary staff are not permitted in brachytherapy patient rooms. No room items are to be removed without clearance from radiation safety or medical physics personnel responsible for the implanted sources.
- Brachytherapy patients are to stay in pre-selected shielded rooms only.
- **The room and patient are not to be released until Radiation Safety approved personnel perform a clearance survey.**

- **If a source becomes dislodged from the patient:**
  - Do not touch the source! If possible, use a broom or some long handling tool to move it to a room corner
  - Remove all unnecessary personnel from source area and call Radiation Safety and Radiation Oncology.
  - If possible, using long tweezers, place source in the shielded container normally provided and located in the patient's room along a far wall
  - If you can not get the source into the shielded container, try to get the source to the corner of the room via remote handling tool, yardstick, broom, etc.
  - Do not leave source near patient or attempt to re-insert source in patient

Notify Radiation Safety and Radiation Oncology if a source becomes dislodged, or if there is a medical emergency (including patient death).

Guidelines for Nursing Personnel Working with Prostate Seed Implant Brachytherapy Patients

Prostate brachytherapy is a minimally invasive procedure that implants small radioactive pellets (called seeds) that are about the size of a grain of rice into the prostate where they emit very low energy radiation, which is primarily absorbed in the treatment area immediately surrounding the seeds. Needles containing the seeds are inserted through the skin of the perineum. The radioactive material within the seeds gives off localized radiation for a number of months. Typically 50-100 seeds containing Pd-103 or I-125 are permanently implanted.

These patients usually are administered an amount of radioactive material that is below regulatory release limits, and under normal conditions, patients can go home. For certain reasons, these patients may be hospitalized in a private room. No specific room is required for prostate brachytherapy treatments. The following guidelines should be observed:

If Radiological Physics or EHS has not placed signs on the patient room or chart, call 4-5421 or 2-4911 for assistance and further instructions.

- The use of personnel monitoring badges (dosimeters) is not necessary when attending these patients. Radiation exposure from these patients is very low.
- Provide all necessary care, but try to minimize time spent with patient, and work no closer to patient than necessary.
- Primary hazard: Some seeds may be lost through urination. If the patient does not have a urinary catheter in place, any seed(s) that are lost through urination can be flushed. If a patient does have a catheter and catheter bag in place, the bag should be visually inspected for seeds. If a seed is found follow these procedures:

Do not attempt to remove the seed. Immediately notify EHS-Radiation Safety or the Radiation Oncology physicist for disposal

The following nursing guidelines apply:

- **Observe nursing instructions if posted** with the "Radiation" sign and any Radiation Safety instructions in the patient's chart.
- If you are the primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members and visitors. Note the following:
- Other hospital staff members and visitors are allowed in patient room if instructions are observed.
- Housekeeping and Dietary staff are not permitted in prostate brachytherapy patient rooms. No room items are to be removed without clearance from Radiation Safety. It is especially important to hold the catheter and bag for a radiation survey before disposal.
- The room is not to be released until Radiological Physics (4-5421 days) or EHS (PIC 3454 evenings) performs a clearance survey.

Notify the radiation oncology physicist at 4-5421, Environmental Health & Safety(Radiation Safety) and Radiation Oncology resident on-call if there is a medical emergency (including patient death).

Guidelines for Nursing Personnel
Working with Breast Seed Implant Patients

Use of I-125 seeds for localization of non-palpaple lesions in the breast (RSL) is a minimally invasive procedure that implants small radioactive pellets (called seeds) that are about the size of a grain of rice into the lesions in the breast where they emit very low energy radiation. This radiation is primarily absorbed in the breast tissue immediately surrounding the seeds. Needles containing the seeds are inserted into the breast using mammography or ultrasound guidance. The radioactive material within the seeds gives off localized radiation for several hours to a maximum of 5 days. Using a special radiation detector, the seeds help the surgeon locate the lesion for excision. The lesions containing the seed(s) are then transported to Surgical Pathology. Implanted seeds typically contain 50-300 uCi of I-125. These are considered low activity seeds.

These seeds are for diagnostic purposes and not therapeutic. Consequently the seed should be left in place for as little time as possible to deliver as low a dose as possible to the healthy surrounding breast tissue.

- Patients must be carefully evaluated for ability to return at scheduled time for surgery.
- Seed should not be placed until all pre-operive testing has been completed and a definitive plan for surgical excision exists so that cancellation of surgey is unlikely.
- Patients who are breastfeeding will typically have same day RSL.
- A green armband with the word "SEED" and number of seeds will be worn by the patient to alert others of the presence of the seeds.
- All specimens containing removed seeds are labeled with a green seed sticker and a Caution Radioactive Materials sticker as well.

These patients are administered an amount of radioactive material that is below regulatory release limits, and under normal conditions, patients can go home with seeds in place. The following guidelines should be observed:

- Mammography staff involved in the placement of the seeds are required to complete radiation safety training and are issued a radiation dosimeter. The use of personnel monitoring badges (dosimeters) is not necessary for hospital staff outside of Mammograph who may need to provide care to these patients. Radiation exposure from these patients is very low.
- Provide all necessary care, but work no closer to patient than necessary.
- Primary hazard: There is potential for the seeds to come loose or be lost during implant, surgical removal or handling in surgical pathology. If a seed is lost (or found) follow these procedures:

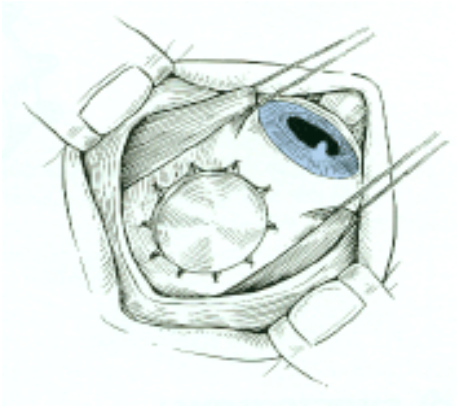
Do not pick up the seed with fingers. Reverse action tweezer must be used to pick up the seed and place in a shielded container. Immediately notify EHS-Radiation Safety at 2-14911.

The following nursing guidelines apply:

- Observe nursing instructions if provided. Generally, there are no specific precautions necessary for the care of these patients. The radiation level associated with these patients is very low**.**

- The Authorized User-physician involved in implantation and the surgeon performing removal are responsible for the safe handling of the seeds. Special handling instructions should be communicated to you by the physician during surgical time-out, etc.
- If a seed is accidentally cut into or damaged, escape of radioatve material an ssubsequesnt contaminatin of the patient and staff is possible. Personnel shall move away from the source (but remain in the room) and call Radiation Safety immediately to notify them of the accident.
- If a source rupture is suspected, do not leave the room. All know sources of radiaon will be shielded and forceps should be used t pick up source fragments and placed in the shielded container.
- Personnel and euiment will be surveysed. Persons who have been surveyed anare free of contmainatin should move to a clean portion of the procedure room. Once Radiation Sfaetgy arrives, additnal survyes wil be performed to veriy personal are free of contamination.

Guidelines for Nursing Personnel
Working with Eye-Plaque Brachytherapy Patients



A radioactive plaque is a small, dish-shaped gold cap device that contains radioactive sources. Ophthalmic plaque brachytherapy is the most commonly used "eye-sparing" treatment for choroidal melanoma. Eye-plaques come in various sizes, typically between 10 and 20 mm diameter. Eye-plaques contain rice-sized, radioactive iodine-125 seeds that emit low energy photons. These photons are effectively blocked by the gold of the plaque creating a directional source. The radioactive eye-plaque is sewn onto the eye so that it covers the intraocular tumor shadow, plus a 2-3 mm "free-margin." With the plaque in place, radiation is continuously delivered over a 4-day period, and then the plaque is removed. No radioactivity is retained inside the patient once these sources are removed.

Patients with eye plaques are typically outpatients. A lead eye patch is placed over the plaque to reduce the radiation emitted from the plaque. The patch remains in place over the plaque during the treatment period and may be removed briefly to provide necessary care. The patient is instructed to go straight home and remain there for the duration of treatment. The patient is instructed when to return for plaque removal. A yellow wristband describing the type and amount of radioiodine in the plaque must be worn at all times.

If the patient is an *inpatient*, the following guidelines should be observed when working with eye-plaque patients:

- The use of personnel monitoring badges (dosimeters) is not necessary when attending these patients.
- The patient may not leave the room while the radioactive implant is in place. The lead eye patch is to remain in place over the plaque during treatment (may be removed briefly to provide necessary care).
- Provide all necessary care, but try to minimize time spent with patient, and work no closer to patient than necessary.
- Observe nursing instructions posted with the "Radiation" sign and any radiation safety instructions written in the patient chart.
- As primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:

  Eye plaque patients receive written patient instructions from Radiation Oncology.

  Other hospital staff members are allowed in patient room if instructions are observed.

  Visitors are also permitted provided the visitor stay times (when applicable) and instructions are followed as posted with the "Radiation" sign. All visitors are to remain a distance of 2 meters (6 feet) from the patient. Visitors under 18 and pregnant visitors are not permitted.

  Housekeeping and Dietary staff are not permitted in eye-plaque brachytherapy patient rooms. No room items (except food trays) are to be removed until cleared by Radiation Safety. Items that will be monitored include linens, patient gowns/clothing, and regular & medical waste.
- No specific room is required for eye-plaque treatments; however, these procedures are to be performed on a floor where the nursing staff is trained in handling such radioactive implant patients.

- The room is not to be released until Radiological Physics or OEHS-Radiation Safety performs a clearance survey.

- **If a source or plaque becomes dislodged from the patient:**
  - do not touch the plaque or any seeds!
  - remove all unnecessary personnel, and call Radiation Safety and Radiation Oncology.
  - try to get the radiation source to the corner of the room via remote handling tool, long broom handle, yardstick, etc.

Notify the physicist-on-call, Radiation Safety and Radiation Oncology if a source becomes dislodged or if there is a medical emergency (including patient death) or the patient arrives at the ER.

Guidelines for Nursing Personnel Working with P-32 Patients

P-32 (phosphorus-32) is a high-energy, pure beta emitter and is routinely administered directly into the peritoneal cavity of some cancer patients. P-32 colloidal solutions may also be injected into brain cysts. Once administered, the radiation exposure hazard is minimal because most of the P-32 beta particles cannot escape the patient's body once administered. Contamination is the primary concern with these patients as it is possible for the treatment site to leak. The following guidelines should be observed:

- If you have been assigned a personnel monitoring badge (dosimeter), always wear it when attending the patient. Wear the badge between your waist and collar and make sure that the badge worn is the one issued in your name for the current monitoring period. Do not share badges with other workers. Do not take you badge home with you. When you are not working, store your badge in a controlled area away from all radiation sources.

- Provide all necessary care, but:

  -try to minimize time spent with patient
  -work no closer to patient than necessary
  -wear disposable **gloves** while attending patient

- Carefully note instructions posted with the "Radiation" sign and any radiation safety instructions written in the patient's chart.

- As primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:

  Other hospital staff members are allowed in patient room if stay times and other instructions are observed. (Exception: Personnel who do not routinely work with radiation therapy patients may not be required to wear a personnel monitoring device. Consult OEHS-Radiation Safety with questions.)

  Visitors are also permitted, provided instructions are followed as posted with "Caution Radiation" sign.

  Housekeeping and Dietary staff are not permitted in P-32 patient rooms. No room items are to be removed without clearance from OEHS-Radiation Safety.

  Visitors under 18 and pregnant visitors are not permitted.

- No specific room is required for P-32 treatments; however, these procedures are ideally performed on the Ob/Gyn floor, where the nursing staff routinely handles P-32 patients.

- If radiation isolation procedures are in place, no room items are to be removed without clearance from OEHS-Radiation Safety. Note: Radiation Safety will consult with the nursing staff to determine whether or not the treatment site is leaking. If it has been determined that the treatment site is not leaking, Radiation Safety may release radiation isolation procedures.

Notify Radiation Safety and Radiation Oncology if the treatment site begins to leak after radiation isolation procedures are released, if you suspect contamination outside the treatment area, or if there is a medical emergency (including patient death).

Guidelines for Nursing Personnel Working with I-131 Therapy Patients

I-131 is used to treat patients with thyroid carcinoma or hyperthyroidism. I-131 is generally administered orally in a liquid, capsule, or caplet form. Major therapies are procedures involving 33 millicuries or more. Any patient receiving major therapies may be admitted to the hospital as determined by patient-specific dose calculations. If calculations demonstrate the potential total effective dose equivalent to any individual would be greater than 500 millirem, the patient shall remain hospitalized until the activity is less than 33 millicuries, the measured dose rate at one meter from the patient is less than 7 millirems per hour, or patient-specific calculation demonstrates that the potential total effective dose to any individual would not be greater than 500 millirem. Radiation **exposure and contamination** are both concerns when working with I-131 patients. The following guidelines should be observed when working with I-131 patients:

- I-131 therapeutic procedures may only be performed in two specifically lead-shielded rooms on 3 East.

- Always wear your personnel monitoring badge (dosimeter) when attending the patient. Wear the badge between your waist and collar and make sure that the badge worn is the one issued in your name for the current monitoring period. Do not share badges with other workers. When you are not working, store your badge in a controlled area away from all radiation sources.

- Provide all necessary care, but:

  -try to minimize time spent with patient
  -work no closer to patient than necessary
  -wear disposable gloves, gowns, and booties when attending patient

- Carefully note instructions posted with the "Caution Radiation" sign and any radiation safety instructions written in the patient's chart.

- As primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:

  Other hospital staff members are allowed in patient room if stay times and other instructions are observed. (Exception: Personnel who do not routinely work with radiation therapy patients may not be required to wear a personnel monitoring device. Consult OEHS-Radiation Safety with questions.)

  Visitors may be permitted if they observe the visitor instructions posted at the room entrance.

  Housekeeping and Dietary staff are not permitted in I-131 patient rooms. I-131 patients are to be provided with isolation food trays. Note: Housekeeping may accompany Radiation Safety personnel into patient room during clean-up process under unusual circumstances.

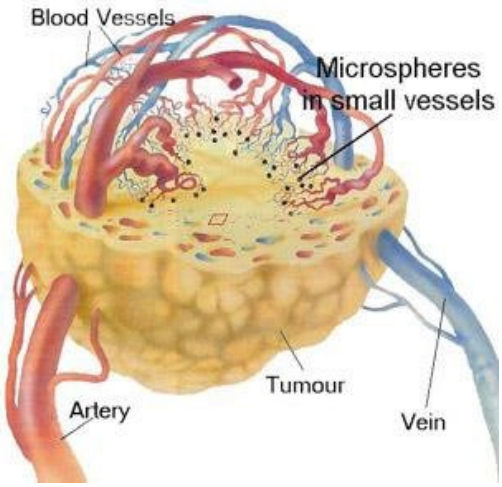
- **Do not remove room items** without clearance from Radiation Safety.

- OEHS-Radiation Safety will survey the patient daily and will notify physician when activity contained in patient is below release criteria.

Notify Radiation Safety and Nuclear Medicine (see posted emergency numbers) if there is a **spill of patient urine, the patient vomits or if there is a medical emergency** (including patient death).

Guidelines for Nursing Personnel Working with Y-90 Microsphere Brachytherapy Patients

"Therasphere" or "SIR-Sphere" microsphere brachytherapy uses a colloidal suspension of extremely small Y-90 integrated glass or coated resin spheres (i.e., diameters on the order of 20-40 microns). These patients receive a permanent implant of microspheres to the liver via an intra-arterial (hepatic) catheterization procedure. Y-90 is a radioactive material that emits high-energy beta radiation. Beta radiation has a definite range, and at its maximum energy only travels 11 mm (< 0.5 inches) in tissue and does not penetrate outside the body. Secondary radiation, in the form of X-rays, is produced when some betas are absorbed in the liver and other parts of the body. These X-rays are able to penetrate outside the body. Given the nature of the procedure, radiation emitted from the patient is low.



These patients are administered an amount of radioactive material that is below regulatory release limits, and under normal conditions, patients are released to go home. For certain reasons, or as a special medical precaution, some patients may be hospitalized for observation in a private room with private bathroom facilities. No special shielding within the room is required. The following guidelines should be observed:

- Carefully note instructions on the "Caution Radiation" sign and any radiation safety instructions written in the patient's chart.

- As primary contact for matters of the patient's care, be prepared to answer questions from other nurses, physicians, technical staff members, and visitors. Note the following:

  Visitors are permitted provided instructions are followed as posted with the "Caution Radiation" sign. It is suggested that children and pregnant females do not visit.

  There are no restrictions governing visitor or caregiver stay times. The patient may leave the room, allowing for minimal contact with other patients, hospital staff, etc.

  Items that the patient touches do not become radioactive. If any of the spheres leave the tumor site, the patient's urine may be radioactive, and universal precautions are to be used when handling foley bags. If a patient does have a foley bag, the contents may be disposed down the drain but the bag must remain within the room until surveyed by Radiological Physics or OEHS-Radiation Safety. Urine bags should be double contained (with an emesis basin, etc.) to minimize any spills.

- Although highly unlikely, the patient's blood may be slightly radioactive, and universal precautions should be utilized when checking or changing the dressing at the catheterization site. Please notify Radiation Oncology, Radiological Physics and Radiation Safety if the catheterization site is weeping or bleeding excessively or if an abscess forms and must be drained. Abscesses should be drained in the presence of a medical physicist. Radioactive microspheres may be present in the drained blood and require proper handling and disposal.

Notify OEHS-Radiation Safety if there is a spill of patient urine or if there are questions pertaining to radiation safety. Notify Radiation Safety and Radiation Oncology if there is a medical emergency (including patient death).

Guidelines for Nursing Personnel
Working in Radiographic/Fluoroscopic Procedures

- A personnel monitoring dosimeter (badge) should always be worn when working with radiographic/fluoroscopic equipment or in radiographic/fluoroscopic procedures. The dosimeters worn should be those issued for the current time period and should be worn at the collar for those workers who wear only one badge. For those workers who have been issued two badges, one should be worn at the collar and the other at the waist under the lead apron.

- Remain in room during radiographic/fluoroscopic procedures only if necessary. Less time spent around a radiation source means a lower radiation exposure to the individual. Remember: **The main source of exposure is radiation scattered from the patient.**

- If you must remain in the room during these procedures, you must wear a lead apron of at least 0.25 mm lead equivalence. Note: A lead apron of 0.25 mm lead equivalence will reduce scattered X-rays by 95%.

- If it is necessary to restrain a patient during an X-ray exam, mechanical restraining devices should be used whenever possible. If a patient must be held in place by an individual for an X-ray exam, that individual shall be protected by whole body apron of at least 0.25 mm lead equivalence. Any part of the individual's body in the X-ray beam during the exposure must be protected by at least 0.5 mm lead equivalence.

- Since radiation decreases rapidly with distance, the further one is from the patient during the actual X-ray examination, the smaller your exposure. Maintain the maximum distance possible from the patient during radiography and fluoroscopy.

- **Exposure levels**: An individual located four feet from the patient's bed at the time that radiographic exposure using a 14 x 17 film is made, may typically receive about 0.010 millirem. To receive 500 millirem, one would have to remain at that distance for 50,000 X-ray exposures. An individual located four feet from a patient undergoing fluoroscopy may typically receive about 0.50 millirems per minute while the machine is "on". To receive 500 millirem, one would have to be in the location for 15 - 20 hours with the machine operating.

Important!

Report any unusual or unsafe condition involving sources of radiation to the OEHS-Radiation Safety Officer (RSO) at 982-4911. Any non-emergency questions during normal duty hours may be directed either to the RSO or to the UVa Office of Environmental Health and Safety (OEHS) at 982-4911. UVa Radiation Safety can be reached after normal working hours at pager 923-5047.

For information about radiation exposure during pregnancy, call OEHS Radiation Safety at 982-4911.

Use Time, Distance and Shielding, as well as disposable gloves and lab coats to keep your radiation exposure **As Low As Reasonably Achievable (ALARA)**.

The UVa Radioactive Materials licenses, X-ray registrations, regulations, inspection reports and exposure reports are available for review in the Office of Environmental Health and Safety, Radiation Safety Section.

The U.S. Nuclear Regulatory Commission's "Notice to Employees" form is posted at various locations within the University and Hospital where radiation sources are used. Refer to this bulletin for instructions and telephone numbers.

For information that may not be posted, contact the Radiation Safety Officer or the Hospital Assistant Radiation Safety Officer at 243-1712.

Radiation Protection Quiz

1. UVa EHS-Radiation Safety can be reached after hours at:

   a. 982-9911
   b. 982-5727
   c. 982-4911
   d. Charlottesville 911

2. Radiation workers are allowed whole body radiation doses of:

   a. 100 millirem/year
   b. 1.0 rem/quarter
   c. 500 millirem/year
   d. 5000 millirem/year

3. The fetus of the "declared" pregnant radiation worker is allowed a dose of:

   a. 100 millirem/year
   b. 500 millirem/year
   c. 500 millirem throughout the pregnancy
   d. 5000 millirem

4. ALARA stands for:

   a. as long as radiation allows
   b. as low as reasonably achievable
   c. as low as rationally attainable
   d. as long as regulations allow

5. The three basic principles used in protecting oneself from radiation exposure are:

   a. time, distance, shielding
   b. ventilation, rules and regulations, procedures
   c. containment, protective clothing, surveys

6. Radiation workers at UVa Hospital receive a yearly average whole body radiation dose of:

   a. less than 100 millirem
   b. 500 millirem
   c. 5 rem
   d. 5000 millirem

7. The ALARA concept is based on the assumption:

   a. that only a large radiation dose can be harmful
   b. that any radiation dose can have some adverse effect
   c. that a little radiation dose can be beneficial

8. A radiation worker is <u>required</u> to be monitored if:

   a. he/she is likely to receive in excess of 10% of the dose limits
   b. he/she wants to be
   c. if the annual radiation dose is likely to be greater than 10 millirem
   d. if any radiation is present in the workplace

9. A 0.25 mm lead equivalent apron will reduce scattered X-rays by:

a. 10%
b. 20%
c. 50%
d. 95%

10. Those persons who must remain within 6 feet of the patient or X-ray tube during a radiographic exposure must:

a. sign a waiver
b. wear a film badge
c. be protected by a whole body apron of at least 0.25 mm lead equivalence

11. Which statement about brachytherapy is FALSE:

a. you should try to work behind mobile shields whenever possible
b. other hospital staff members are allowed in patient rooms if stay times and posted instructions are observed
c. pregnant visitors and minors ARE allowed in radiation isolation rooms
d. the room and patient ARE NOT to be released until cleared by Radiation Safety

12. If a brachytherapy source becomes dislodged from the patient, you should:

a. not touch the source
b. remove all unnecessary personnel and call Radiation Safety and Radiation Oncology
c. try to get the source to the corner of the room with a broomstick, etc.
d. do all of the above

13. Housekeeping and Dietary Staff ARE permitted to enter radiation isolation rooms:

a. True
b. False

14. Radiation is useful in medical diagnosis because:

a. of its ability to cause biological damage
b. lead walls can absorb it
c. of its ability to penetrate tissue
d. it is easy to get a radiation-use license

15. Which of the following is a measure of radiation dose in the human body?

a. Curie
b. Roentgen
c. rem
d. mR/hr

Worker Acknowledgement

1. After you have reviewed the Radiation Safety Training Manual, please feel free to contact your supervisor or the Radiation Safety Officer at 982-4911.

2. After your questions are answered or if you have no questions, please complete the short quiz using the answer sheet below and provide your signature and other information requested at the bottom. Return this page to: OEHS-Radiation Safety Office, Box 400322. You may keep the manual as a reference source. There is no "passing score" associated with the quiz, but quiz results will be evaluated to determine any need for further training.

3. If you routinely work with or around radiation, you may be classified as a "radiation worker." Consult with your supervisor for verification of radiation worker status. If you are a "radiation worker," please enclose (along with this signed memo) a completed radiation worker registration form. Information on this form will be used to determine your personnel monitoring and training needs.

I have reviewed this manual and have been given an opportunity to ask questions about its contents and all applicable policies and procedures.

Signature: _____

Typed or Printed Name: _____

Department: _____

Job Title: _____

Date: _____

Quiz Answers:

1._____	6._____	11._____	EHS Use Only:
2._____	7._____	12._____	
3._____	8._____	13._____	_____% correct
4._____	9._____	14._____	
5._____	10._____	15._____	

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