UNIVERSITY HOSPITAL
Newark, New Jersey

Radiation Safety

2021 - 2022

Radiation Safety Awareness Training

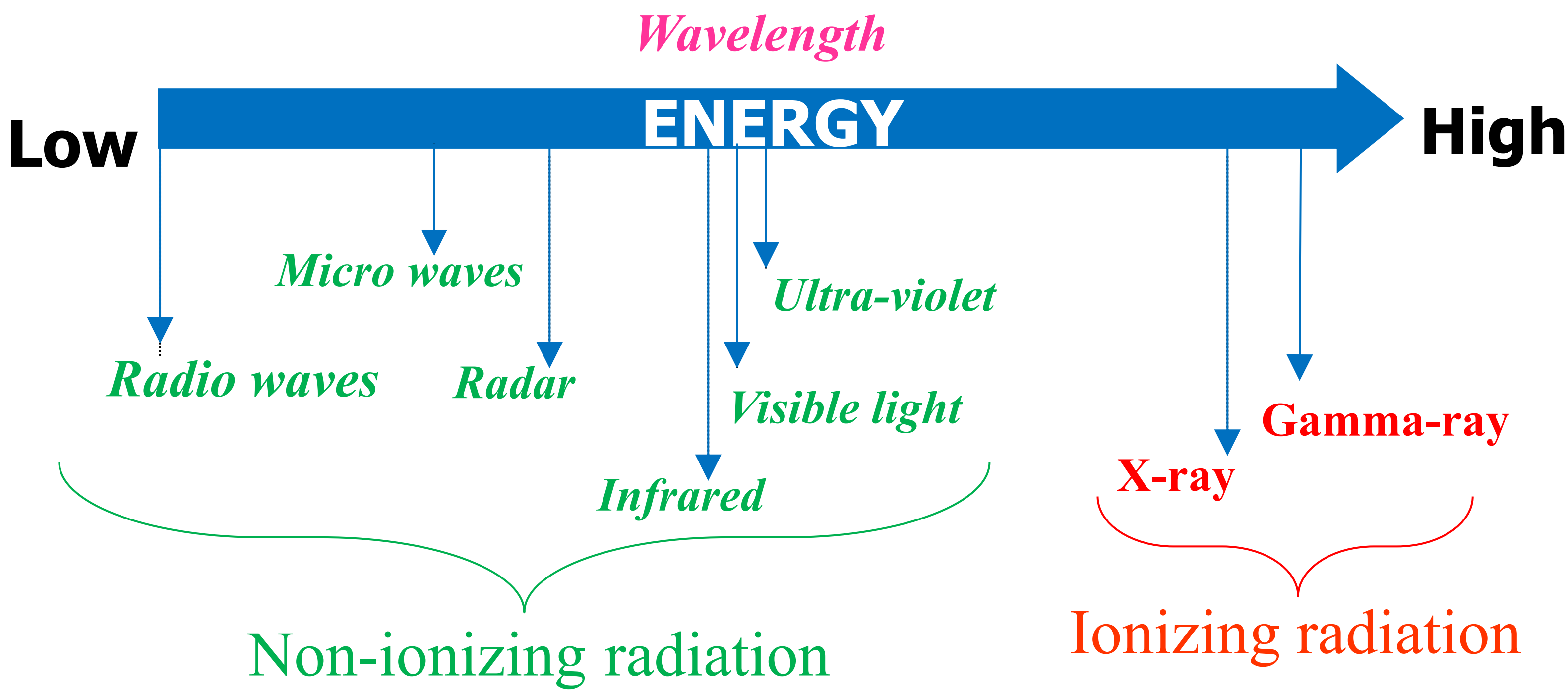
- This training is intended to provide an awareness level of training regarding the presence of radioactive materials and radiation producing machines found on the RBHS Newark Campus and in University Hospital.
- Should your work require attendance at full radiation safety training, you will be so instructed.
- Should you have questions or concerns, do not hesitate to contact Rutgers Environmental Health and Safety (REHS):
  - **Prasad Neti**, PhD, Radiation Safety Officer, RBHS Newark: (973) 972-5305
  - **Patrick J. McDermott**, CHP, University Health Physicist: (848) 445-2550

Identification of Radioactive Material Use Areas at University Hospital

Each door is posted with “Caution-Radiation Area” sign where radioactive patients are located. These signs have a yellow background with a purple or black warning symbol as shown below.

Electromagnetic Waves

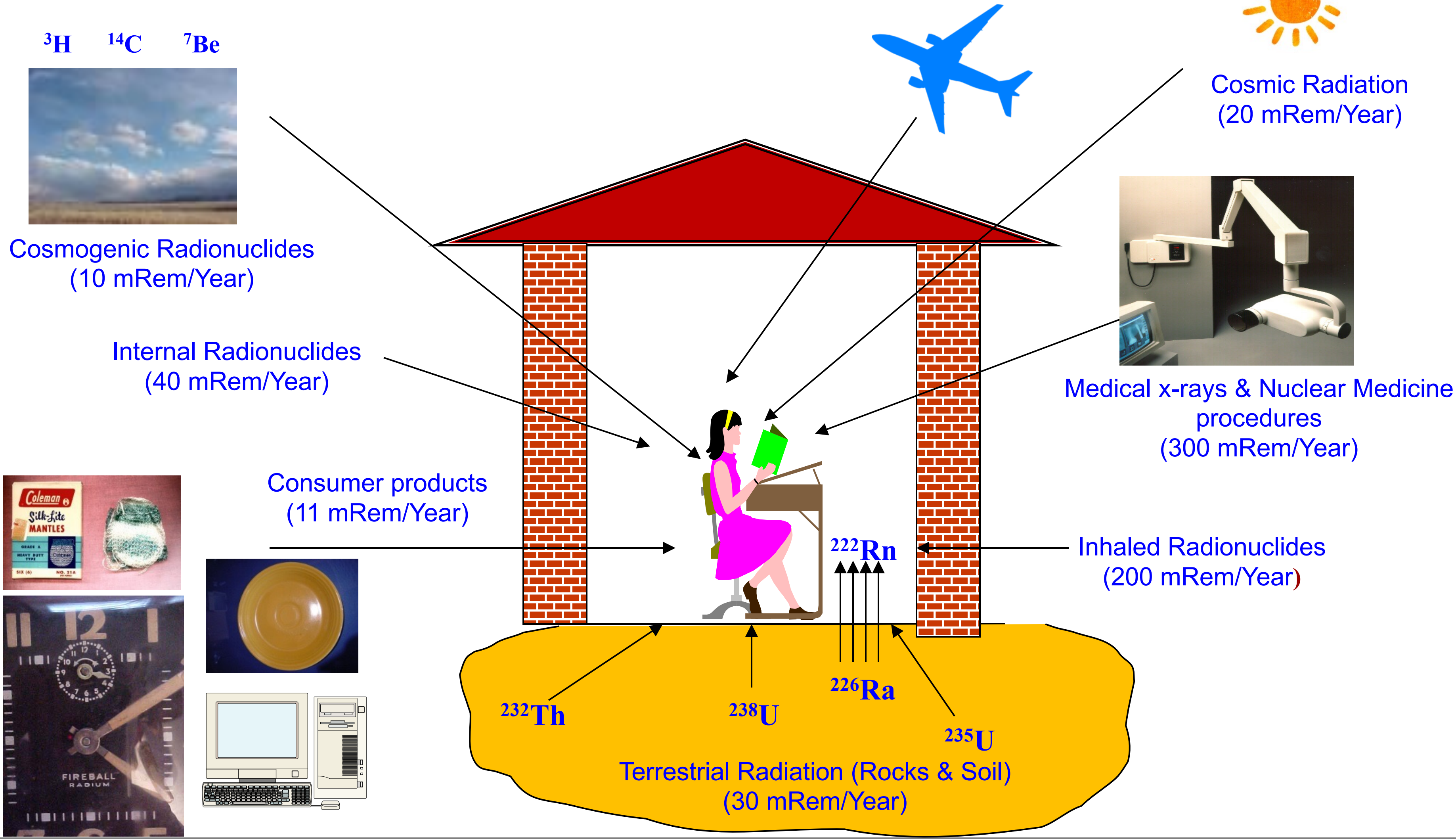
Electromagnetic waves have different names depending on their wavelength and produce either ionizing or non-ionizing radiation.



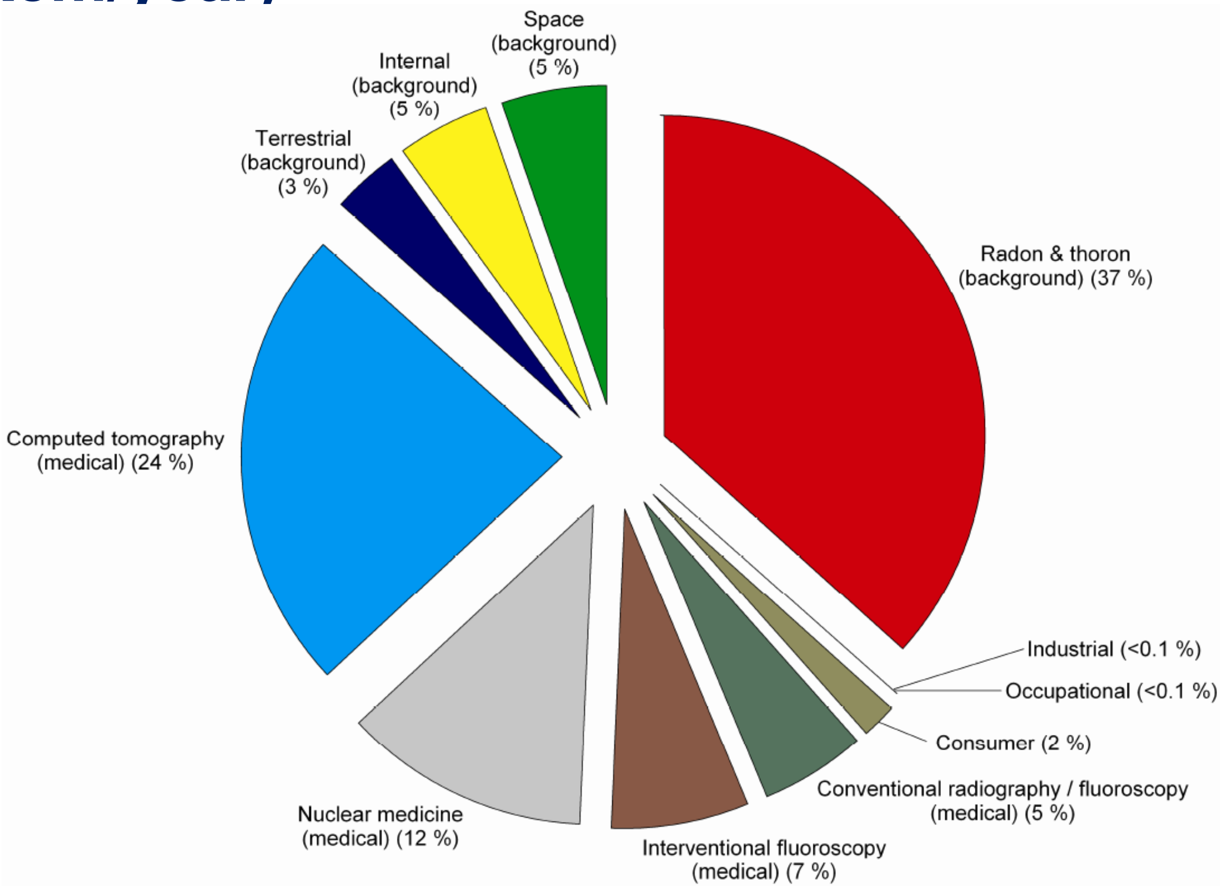
How can we detect Radiation?

Radiation can be detected by a **Geiger-Muller survey meter**, also known as **Geiger Counter**.

Radiation Exposure from Nature and Consumer Products



Average Annual Radiation Exposure to General Public (620 mRem/year)



Ionizing Radiation Exposure of the population of the US. Bethesda, MD: National Council on Radiation Protection and Measurements; 2009. NCP report 160.

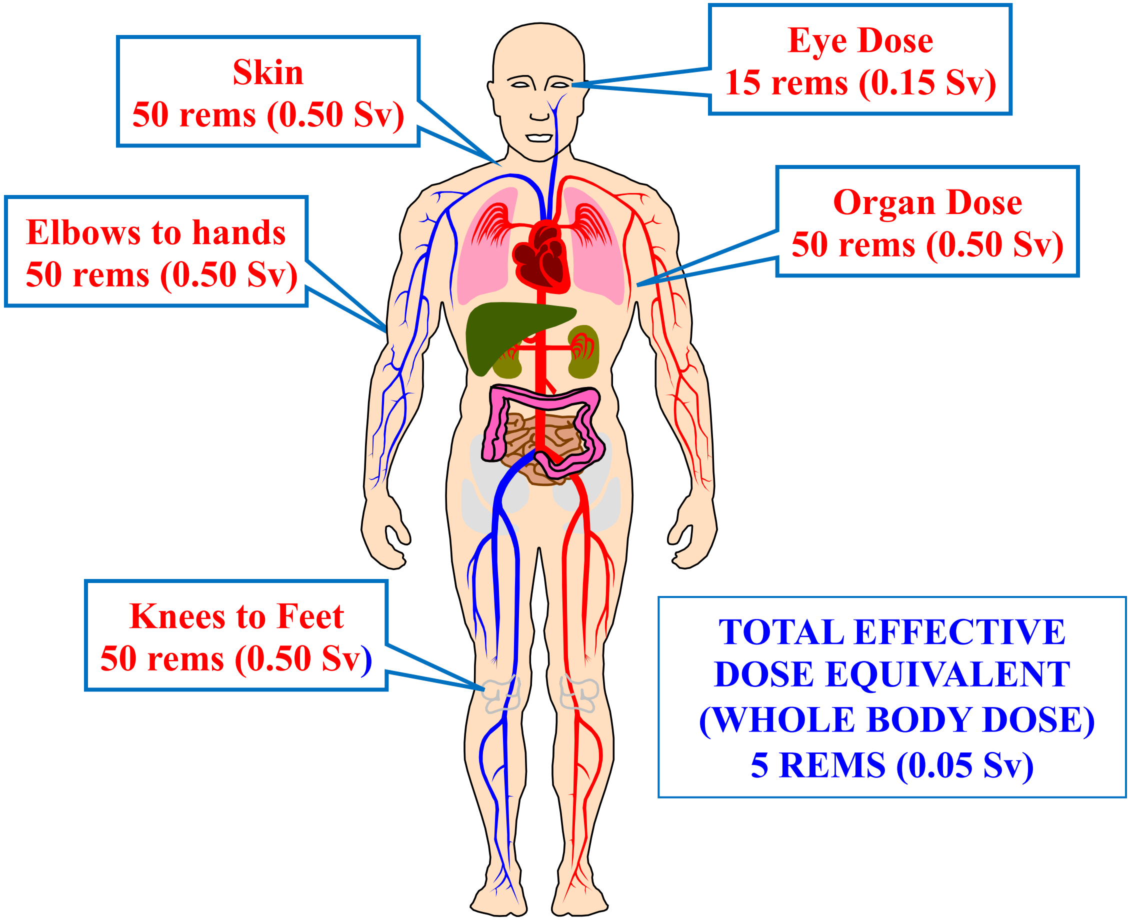
Radiation Exposure from Natural and Consumer Products

Average public dose in US is 620 mRem/year:

- The average public dose has increased from 360 mRem/yr in 1986 to 620 mRem in 2009, mostly from medical exposure.
- Approximately 37% of dose was attributed to radon coming from homes we live in
- An additional 13% attributed to other natural sources (cosmic, terrestrial, internal)
- Total ~50% attributed to natural sources
- <u>Medical comprised ~48%</u>

Radiation Exposure from Natural and Consumer Products

Dose Limits for Radiation Workers:



Annual Radiation Exposure Limits

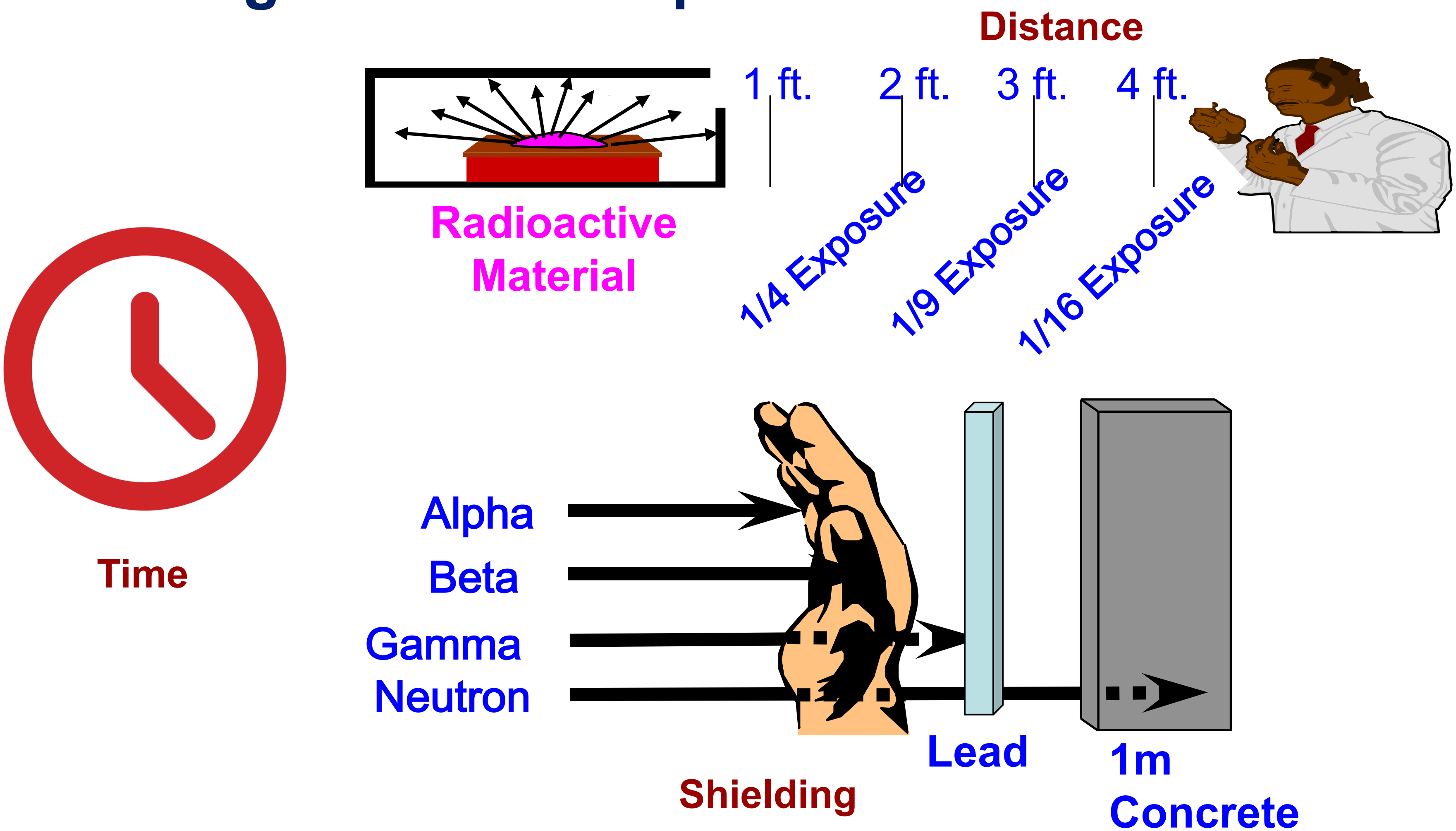
Type of Personnel	Dose Limit (mRem)
Radiation Worker Limit (whole body dose)	5,000/year
Pregnant Radiation Worker Limit(dose to fetus per gestation period)	500/gestation period
General Public Limit (whole body dose)	100/year

Entrance Skin Exposures from typical X-Ray procedure

Procedure	Dose (mRem)
Chest X-Ray (P/A)	15
Abdomen (A/P)	300
Lumbar Spine (A/P)	330
Head CT Scan	1230

1 Rem = 1,000 millirem (mRem); 100 mRem = 1 millisievert (mSv)

Reducing Radiation Exposure



Biological Effects

Typically young and rapid growing cells are more sensitive to radiation.

Sensitivity

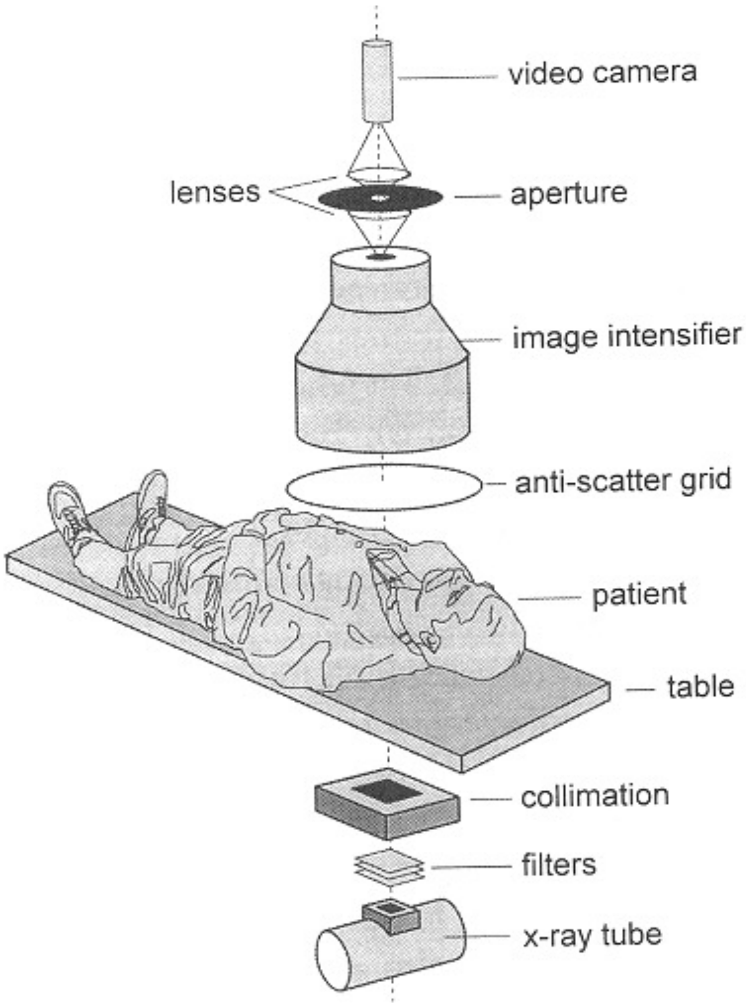
High

- Bone Marrow, Lymph System, Reproductive Organs
- Skin, Inner-layer of Intestines, Eyes
- Muscle, Joints, Central Nerves, Fat

Low

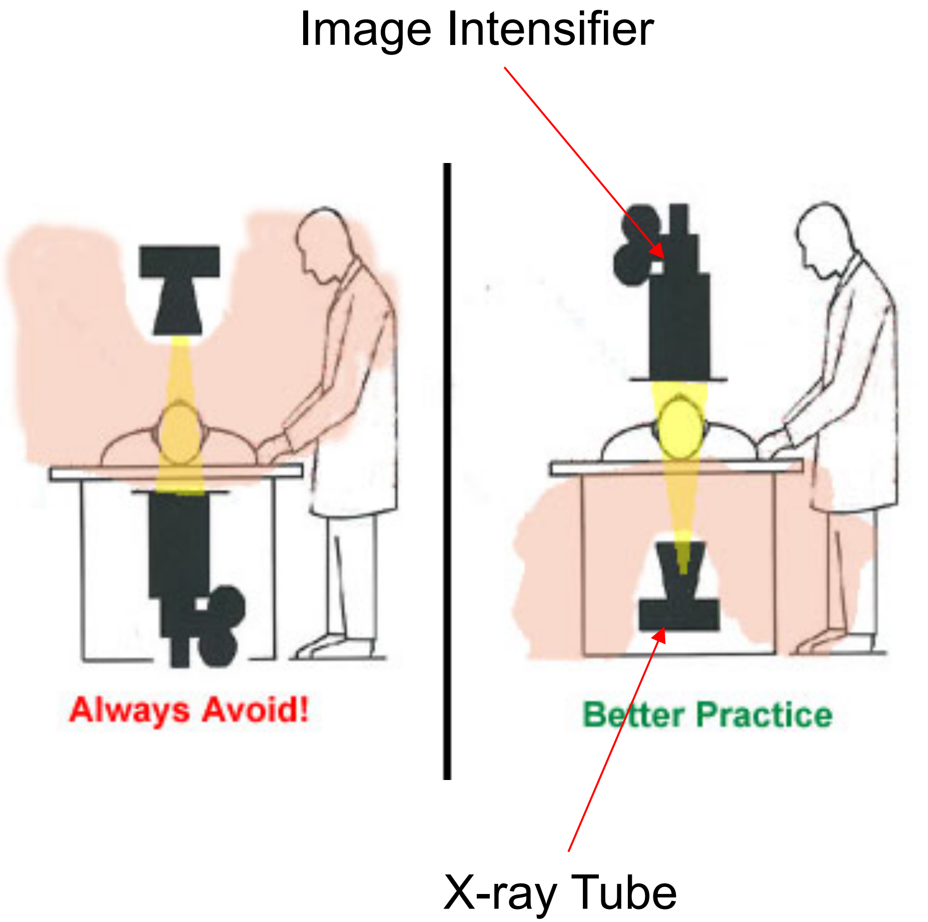
ALARA

- Acronym for “As Low As Reasonably Achievable”
- A basic concept of radiation protection that specifies that radiation exposure to personnel be kept as far below regulatory limits as feasible.
- It implies that every activity involving exposure to radioactive materials and/or radiation producing equipment should be planned to minimize unnecessary exposure to individual workers and also to the worker population.



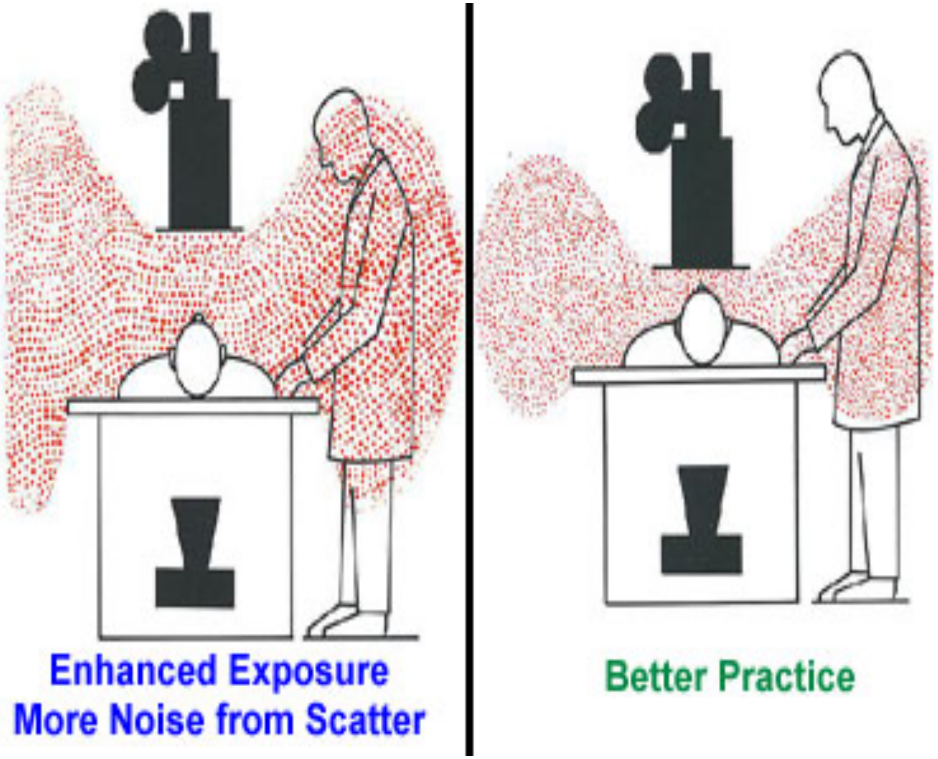
ALARA: X-ray Tube Position

- Position the x-ray tube under the patient not above the patient.
- The largest amount of scatter radiation is produced where the x-ray beam enters the patient.
- By positioning the x-ray tube below the patient, you decrease the amount of scatter radiation that reaches you.



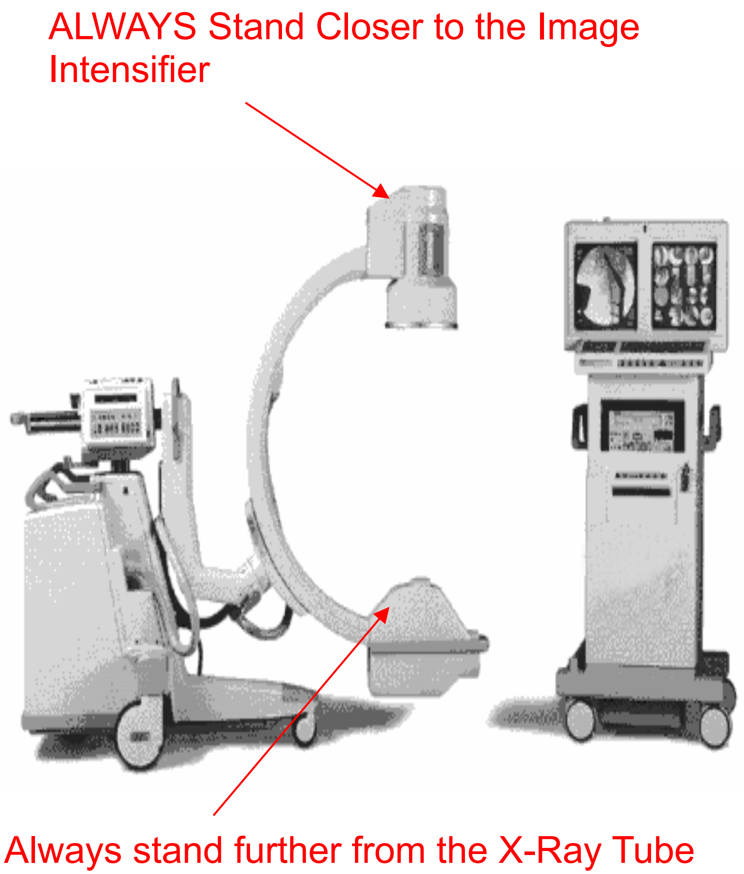
Decrease Air Gap between Image Intensifier and Patient

- Move the image intensifier as close to the patient as possible.
- This decreases patient and operator dose.
- This improves image quality.



ALARA: Operator Positioning of C-arms

- Scatter radiation intensity is <u>less on the image intensifier side as compared to the x-ray tube side.</u>
- For lateral and oblique projections, position the x-ray tube on the opposite side of the patient from where you are standing.



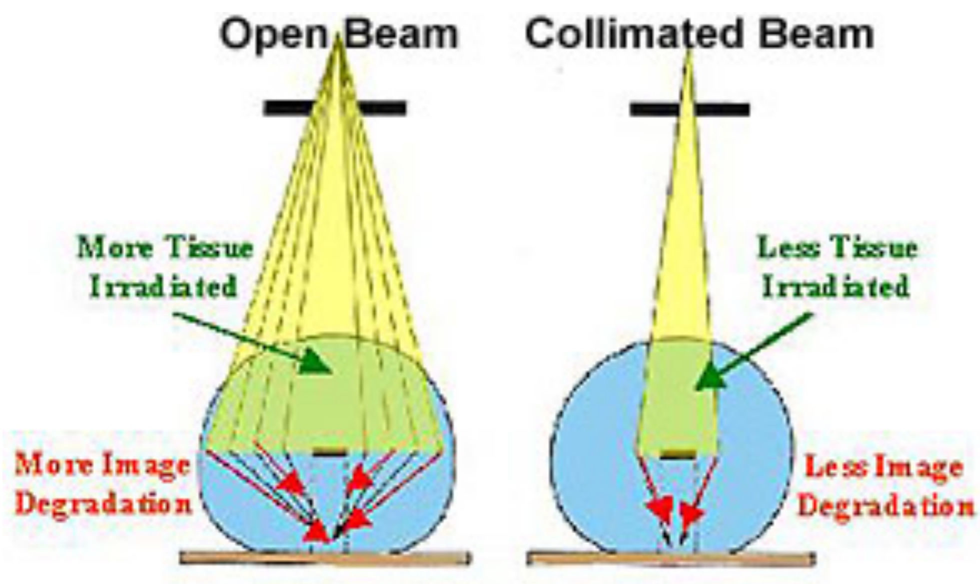
ALARA:
Minimizing use of Magnification Modes on Image Intensifier

- All C-arms have the ability to change the operator’s field of view by using electronic magnification. This is different than using collimation to decrease the x-ray field size.
- Electronic magnification enlarges the anatomy being viewed, but does so at the expense of increase patient dose.
- The image intensifier’s magnification mode is changed by pushing a button that changes a LED from “normal” to “mag1” or “mag2”.
- Only use electronic magnification when you need to see small details in an image – that can not be seen without its use.

ALARA: Collimation

Collimate tightly to the area of interest.

- Reduces the patient's total entrance skin exposure
- Improves image contrast
- Scatter radiation to the operator will also decrease



Brachytherapy

- Brachytherapy is the placement of sealed radioactive sources into or immediately adjacent to tumor.
- Temporary implant: Radioactive material is placed for ~ 4 days (Cs-137), and removed by the radiation oncologist and reuse for another patient.
- Pd-103 seeds are used as permanent implants for treatment of prostrate cancer and do not present any contamination hazard.

Radioactive Sources Coming used in Brachytherapy

Radionuclide	Half Life	Shape Used
Cesium – 137	30 years	Seed
Iridium – 192	74.3 days	Seed
Iodine – 125	59.6 days	Seed
Palladium - 103	17 days	Seed

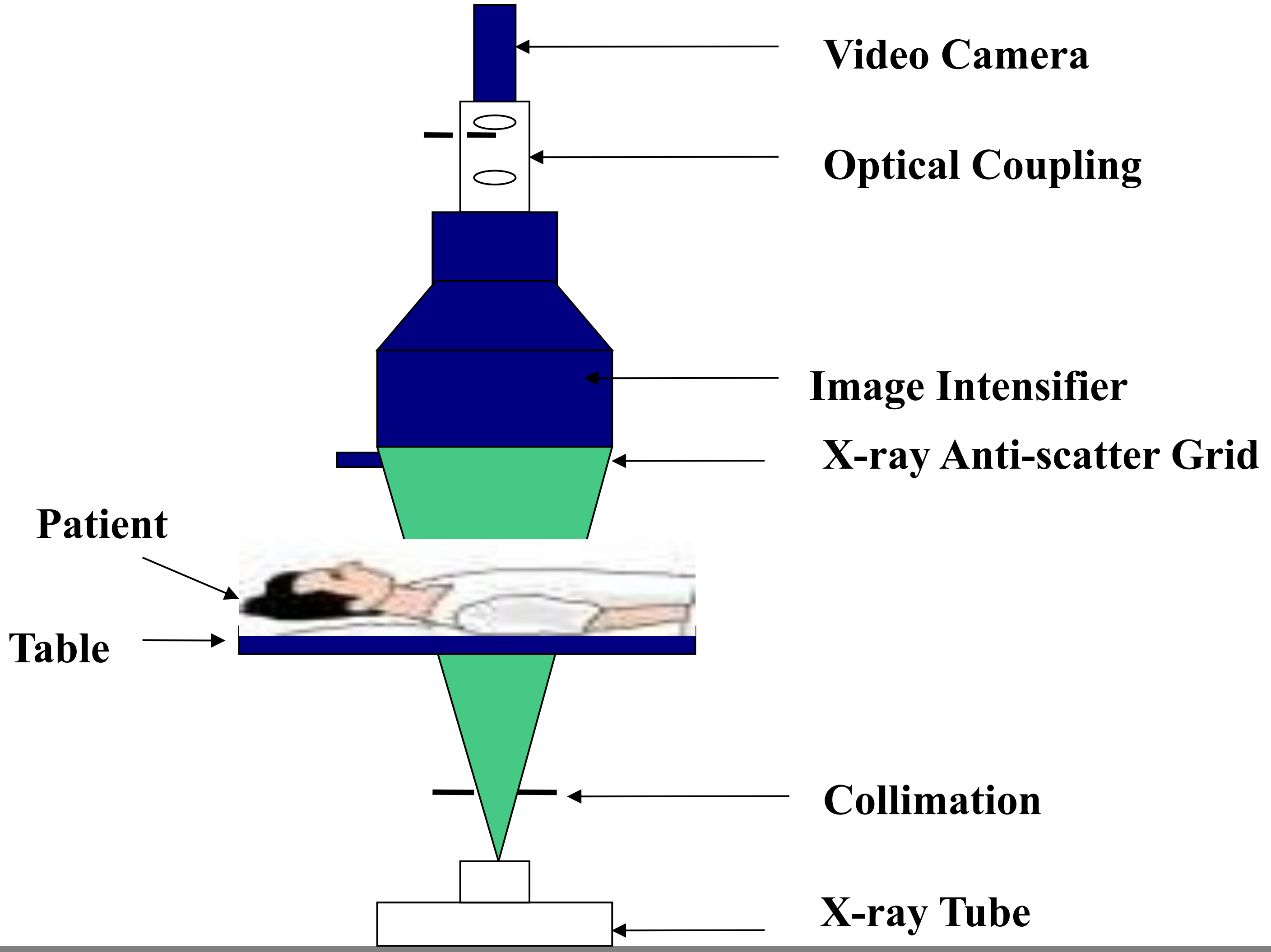
Therapeutic Nuclear Medicine Patients

- Radiopharmaceutical therapy involves the administration of unsealed radioactive materials.
- Commonly used therapeutic radionuclides are Iodine-131 and Strontium-89.

Radiopharmaceutical Therapy with I-131

- I-131 (in capsule form) is administered to treat thyroid cancer patients and mostly localized in the thyroid gland.
- I-131 which is not localized is excreted in the patient’s saliva, sweat, urine, feces, vomit and other bodily fluids.
- Excreted I-131 represents a significant source of contamination as well as radiation exposure.

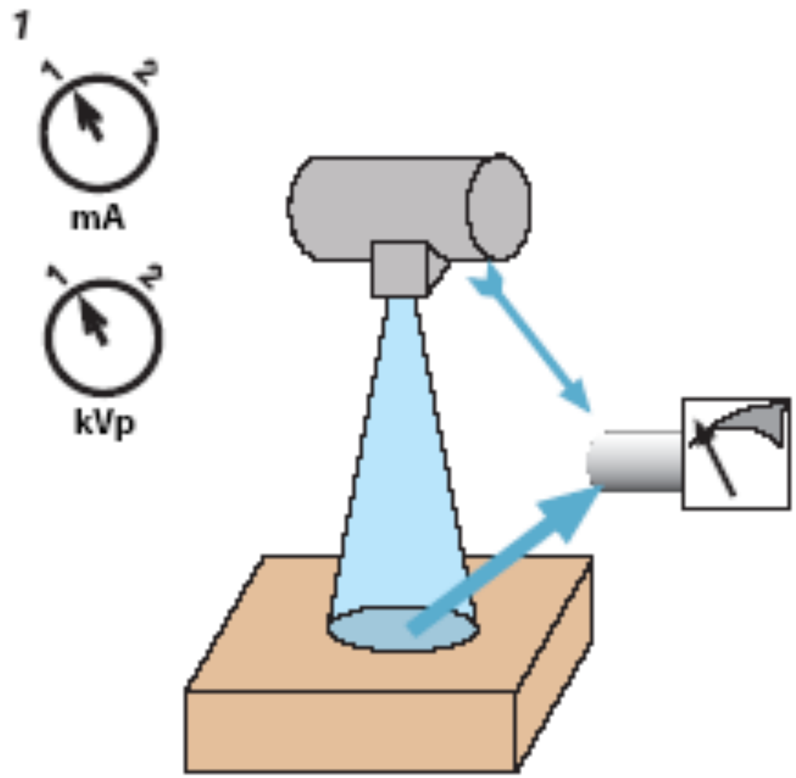
Fluoroscopy X-ray Systems



Fluoroscopy Low Dose Mode

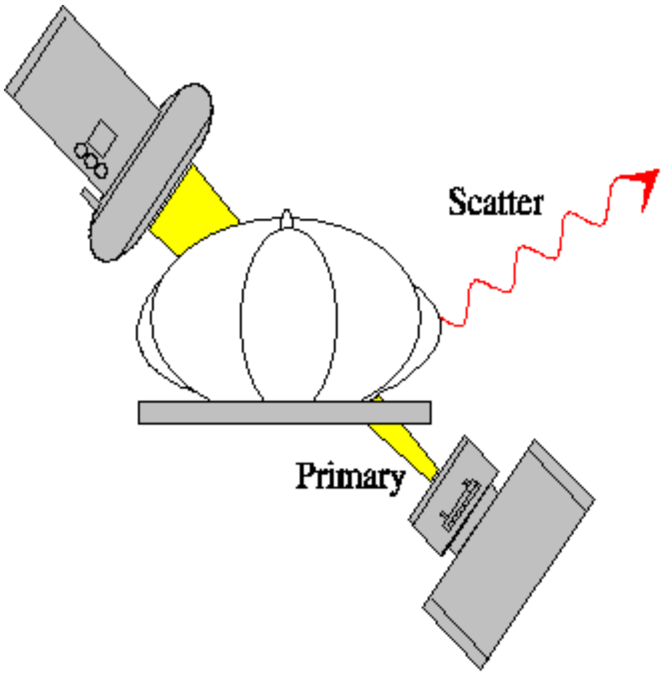
- All modern C-arms have different operational dose modes available to the operator.
- The “Low Dose” mode uses fewer x-ray photons, thus lowers patient dose.
- For larger patients and images that do not have a lot of contrast this mode may not provide adequate image quality.
- The “low dose” mode should be used when possible, to achieve ALARA goals.

The two main sources of stray radiation are leakage from the X-ray tube and scatter from the patient.



Scatter Radiation Exposure

- During image formation, scatter radiation exposure is present within a six foot radius of the patient.
- Scatter radiation exposure is responsible for occupational radiation exposure.

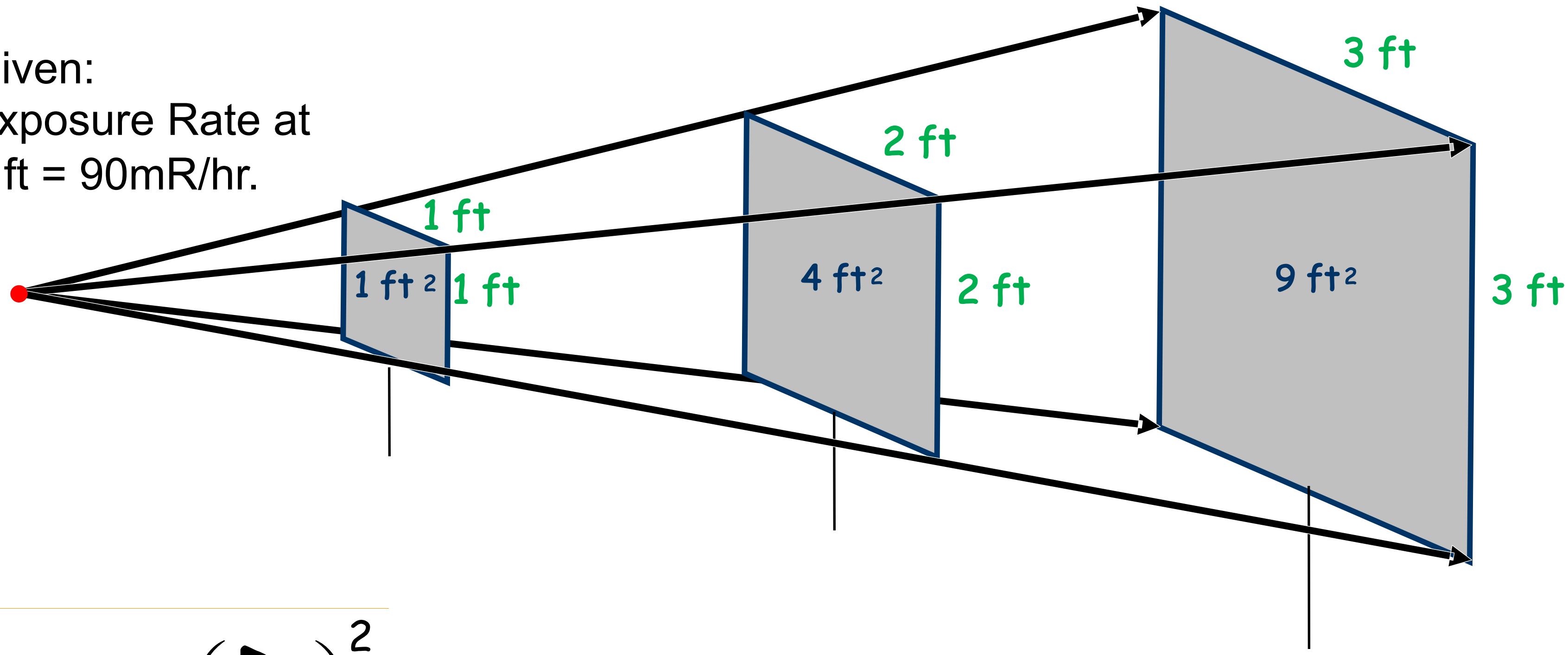


More on Scatter Radiation and the definition of Fluoroscopy

- Scatter radiation does not linger in the room. It is only present when the x-ray beam is on. (i.e. Someone is standing on the beam-on foot pedal.)
- The patient is the main source of scatter radiation during radiographic and fluoroscopic procedures.
- Fluoroscopy is real time x-ray imaging captured on a TV monitor, while radiography is a single image captured with one radiation exposure.
- Fluoroscopy beam-on times are usually less than 5 minutes for most cases.
- Radiography exposure times are less than 1 second for most cases.

Distance

Given:
Exposure Rate at
2 ft = 90mR/hr.



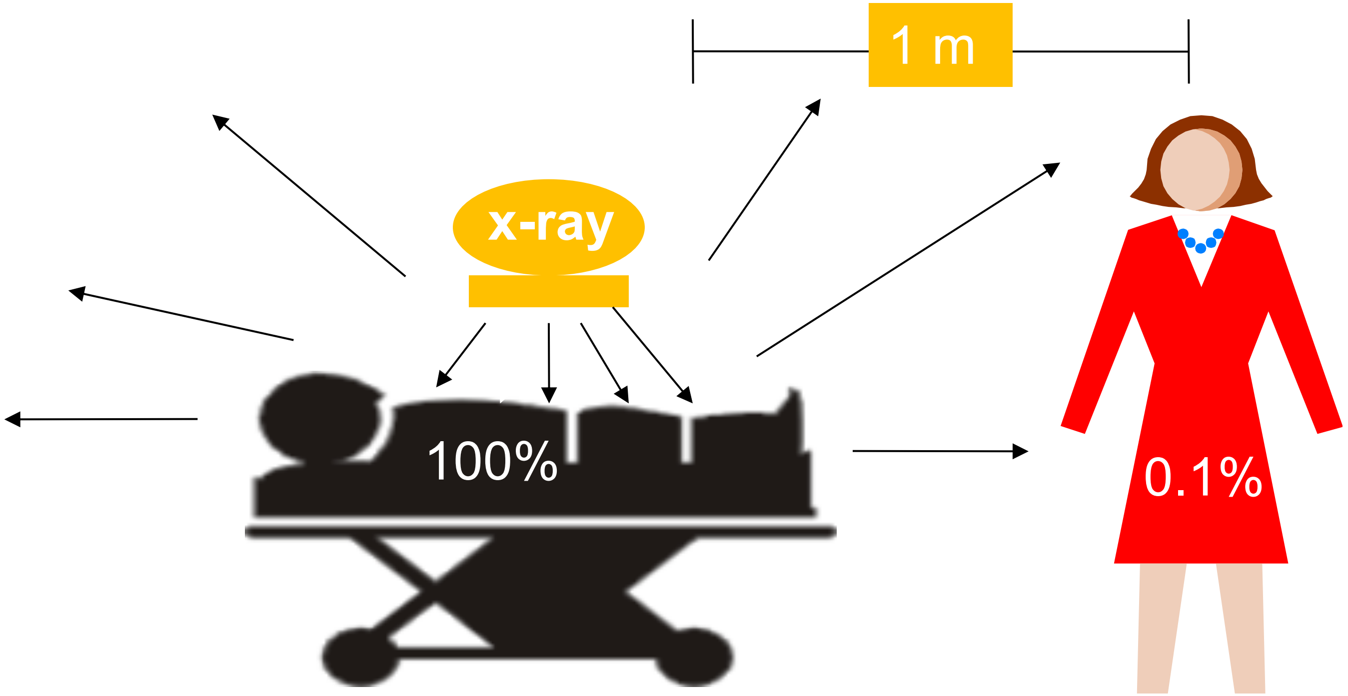
$$E_2 = E_1 \left(\frac{D_1}{D_2} \right)^2$$

Exposure Rate at 4 ft = (90 mR/hr)(2ft/4ft)^2 = 22.5 mR/hr.

Exposure Rate at 6 ft = (90 mR/hr)(2ft/6ft)^2 = 10 mR/hr.

Radiation at 1 meter from patient

About 0.1% of patient entrance radiation exposure reaches 1 meter from patient.



The NCRP recommends that personnel stand at least 2 meters from the x-ray tube, whenever possible. (6 feet = 1.82 m)

Personal Monitoring: Radiation Dosimeters

- Whole body (WB), Collar (CL) and extremity (ring) dosimeters are issued to residents rotating through Radiology, Cardiac Cath and Interventional units utilizing radiation producing machines.
- The sensitive portion of the ring badge must face towards the palm.

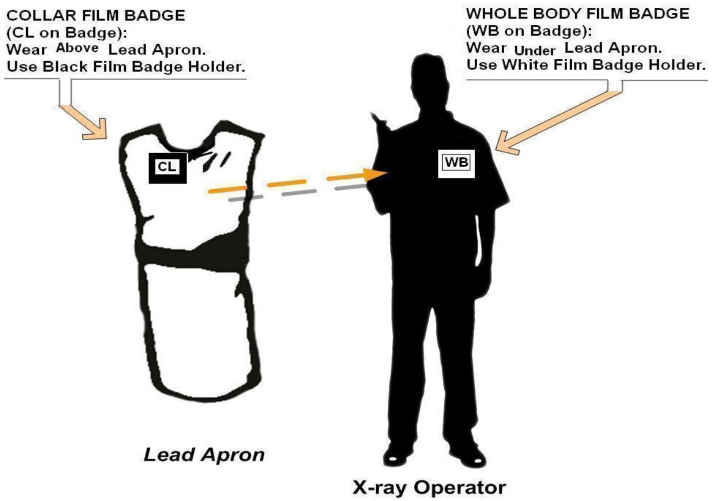
Protective Apparel

Because of the scatter radiation that is present in a room during x-ray exposure or fluoroscopy, the following is mandatory.

- If you are standing within a 6 foot radius of the patient during fluoroscopy or portable radiography, you must wear a lead apron.
- If you are standing within a 3 foot radius of the patient during fluoroscopy, you must wear a thyroid shield and a lead apron.

Who needs to wear a radiation dosimeter (badge)?

- Anyone who stands within a fluoroscopy room must wear a radiation dosimeter.
- Wear one of the radiation dosimeters (WB) inside lead apron and the other dosimeter (CL) outside of your lead apron at the collar level.
- Wear TLD dosimeter on your lab coat between the shoulders and the waist.



Declaration of Pregnancy

- Cells that are rapidly dividing are more sensitive to radiation exposure.
- A lower dose limit is available for workers who declare their pregnancy in writing (500 millirem for entire gestation).
- To declare your pregnancy in writing please contact the Radiation Safety Officer. Declaration of pregnancy is always voluntary.
- Pregnant workers can continue to work around c-arms while they are pregnant since the lead apron will protect the fetus from scattered radiation. A wrap around lead apron is recommended.
- The pregnant worker will be assigned another radiation monitor (FS) after she declares her pregnancy in writing. The second radiation monitor will be worn under the lead apron.

For questions, please contact:

- **Radiation Safety Officer**
  Prasad Neti, PhD

- **Health Physicists**
  Sivakumar Munisamy, PhD
  Sarah Spence, MS

- **Radiation Safety Technologists**
  Sabyasachi Ganguly, PhD
  Emilio Vega, BS

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http://rehs.rutgers.edu/umdnj_transition_toolkit_Rad.html

Wear Your

Dosimeter

&

Aprons!

Please click here to be directed to the Attestation page.
The certificate of completion will generate after submission.

Thank you.