

RADIATION SAFETY FOR NURSES

HOW TO USE THIS HANDOUT

This handout is in two parts, and you should use each part differently.

The first part, *Radiation Safety Review* contains essential information for all nurses whose duties may involve radiation and/or radiation sources. Please read all of this section as soon as possible.

The second part, *Radiation Safety Procedures*, contains specific radiation safety rules for the nursing care of patients undergoing each of the major procedures involving radiation and/or radiation sources. Please read the section on each procedure before providing patient care connected with that procedure. If you are already providing care in connection with a procedure, read the appropriate section immediately, to review the safety rules for nurses.

Page numbers for these procedures are:

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Radiation Safety Review

INTRODUCTION

As an experienced professional in your field, you may already be familiar with radiation safety; but no matter how much you know, you need to review the key points, for two reasons:

- State regulations and Kaiser Permanente policies both require an annual review of radiation safety procedures in your professional specialty.
- Under the pressures of time and work load, even experienced nurses can become somewhat lax about routinely taking proper safety precautions.

For people who consistently practice radiation safety, the risk is truly negligible. But for people who are uninformed, forgetful, or just careless, the risk increases. So no matter how experienced you are with radiation, take some time to refresh your memory by reading this review.

SOURCES OF RADIATION

In medical facilities, the five most common sources of ionizing radiation are:

- X-Ray producing equipment, usually found in the radiology department, and in surgery, emergency, and patient care areas, as well as in specialized areas such as the cardiac catheterization lab.
- Diagnostic radionuclides, usually found in the nuclear medicine department and in patient care areas.
- Therapeutic radionuclides, usually found in the nuclear medicine department, and in patient care areas where therapeutic nuclear medicine patients are cared for.
- Brachytherapy sources, usually found in the same areas as therapeutic radionuclides.
- Radiation therapy equipment, usually found in the radiation therapy department.

Now let's look more closely at each source of ionizing radiation.

X-Rays

X-Rays are produced by several types of equipment. The types of x-ray equipment that you encounter depend on your specialty. In general though, nurses most often see mobile radiographic and C-arm fluoroscopy units.

Diagnostic Radionuclides

Diagnostic radionuclides are radioactive materials used in nuclear medicine departments. They include technetium-99m, gallium-67, thallium-201, and others. Overall, the risk presented by diagnostic radionuclides is minimal.

Therapeutic Radionuclides

Therapeutic radionuclides are *unsealed* radioactive materials administered in therapeutic doses to patients orally or by injection. They include:

- Radioiodine (I-131), usually administered orally to treat hyperthyroidism and thyroid cancer.
- Radiophosphorus (P-32), which is administered by injection to treat certain types of cancer.

Therapeutic radionuclides present *potential* radiation hazards. But if proper safety practices are followed carefully, the risk here is also minimal.

Brachytherapy Sources

Brachytherapy procedures use *sealed* sources containing radioactive material in therapeutic quantities to treat certain types of cancer. These sources are inserted into patients' bodies, in areas such as the uterus, breast, and naso-pharynx. The most commonly used radioactive materials include:

- Radioactive cesium (Cs-137).
- Radioactive iridium (Ir-192).
- Radioactive iodine (I-125).

Although brachytherapy sources containing radioactive materials are sealed, they do present potential radiation hazards. Here again, the risks are greatly reduced by following sound safety practices.

Radiation Therapy Equipment

Radiation therapy equipment uses ionizing radiation to treat certain forms of cancer and other abnormal tissues. This equipment focuses high-energy radiation from outside the body, on carefully selected tissues. It is usually administered in therapeutic doses. The linear accelerator and cobalt (Co-60) teletherapy units are examples of radiation therapy equipment.

RADIATION HAZARDS

The potential hazard from radiation is exposure to ionizing rays or particles. Radiation exposure can occur in three types of situations:

- When you are near an x-ray machine that is actually making an exposure. In this situation, x-rays scatter and can expose an unshielded body.
- When you are near or in contact with a patient undergoing brachytherapy or radionuclide therapy. In this situation, radiation is emitted from the patient's body, and/or from objects that have been contaminated by radioactive material.
- When you or your clothing have been contaminated by radioactive material.

Radioactive Contamination

Normally, potential radiation hazards are evident, because they are associated with specific areas, equipment, and procedures. But radioactive contamination is not. By definition, radioactive contamination is the presence of radioactive materials *anywhere* they don't belong — that is, anywhere they are not appropriately identified, contained, and controlled.

Contamination is especially hazardous because it can be present without your knowing it. With people, contamination may be external (contact with the skin) or it may be internal, due to ingestion, inhalation, or absorption of radioactive material. This can happen with radionuclide therapy, but is unlikely in brachytherapy, because sealed brachytherapy sources are not likely to leak or break.

Radioactive contamination can produce significant levels of localized radiation exposure.

Sources that DO NOT Produce Ionizing Radiation

Remember that the hazards we are discussing are produced by *ionizing radiation*. Occasionally, people think there may be a radiation hazard in other situations where there is actually none, because *there is no ionizing radiation*.

Selected examples of things that do *not* produce ionizing radiation include x-ray machines that are not actually making an exposure, patients who have had x-rays or external beam radiation therapy treatments, nuclear medicine imaging equipment, iodine contrast material used in patients for x-ray imaging, ultrasound equipment, and microwave ovens.

State and Kaiser Permanente Standards

Five thousand mrem per year is the maximum exposure permitted by state regulations for workers considered to be “occupationally exposed.” (Occupationally exposed workers are people such as x-ray and nuclear medicine technologists who *routinely* and regularly work with and around radiation and radioactive materials.)

Kaiser Permanente's own standards are more conservative than the state's. We set standards to achieve radiation exposure levels “As Low As Reasonably Achievable” (**ALARA**). For example, our maximum permissible exposure per year for occupationally exposed workers is **1,000 mrem** — only one-fifth of the limits allowed by state regulations. Here is a summary of state and Kaiser Permanente radiation exposure standards for *occupationally exposed workers*:

Maximum Permissible Whole Body Dose

Period	State Standard	Kaiser Standard
Month	(no standard)	150 mrem
Year	5,000 mrem	1,000 mrem

Keep in mind that these are *maximum allowable* doses for occupationally exposed workers. The amount actually received is normally much less. For all workers who are *not* considered to be occupationally exposed, the maximum extra exposure is 100 mrem per year — the same as for the general public.

What this means to you depends on your particular job responsibilities:

- If you do not routinely and regularly work with or near radiation sources, you are “non-occupationally exposed.” In this case, you will probably receive no extra radiation whatever.
- If you work with patients receiving therapeutic doses of radioactivity, you may receive around 50 extra mrem per year. (You are still not “occupationally exposed”).

Pregnant Personnel

Kaiser Permanente policies discourage pregnant personnel from caring for patients receiving therapeutic radiation (except for external beam radiation therapy), and from holding patients receiving x-rays. If you should become pregnant, be sure to inform your supervisor promptly.

RADIATION SAFETY PRECAUTIONS

To minimize exposure, you need to take five routine precautions:

- Recognize radiation sources.
- Reduce your exposure time.
- Increase your distance from radiation.
- Shield yourself from radiation.
- Avoid radioactive contamination.

Recognize Radiation Sources

Radiation sources are marked by the international radiation hazard symbol: a purple trefoil on a bright yellow background. When you see this sign:

- Make sure you are aware of the source of the hazard.
- Be sure that you are authorized to be in the posted area (and if not, do not enter it).
- Take appropriate precautions to reduce exposure and avoid contamination.

- Do not handle material labeled as radioactive unless you are trained and authorized to do so.

Reduce Your Exposure Time

The key to reducing your exposure time is planning. Make sure in advance that you have everything you need so that you can complete necessary procedures near a radiation source as quickly as possible.

Increase Your Distance From Radiation

Radiation levels vary inversely with the square of the distance from their source — that is, levels decrease sharply with distance. The farther away you place yourself, the less radiation you are exposed to.

Shield Yourself from Radiation

Shielding will also reduce the level of radiation. Shielding is very effective with x-rays. Wear a lead apron, where provided. If your hands may be in the x-ray beam, wear lead gloves unless doing so would compromise patient care. Use lead shields when available.

In diagnostic nuclear medicine and radionuclide therapy, a lead apron is not effective. An appropriate bedside shield is effective in some situations (such as brachytherapy), and should be used wherever provided.

Avoid Radioactive Contamination

In general, try to avoid radioactive contamination by taking the precautions you would use with infectious agents:

- Wear gloves, a gown, and shoe covers if indicated.
- Avoid contact with objects or areas that may be contaminated.
- Don't eat, drink, or smoke in areas where radioactive materials are in use.
- Don't apply cosmetics or groom your hair while in the area.
- Wash your hands when leaving the area.
- Read and follow all signs and instructions.

And remember: Don't handle radioactive materials unless you are trained and authorized to do so.

RADIATION DOSIMETERS

Though you are unlikely to receive more than moderate amounts of radiation in performance of your duties, you may be issued a personnel monitor or dosimeter (badge) in some situations, to ensure compliance with all limits set by regulation and good practice. (You will be assigned a dosimeter *only* if your job responsibilities require it. If you have any question about whether or not you should receive a dosimeter, see your supervisor.)

If you wear a badge, it is essential that you use it properly. To do this:

- Always wear it when required.
- Always wear it in the proper place. Where you place your badge depends on your particular work. If you are issued a badge, you will be shown where to place it.
- Never wear someone else's badge, or lend your badge to anyone.
- Never take the badge home.
- Store the badge at work in a designated area free from stray radiation, heat, and moisture. These things can damage the film packet.
- Never open the dosimeter packet.
- Return the badge promptly at the end of each month, for processing.
- Keep track of your badge readings. They indicate the amount of radiation you have received. You have a right to see these readings.

THE REGIONAL RADIATION SAFETY MANUAL

The Regional Radiation Safety Manual is the authoritative reference for radiation safety policies and procedures. This guide, which is based on that manual, contains the basic procedures you will need, presented in quick reference form.

If you want more in-depth information about procedures and nursing duties of particular interest to you, you will find this additional information in the *Regional Radiation Safety Manual*. Here are the principal manual sections that may be of interest to nurses:

- Bioassay procedures: Quantification of Iodine-131 present in thyroid tissue:

Section 11-03

- Damaged Sealed Sources: Section 35-55
- Emergency assistance: Section 35-56
- Eye and thyroid protection: Section 11-05
- Major spills of radioactive material: Section 35-53
- Minor spills of radioactive material: Section 35-51
- Nursing care of patients receiving brachytherapy: Section 42-05
- Nursing care of patients receiving radioactive chromic phosphate in the pleural or peritoneal space: Section 42-03
- Nursing care of patients receiving radioactive chromic phosphorus intravenously in therapeutic amounts: Section 42-04
- Nursing care of patients receiving radioactive iodine therapy: Section 42-02
- Nursing care of patients receiving radioactive material for diagnostic procedures: Section 42-01
- Personnel dosimetry policy: Section 11-01
- Pregnant Personnel: Section 11-04
- Radioactive patient waste disposal: Section 33-05

THE AREA RADIATION SAFETY OFFICER (ARSO)

The Area Radiation Safety Officer (usually called the "ARSO") is the person who is responsible for radiation safety throughout the facilities in your area.

In most cases, you should discuss any questions or concerns you might have with your supervisor. However, there are situations in which you can contact your ARSO directly.

If there is an emergency and you cannot contact your ARSO, you can contact the physicist-on-call during normal working hours by phoning the Medical Physics Department. After normal hours, use the pager procedure for contacting Medical Physics. You will find it in section 35-56 of the *Regional Radiation Safety Manual*.

Your Area Radiation Safety Officer is:
(fill in information below)

Name : _____

Dept.: _____

Telephone: _____

IN CONCLUSION

Kaiser Permanente is working actively to protect you. Our comprehensive radiation safety program includes:

- Setting safety standards that are more conservative than state requirements.

- Monitoring all radiation-related activities for safety.
- Providing training such as this.

And finally, remember that we know how radiation works, we know how to handle it with complete safety, and we know how to use its great potential for the benefit of our patients.

DIAGNOSTIC X-RAY

Key Concepts

- The first key to safety is *distance*. Stay out of the area, if possible — but at least six feet away.
- The second key to safety is *shielding*. Wear a lead apron if you are participating in an x-ray

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procedure.

Safety Procedures

1. Do not enter a surgery, recovery room, or emergency room during x-ray exposures unless you are needed there, and are wearing an apron.
2. If holding or restraining a patient, wear a lead apron. Wear lead gloves if your hands may be in the beam (for example, when you must hold the film cassette in position). The beam path is indicated by the visible “locator” light used to position the equipment. This light, of course, is *not* an x-ray beam and *does not* contain any ionizing radiation.
3. If your duties may require you to turn your back to the radiation source, wear a wrap-around apron that will protect your sides and back.
4. If not holding the patient or *required* for nearby patients, *leave* the room until the x-ray procedure has been completed.
5. If you *must* remain in the room for some reason, step back at least six feet from the beam.
6. During “cine” fluoroscopic exposures, step back

or leave the room if possible.

7. If movable shielding is available, use it.
8. When working with mobile units, stand behind the remote control console when making exposures (if practical).
9. If you have been assigned a badge, wear it at collar level *outside* the lead apron.
10. In the Neonatal Intensive Care Unit, the risk of radiation exposure to nurses is low (without protective shielding) and *very* low (with shielding). The hazard to adjacent neonates is minimal.

DIAGNOSTIC NUCLEAR MEDICINE

Key Concepts

- The overall hazard from radiation is very small because of the low quantities and short half-lives of the radioactive materials used.
- Patient wastes, however, can pose a hazard if not dealt with appropriately.

Safety Procedures

1. Radiation exposure is not significant. Minor contamination is possible from patient body wastes and fluids.

2. No personnel dosimeter (badge) or lead apron is necessary.
3. Provide patient care according to usual procedures, and any instructions in the chart.
4. When cleaning up patient wastes or body fluids that may be contaminated soon after a nuclear medicine examination:
 - a. Wear disposable latex gloves.
 - b. Set any possibly contaminated materials or objects aside to be surveyed and disposed of according to procedures provided by nuclear medicine.
 - c. Place possibly contaminated linen in a properly labeled bag and store according to procedures provided by nuclear medicine.
 - d. Flush patient wastes and body fluids down the nearest toilet. Avoid splashing. Flush twice to ensure complete disposal. Wash bedpans or urinals thoroughly before reusing.
 - e. Wash your hands with gloves on.
5. Do not wear a lead apron. It does not provide effective protection against radiation emitted by diagnostic radionuclides.

THERAPEUTIC NUCLEAR MEDICINE: RADIOIODINE THERAPY

Key Concepts

- Radioiodine (I-131) therapy involves the administration of *unsealed sources* of radiation, usually orally, to treat hyperthyroid conditions and thyroid cancer.
- The procedure offers the possibility of a certain amount of radiation hazard, unless proper safety procedures are followed.

Safety Procedures

- A. Access to the patient:
 1. Patient must be in a private room with private bathroom.
 2. The room door is to be posted with nurses' instructions and with a radiation or radioactive materials sign.
 3. Do not enter the room or allow others to enter unless authorized and adequately trained.
 4. Housekeeping, food service, maintenance,

visitors, etc. may not enter unless approved by the nurse in charge.

5. The patient may not leave the room.

B. Visitors:

1. No visitors during the first 24 hours.
2. No pregnant visitors or children under 18 at any time.
3. After 24 hours, other visitors may be permitted, according to the instructions provided by nuclear medicine personnel.
4. The patient must stay in bed throughout the visit.
5. Visitors must remain at least six feet away from the patient.
6. Visits must end within the "limits of stay" time posted on the patient door and/or in the patient chart.

C. Patient care:

1. Before providing care, read any special instructions or restrictions posted on the door or noted in the patient's chart.
2. Do not provide care if you are pregnant or think you might be.
3. Do not remain in the room longer than the "limits of stay" time posted on the door and/or in the chart.
4. Plan your activities before entering, so that you can provide speedy, efficient care.

D. Your personal protection:

1. Wear your badge at waist level.
2. Do not wear a lead apron. It will not provide effective protection, and it can hamper your movements.
3. Wear latex gloves, shoe covers, and gowns, if indicated in the nurses' instructions. Remove them *before* leaving the room and place them in the disposal containers provided.
4. Before leaving the room, wash your hands with gloves on, dispose of the gloves in the specially marked bag provided for contaminated trash, then wash your hands again.
5. Do not eat, smoke, apply cosmetics, or groom your hair in the patient's room. (Of course, smoking is not permitted *anywhere* in a Kaiser Permanente building.)

E. Contaminated patient wastes:

1. Never try to clean up any patient vomitus

- or other body fluid spillage. Instead, cover with a towel or other absorbent material.
2. Call nuclear medicine personnel and/or the responsible physician immediately.
- F. If you think you may be contaminated:
1. Move away from the source of contamination, but do not leave the area.
 2. Remove any clothing and accessories (such as watches) that might be contaminated.
 3. Wash the suspected area thoroughly with large amounts of mild soap and water. (Do not scrub hard enough to risk breaking your skin.)
 4. Have someone else telephone the nuclear medicine department.
 5. Wait for instructions from the nuclear medicine department.
- G. Room protection, survey, and release:
1. Areas and objects in the room that may become contaminated should be covered by nuclear medicine personnel with protective material (such as absorbent, disposable cloths, "Chux", and plastic bags and sheeting).
 2. Do not remove any objects from the room until they and the room have been surveyed for contamination and released by nuclear medicine personnel.
 3. *Verify* that this survey has been completed and radiation warning signs have been removed before removing objects and releasing the room.

THERAPEUTIC NUCLEAR MEDICINE: RADIOPHOSPHORUS THERAPY

Key Concepts

- Radiophosphorus therapy involves the administration of unsealed radiation sources to treat various forms of cancer.
- In general, the risk of radiation exposure is relatively low.
- Radiophosphorus may be administered intravenously or into the pleural or peritoneal spaces.
- Details of safety procedures depend on the method of administration.

Safety Procedures

NOTE: Because radiophosphorus therapy is performed very infrequently, nursing care procedures for this therapy are not included in this guide.

However, in the event that you do provide care for a radiophosphorus patient, it is essential that you review the appropriate procedures and precautions. They are covered fully in the Regional Radiation Safety Manual, Sections 42-03 and 42-04.

BRACHYTHERAPY

Key Concepts

- Brachytherapy involves the application of *sealed sources* of radiation to the skin or into body openings. It is used to treat various forms of cancer.
- The procedure offers the possibility of a certain amount of radiation hazard, unless proper safety procedures are followed.

Safety Procedures

A. Access to the patient:

1. Patient must be in a private room with private bathroom.
2. The room is to be posted with a radiation or radioactive materials sign.
3. Do not enter the room or allow others to enter unless authorized and adequately trained.
4. Housekeeping, food service, maintenance, visitors, etc. may not enter unless approved by the nurse in charge.
5. The patient may not leave the room, and may be restricted to bed, as detailed in the nursing instructions.

B. Visitors:

1. No pregnant visitors or children under 18 at any time.
2. Other visitors are permitted, according to the instructions provided by radiation therapy personnel.
3. The patient must stay in bed throughout the visit. (As noted above, the patient may be confined to bed at *all* times.)
4. Visitors must remain at least six feet away from the patient.
5. Visits must not be longer than the "limits of stay" time posted on the patient door

and/or in the patient chart.

C. Patient care:

1. Before providing care, read any special instructions or restrictions noted in the patient's chart.
2. Do not provide care if you are pregnant or think you might be.
3. Do not remain in the room longer than the "limits of stay" time posted on the door and/or in the chart.
4. Plan your activities before entering, so that you can provide speedy, efficient care.

D. Your personal protection:

1. Do not wear a lead apron. It will not provide effective protection.
2. Use any other shielding barriers provided, such as a bedside lead shield.
3. Wear your badge at waist or collar level. When using a bedside shield, wear the badge at collar level.

G. Room survey and release:

1. Do not remove any objects from the room until they and the room have been surveyed and released by radiation therapy personnel.
2. *Verify* that this survey has been completed before removing objects or releasing the room.

H. Dislodged radiation source:

1. Description: A dislodged sealed source is a capsule or needle that has been dislodged from its position in the patient. It is usually found in patient clothing or bed linen, or on the floor.
2. To secure a dislodged sealed source:
 - a. Use long-handled forceps. Do not touch the source with your hands.
 - b. Using the forceps, pick up the dislodged source and place it in the radiation-shielded container left in the room by radiation therapy personnel.
 - c. Call the radiation therapy physician immediately.

RADIATION EMERGENCIES

Radioactive Material Spill

- The basic objectives in dealing with radioactive spills are to prevent contamination of others by restricting access to the spill area and to summon expert help to clean up the spill and check the area.
- After a spill, notify others in area, clear area of non-contaminated people, restrict access to area, and call nuclear medicine. If spill is *major*, do not clean it up, and, if nuclear medicine cannot be reached, contact the ARSO immediately.
- *Never* attempt to clean up the spill yourself (except in the case of minor amounts of body wastes or fluids from patients containing diagnostic radionuclides).

Personnel Contamination

- The key concepts are to remain in the area of contamination, restrict others from entering it, and obtaining expert help in decontamination.
- If you may be contaminated:
 1. Do not leave the contaminated area, but move as far away as you can from the source of contamination.
 2. Remove all accessories (such as a wrist watch and jewelry), and any clothing that might be contaminated.
 3. Wash thoroughly with generous amounts of warm water and mild soap. Do not scrub hard enough to risk abrading your skin.
 4. Have *someone* else contact nuclear medicine, and then wait for their instructions.

Code Blue Patient

- A degree of radiation hazard is present *only* with patients containing *therapeutic* amounts of radionuclides or brachytherapy sources.
- The degree of hazard from radiation or radioactive contamination will vary, depending on the procedure that the patient is undergoing at the time. In any case, the risk to you is less significant than the risk to the code blue patient.
- Carry out code blue procedures in the usual manner.

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- If you think you may have been contaminated, contact the nuclear medicine department.

Emergency Surgery

- A degree of radiation hazard is present *only* with patients containing *therapeutic* amounts of radionuclides or brachytherapy sources.
- Without notification and proper precautions, surgical staff, areas, and equipment could receive unexpected exposure to radiation or contamination from radioactive materials.
- If possible, do not move the patient until you have consulted the nuclear medicine or radiation therapy physician.

Death of Patient

- A degree of radiation hazard is present *only* with patients containing *therapeutic* amounts of radionuclides or brachytherapy sources.
- Without notification and proper precautions, people, equipment, and facilities involved in post-mortem procedures could receive unexpected exposure to radiation or contamination by radioactive materials.
- Restrict room access and do not allow the body to be removed until authorized by nuclear medicine or radiation therapy physician.