

Walter L. Robinson & Associates Presents.....



Note

This presentation is intended
for annual in-services
or initial radiation safety
orientations

“What Every Nurse Needs To Know to Safely Work With Or Around Radiation or Radioactivity”



Cardinal Principles of Radiation Protection

- Time - execute specific required tasks as swiftly as effectively possible
- Distance - doubling your distance from a source of radiation reduces the exposure by a factor of four
- Shielding - wear or interpose lead between you and the source of radiation

PERSONNEL SHIELDING

- Lead amalgams (lead/tin) aprons are lighter and just as effective at reducing X-ray scatter in fluoroscopy
- Two-piece lead skirt/vest (0.5 mm Pb total equivalence front, 0.25 mm Pb back) are highly recommended as they prevent spinal compression due to better weight distribution



**Wraparound skirt/vest type
lead apparel minimizes
weight on spine**



**Full-length lead
apron with
support belt**

Both are 0.5 mm lead equivalent

Lead Apron Integrity

- Small pinholes and wrinkles do not compromise lead apron integrity.
- Keeping lead aprons on special racks to prevent folding preserves lead integrity and prevents shredding of layers inside apron
- Aprons do not need to be fluoroscoped or radiographed to be “inspected” by a qualified expert.



Lead aprons shown here are skirt/vest variety. Although they could be organized better, hanging them up does prevent wrinkles that lead to creases, and eventual tears.

Lead Apron Use

- Do not expect a lead apron to protect you in a direct primary beam as they are intended to protect only from scatter
- They are 90-95% effective in reducing the dose from scatter
- You should wear a lead apron or equivalent when you are required to be within 4 feet from the source of scatter (radiographic or fluoroscopic)

Other Leaded Garb

- Leaded collars are always personally optional, as the thyroid is 10 times less sensitive to external radiation
- Leaded glasses (acrylic or 0.5 mm Pb equivalence) should always be worn by any staff required to have their eyes within 4 feet from the source of fluoroscopic scatter



Glasses with side shields and Thyro-Shield



Glasses with side shields



0.25 mm Pb Thyroid Collar and 0.5 mm Pb Glasses-wraparound are best

Radiation Safety Philosophies and Concepts

- Background (BKG): Inescapable radiation exposure that we are always exposed to. It is three times higher in Denver, Colorado vs. East Coast
- A.L.A.R.A. - A radiation “mission statement” or commitment to keep radiation exposures ***As Low As Reasonably Achievable***

RADIATION EXPOSURE REGULATIONS

- 5 REM (5000 mREM) (0.05 Sv) to Total Body, which includes head, torso to knees
- 50 REM (50,000 mREM) (0.5 Sv) to extremities, which includes hands, feet and skin
- 15 REM (15,000 mREM) (0.15 Sv) to eyes

Fetal Exposure Limits

- The mother's external badge (worn at waist location) under lead apron, is generally taken to be the fetal dose of record; however, actually it is probably about 30 % of that dose, since the fetus is not on the surface of the body.
- The limit is 0.5 REM/declared pregnancy period (not to exceed 50 mREM/mo.) Without a written "declaration" the woman is allowed to get 5 REM/yr.

Radiation Exposure During Pregnancy

- Most hospitals have an all-department or “global” policy that allows the A.L.A.R.A. principle (depth of trained staff) to be applied to decisions pertaining to changes in job duties following declared pregnancy status.
- Since most staff do not routinely exceed the 0.5 REM limit in 9 months, (especially when the baby badge is worn under a lead apron for X-ray exposures), usually no change in duties is required.

When is a “Badge” Required?

- When staff could reasonably be expected to regularly receive an exposure greater than 40 mREM/mo.
- If you are not badged your employer is required to keep your exposure below a limit that is 10 times lower!
- The average X-ray tech gets less than 40 mREM/mo., if not doing special fluoroscopy or cath lab procedures. The average nurse gets less than 10 mREM/mo, unless performing a lot of C-arm fluoroscopic procedures.

Special Case for Double Badging

- If a department contracts a temporary nursing service to provide staff that will be exposed occupationally, then the agency will need to provide a badge and the hospital is required to provide a badge also, only if the person will work at more than one client during the tenure of service.

•Luxel Total Body Badge



•T.L.D. Ring Badge



Care and Feeding of Badges

- Always leave badges at your workplace-do not take them home (heat, wash, loss, forget).
- Keep badges in a low radiation background area-especially controls. Controls are important.
- Do not leave badges on clothing or lead apron (others may use)-especially one left in an X-ray room (exposures recorded may not be attributable to you).
- If badge is lost-immediately notify your supervisor for a "stat" (2 day) replacement.
- If required to wear a badge, do not begin work without your badge or temporary dosimeter (should be available for emergencies).
- Learn how to read your badge report, and put it's readings into perspective-ask RSO



Luxel Badge Storage Rack

How to read your badge report.

- Current month should be <40 mREM
- Current quarter should be <120 mREM
- Current year must be <5000 mREM
- Lifetime should be A.L.A.R.A.
- Once assigned a badge, you are a “radiation worker”, as such you are allowed a once in a lifetime 25,000 mREM exposure for life-saving. Such exposures must be planned and approved by the RSO and management.

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RADIATION DOSIMETRY REPORT



ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT IN WORK	TIME DAYS	PAGE NO.
103116		0027689013	10/11/00	10/02/00		7	1 OF 1

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
	ID	BIRTH	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE		
							07/01/00 - 09/30/00			2000							
00006			M	P	WHBODY	*P	32	33	34	48	50	52	519	521	534	3	01/91

This Month

This Year

Lifetime

M: MINIMAL REPORTING SERVICE OF 1 MREM QUALITY CONTROL RELEASE: JS 1 - PR 7077 - RPT131 - N1 - 27613
* - NO CONTROL SUBTRACTED

Personnel monitoring report shows number of mREM received in the current month, quarter, year, and lifetime.

Where to wear the badge?

- For fluoroscopy, the badge is worn on the collar, outside the lead apparel protection. If staff member is pregnant, a second “baby” badge is issued, to be worn under the lead apron.
- For radiography, mammography, and dexta the badge is worn on the collar.
- For nuclear medicine, the badge is worn on the waist, on the side the person injects. No additional “baby” badge is required-if staff member is pregnant.

What Regulations Apply?

- X-ray Exposure: State Bureau of Radiation Protection, or equivalent
- Radioactivity Exposure: Nuclear Regulatory Commission and State Bureau of Radiation Protection or NRC Agreement State

Which Regulatory Agencies Do Not Have Jurisdiction ?

- O.S.H.A.
- E.P.A.
- J.C.A.H.(O) - recommendations only
- Right-To-Know requirements

Who Reviews Radiation Safety Matters in Your Facility?

- In a hospital with a Nuclear Medicine Department - the Radiation Safety Committee (has quarterly meetings)
- In a hospital or out-patient facility (office) - the Radiation Safety Officer (R.S.O.), usually a physician or physicist. Do you know who your R.S.O. is?
- If no one feels qualified as a full time on site R.S.O., usually a consultant is contracted to assist with these duties

Radiation Safety Committee

- A nurse representative is on the committee, and acts as liaison.
- The committee also includes the RSO and a high-ranking management representative, and other department representatives as needed or invited.
- Any radiation safety concern or problem can and should be discussed here. Radiation safety decisions are final.

Where might you be exposed to radiation in your facility ?

- Nuclear Medicine Department
- Radiology Department
- Radiation Oncology Department
- O.R.
- E.R.
- Patient's Room
- Cystoscopy
- Pain Management Department
- Cardiac Catheterization Laboratory
- Dexa Scanner (Bone Mineral Analysis)

• We will discuss each area in detail

Nuclear Medicine Department

- Full time departmental nurse
- Accompanying a patient
- Patient returns to your duty area with diagnostic or therapeutic radioactivity
- Patient is treated in private room
- Nurse notices patient has been dosed with radioactive material elsewhere



These signs on doors in the nuclear medicine department mean that an exposure risk of 5 mR/hr can exist inside and that a contamination risk exists from radioactive materials stored in this room.

The Nuclear Medicine Nurse

- Must have radiation safety orientation and specific training to understand radiation and radioactivity hazards and how to control and minimize them
- Is provided with total body and possibly ring personnel monitors
- Helps as adjunct liaison with other nurses and patient families



A 3-headed S.P.E.C.T. Gamma Camera

A gamma camera only images nuclear medicine in the body; it is not hazardous

Radioactivity vs. Radiation

- Protection from exposure from Ionizing RADIATION is by the Time-Distance-Shielding principles.
- A RADIOACTIVITY source represents two hazards-exposure (as above) and contamination.
- The risk from contamination is that it spreads the areas of exposure to unknown locations if not immediately controlled. Contamination can possibly lead to ingestion or skin exposure.

Accompanying a Patient

- If you must occasionally accompany a patient to and from the nuclear medicine department, you are not exposed to enough exposure to require a personnel monitor badge, even if the patient has been dosed with therapeutic nuclear medicine. You may, but should avoid-if possible-performing this duty when pregnant. Distance from nuclear cardiology patients on a treadmill should be maximized, if Tc-99m Cardiolite used.

Patient Returns To Your Duty Area With A Dose of Nuclear Medicine

- Most patients will be diagnostically-dosed that are very safe to attend-even if pregnant
- If a therapeutically-dosed patient is not assigned to a private room posted with "Caution" signs, then they are safe to attend-even if pregnant

Patient is Treated in Private Room

- Nursing personnel attending I-131, Ir-192 or Cs-137 patients will require personnel monitoring - usually pocket dosimeters
- Sm-153, Sr-89, P-32, I-125, or Pd-103 patients exposures are so low as not to require personnel monitoring
- Only I-131 has the additional significant hazard of radioactivity contamination

• **The last needs special nursing training from the R.S.O. or his delegate.**

Nurse Notices a Patient That Has Been Dosed Elsewhere

- Most common are I-125 or Pd-103 seed implants. These are no hazard to nursing staff.
- Diagnostic nuclear medicine test patients are no hazard to nursing staff.
- I-131 Therapy patient readmitted within a few days of treatment date should be brought to the attention of your R.S.O.

Radiation Exposure in the E.R.

- C-arm fluoroscopy - if you must be within 4 feet of beam axis, wear a lead apron
- Mobile radiography - if you must be within 4 feet of beam, wear lead apron
- Radiation accident victims present a special problem, but having drills can reduce anxiety

Relative Hazards Comparison

- Fluoroscopy - procedures can include beam on time of up to 1 hour, but has low beam intensity
- Radiography - high intensity exposures are for only a fraction of a second; however, many exposures may be taken over a month. Never remain in the direct beam if required to hold a patient or a film cassette



A mobile radiographic unit may be used in a patient's room

Patient "Holding" Policy

No patient should be held for radiographic or fluoroscopic exposures at any time.

There are positioning devices available to assist you-request them.

In an emergency, when it is in the best interest of the patient, an exception can be made in the name of "common sense"; however, this should never become routine policy. Lead aprons will be provided. Exposure to you for one or a few cases is negligible.

Radiation Exposure in the O.R.

- C-arm fluoroscopy
- Cystoscopy
- Radiography including dental
- Melanoma Sentinel Node Localization
- Brachytherapy Procedures
- Surgery of a Patient with Diagnostic or Therapeutic Radioactive Material

• The last two need special nursing training from the R.S.O. or his delegate.



A Mobile Fluoroscopic C-arm



•Cystoscopic Fluoroscopy Unit

Other Exposure Sources in an O.R.

1. A mobile radiographic dental unit
2. Surgical excision of melanoma tagged with Tc-99m
3. Surgery of I-131 or other unsealed source therapy patient
4. Surgery of brachytherapy patient

1. Exposure from the dental X-ray unit is negligible if a nurse can stand at least 4 feet away from it.
2. Exposure from a Tc-99m tagged melanoma excision affords minimal exposure to nursing staff that can stand 4 feet from the patient. A minor contamination situation exists; however, thorough infection control procedures are adequate to eliminate this minor risk.



Melanoma Sentinel Node Detector with Probes

3. Ideally, surgery on an I-131 therapy patient should be scheduled for at least 1 week following the treatment. In this case, nominal exposure exists.

4. All temporary brachytherapy sources will be removed prior to surgery, so no risk exists.

Permanent brachytherapy sources (i.e. prostate seeds) do not represent an exposure hazard to nurses; however, extreme care must be observed to not dislodge any. If they are dislodged, they must be stored safely.

Radiation in the Radiology Department

- If you can wait in the operator's control booth no lead aprons are required
- If you are required to be within 4 feet of a fluoroscopy procedure, you must wear a lead apron, but you are not required to wear a personnel monitoring badge
- Exposure in special procedures & C.T. is much greater than mammography; ask the tech where to stand.



Conventional Fluoroscopy Room with Overhead Radiographic X-ray Tube



Conventional C.T. Unit

Radiation Exposure in Pain Management

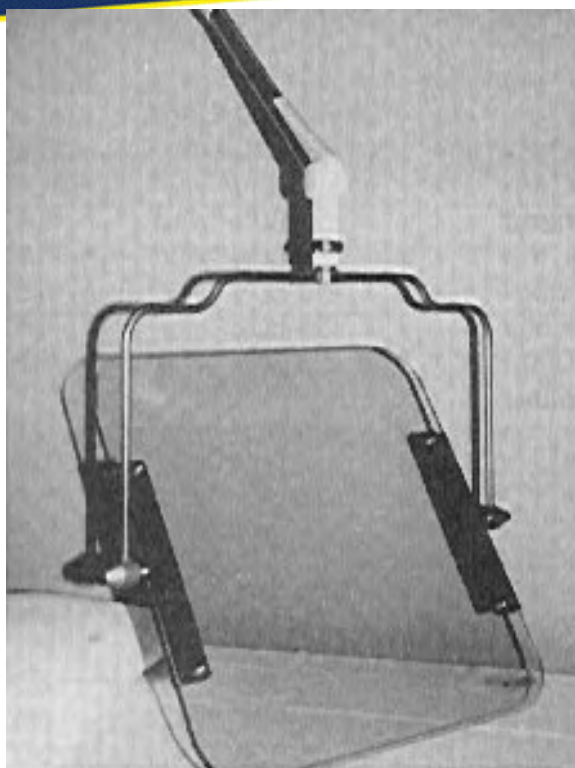
- Primarily exposure is from a mobile C-arm fluoroscopy unit that may be moved from room to room. Such a unit does not need to have the walls leaded in rooms where it is used.
- Always wear lead aprons when required to be within 4 feet of the unit.
- Unless a nurse is permanently assigned to this service, no personnel monitoring badge is usually assigned

Radiation Exposure in the Cath Lab or E.P. Lab

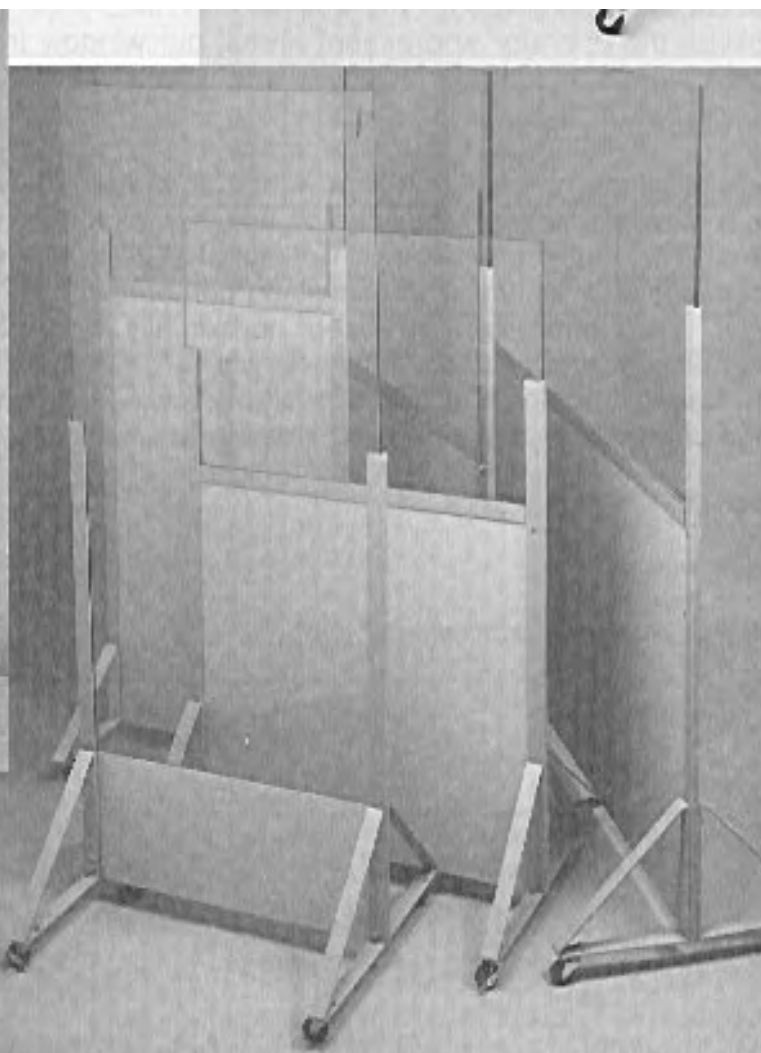
- If you are permanently assigned to this duty, you will be given a personnel monitor badge to be worn on the collar outside the lead apron (leaded skirt/vest) that you must wear if your duties require you to be within 4 feet of the patient
- If you are only accompanying a patient, you may just wait in the operator's control booth, where you will be completely safe



Note mobile lead/lead acrylic barrier behind the "C" arm in this Cath. Lab



**Satellite 0.5 mm
Pb pull down
shield**



**Various lead with lead
acrylic shields**

Fluoroscopic Radiation Management

- For a detailed in-service of radiation safety pertaining to the specific hazards of fluoroscopy request a videotape copy of Walter L . Robinson & Associate's: Fluoroscopic Radiation Management (free to current clients-one copy should already be on site), or view at your own pace at www.walterrobinson.com, as it is accessible from the home page.
- Primarily, but not exclusively, for physicians using fluoroscopy

Radiation Exposure in the Patient's Room

- If your duties require you to be within 4 feet of mobile X-ray equipment (radiographic. or fluoroscopic), ask the technologist for a lead apron
- All diagnostic and some therapeutic nuclear medicine patients usually offer no exposure hazard or special instructions
- Some therapeutic nuclear medicine and some brachytherapy patients require special nursing care - refer to specific instructions at each nursing station, or call the R.S.O.

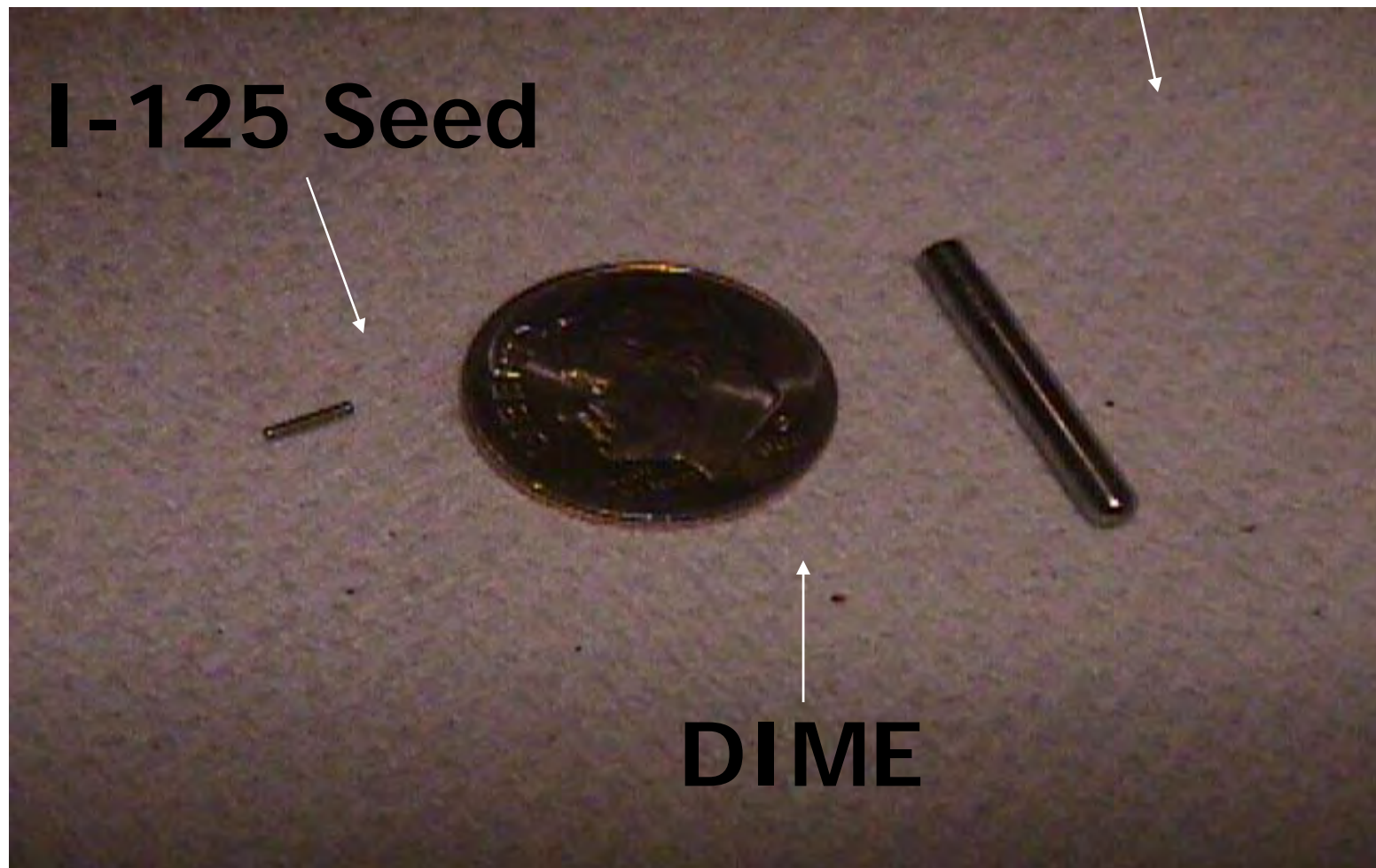
Relative Radiation Exposure from Various Sources in Radiology, Radiation Oncology, and Nuclear Medicine Departments

- Radiation Oncology - Linear Accelerators, High Dose Rate Afterloaders, Gamma Knife, Brachytherapy (Very High)
- Cardiac Catheterization Labs, Special Radiology Procedures, C.T., I-131 Therapy Patients (High)
- C-arm fluoroscopy, general fluoroscopy - including cystoscopy (Moderate)
- General Radiography, mobile radiography (Low)
- Mammography, Stereotactic Mammography, Dexa Scanner or Bone Mineral Analysis (Very Low)

Brachytherapy Treatments

- High Dose Rate (HDR) treatments with Ir-192 is usually done in the linac room, and represents no exposure to nurses.
- Low Dose Rate (LDR) treatments of Ir-192, Cs-137 create some exposure for nurses similar to outdated Radium-226.
- Low Dose Rate treatments using “seeds” such as I-125 or Pd-103 do not provide any exposure hazard to nurses.

Cs-137 Brachytherapy Source



Radiation Oncology Department

- Exposure from the linear accelerator (linac) or “gamma knife” is non-existent, due to the fact that nurses are restricted to staying outside the treatment room.
- Brachytherapy radioactive source treatments represent the only exposure to nurses-but only specific radioactive sources represent hazards. None represent radioactivity contamination hazards.



A modern medical linear
accelerator

Cs-137 and Ir-192 LDR

- Both procedures today are usually performed in the O.R. without radioactive sources. The radioactive sources are loaded into the applicators that are inserted into the patients in their rooms.
- Staff floor nurses must be specifically trained to minimize their exposure if caring for these patients-personnel monitors are provided for these nurses.

Cs-137 Nursing Rad. Safety

- Always wear a personnel monitor (dosimeter) while in the patient room.
- Minimize time with patient in room to that which is absolutely necessary.
- Maximize your distance from the patient while in the room-if possible-while carrying out necessary duties.
- Be able to recognize a dislodged brachytherapy source, and know who to call (RSO or Radiation Oncologist)



Pocket dosimeters are often given to nurses infrequently or irregularly exposed – especially from brachytherapy or I-131 therapy patients.

Exposure in Mammography

- Since nurses are not required in the imaging room, there is no exposure to them (unless it is their own mammography, which has its own set of risks vs. benefits that should not be linked to the occupational exposures discussed here).
- Keep in mind exposure to one body part cannot be equilibrated to a total body exposure.



Mammography X-ray Unit

Bone Mineral Analyzers

- X-ray based (new), sometimes called a “Dexa” scan, or radionuclide-producing bone mineral analyzers (old) afford little or no exposure for a nurse who must accompany a patient to the procedure. Exposure at the operator’s distance is safe even for pregnant staff.



Bone Mineral Analyzer