RADIATION SAFETY

RADIATION SAFETY

OUTLINE

- Radiation
- Signage
- Types of radiation
- The electromagnetic spectrum
- Ionizing radiation
- Dose quantity measures
- Annual radiation dose limits
- A.L.A.R.A.
- BASIC Radiation Protection
- Biologic Effects of radiation
- Symptoms of radiation
- Radiation Dosimetry

- Radiation safety protection
  - Operator
    - Fluoroscopy safety
  - Environment
  - Patient
    - Risks & injuries
- Dose reduction techniques

MRI SAFETY

- MRI Zones
- Emergency Power
- Emergency Quench
- MRI Dangers
- MRI safety
  - Access Screening
  - Anxiety/Claustrophobia
  - Equipment

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WHAT IS RADIATION?

- Radiation: energy in motion that travels through space in the form of particles or waves.
- Radioactivity: spontaneous emission of radiation from the nucleus of an unstable atom

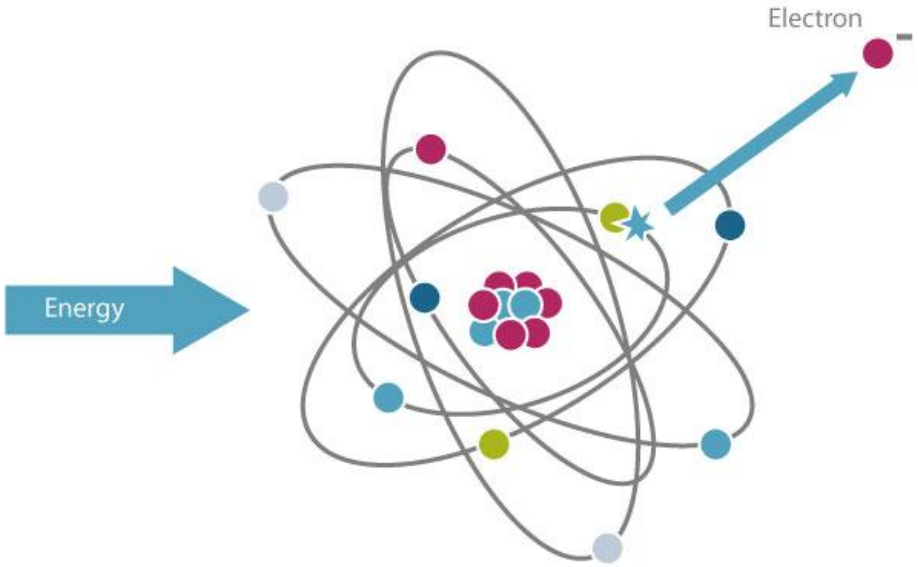
SIGNAGE

- All areas that contain Radiation Producing Equipment and/or Radioactive material must have signage to indicate the level activity present.
- Signage is posted to be visible
- Signage is posted at each entrance to radiation producing equipment / material

TYPES OF RADIATION

- **Non-Ionizing radiation:** Radiation that does not have sufficient energy to dislodge orbital electrons
  - Examples: microwaves, Ultraviolet waves, radio waves, lasers

- **Ionizing Radiation:** Radiation that has sufficient energy to dislodge orbital electrons
  - Examples: alpha, beta, gamma

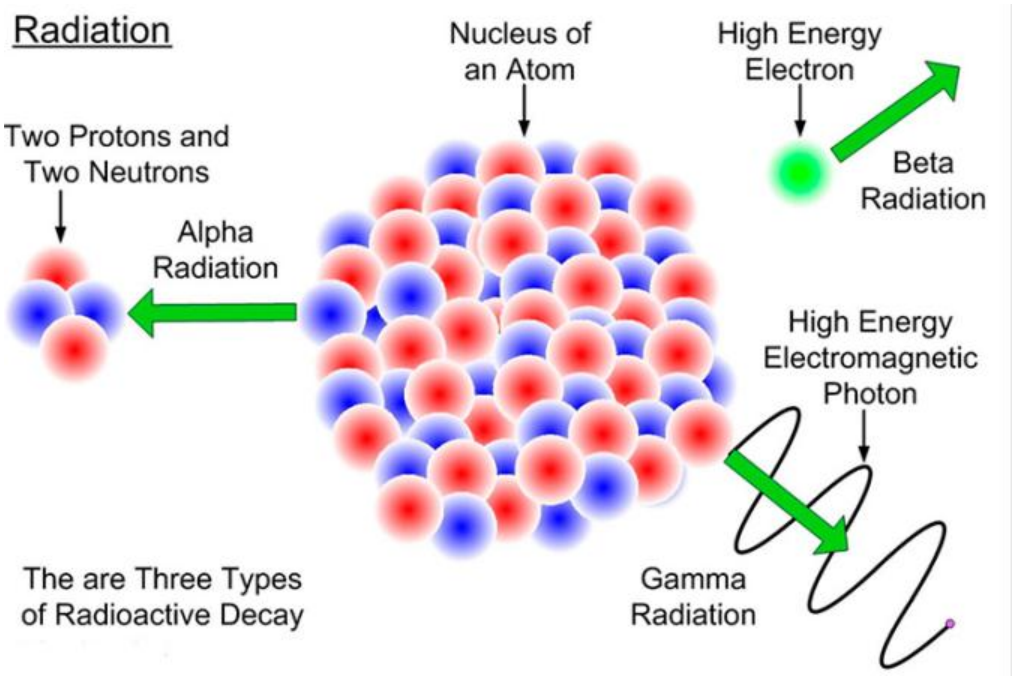


TYPES OF RADIATION

Ionizing Radiation:

Examples:

- Alpha,
- Beta
- gamma



TYPES OF RADIATION

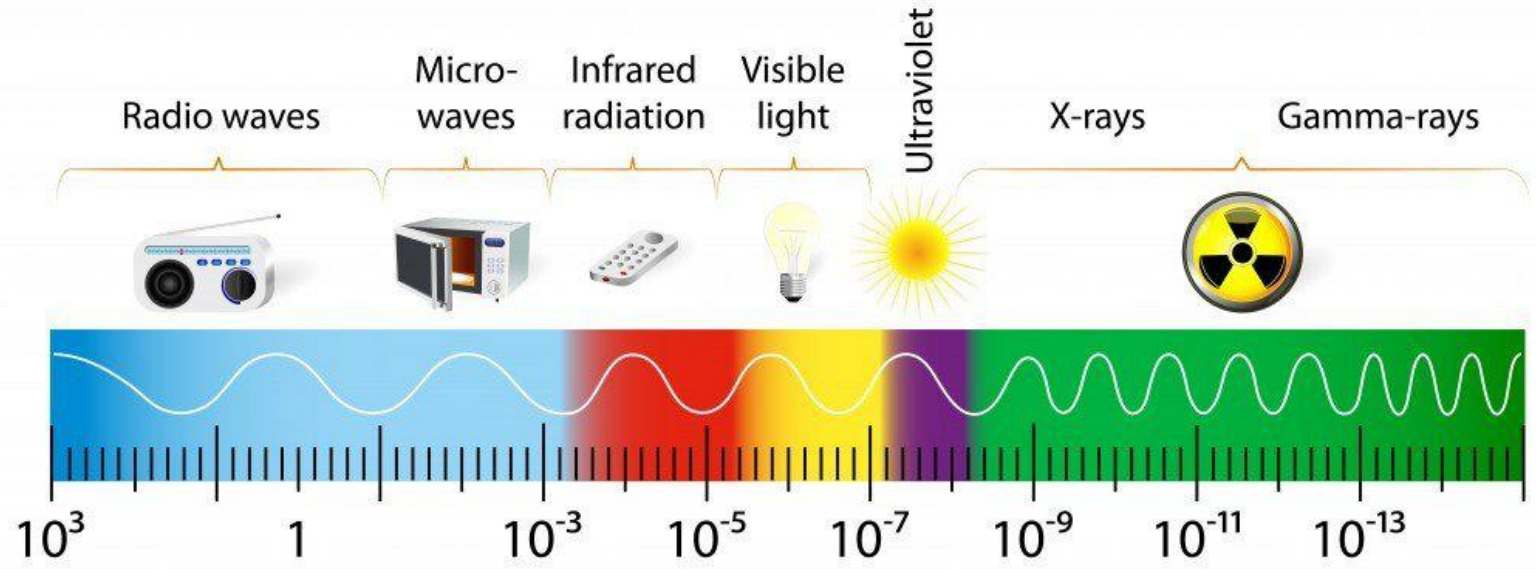
Electromagnetic has no mass

- X-ray: From a x-ray tube
- Gamma Ray: From radioactive material

Particular Radiation has mass takes up space

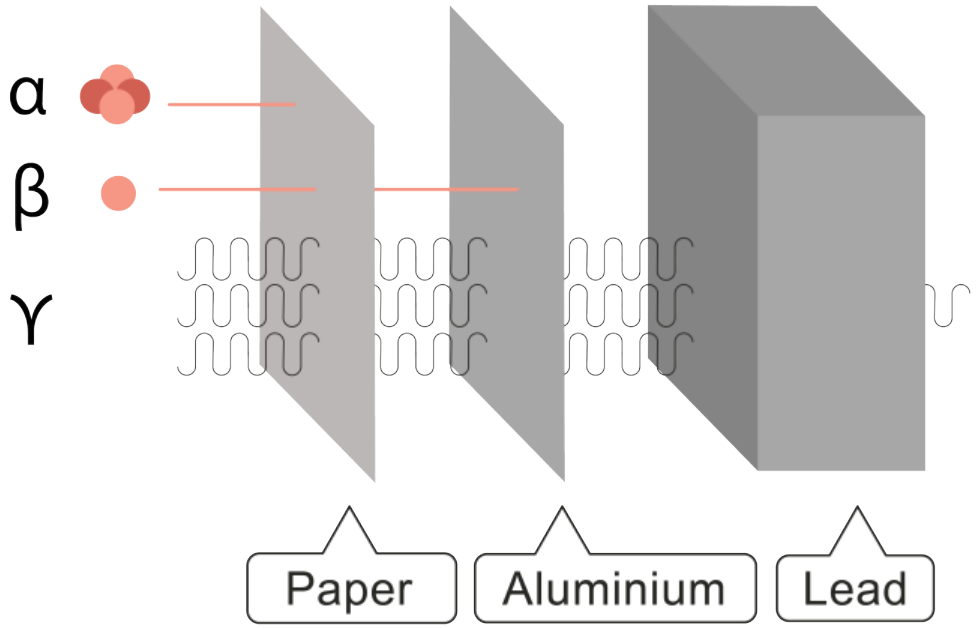
- Alpha particles: From radioactive material
- Beta particles: From radioactive material

THE ELECTROMAGNETIC SPECTRUM



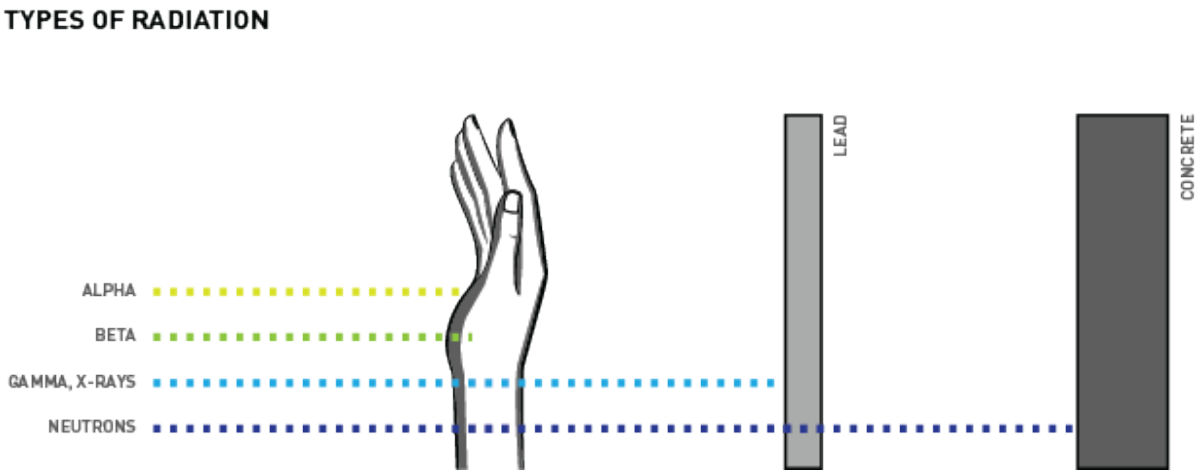
IONIZING RADIATION

- Ionizing radiation ability to penetrate:
  - Alpha, beta, gamma



IONIZING RADIATION

- X-rays and gamma rays can penetrate the body and irradiate organs



IONIZING RADIATION

Gamma Rays and X-Rays

- Gamma rays and x-rays consist of high-energy waves that can travel great distances at the speed of light and generally have a great ability to penetrate other materials. For that reason, gamma rays (such as from cobalt-60) are often used in medical applications to treat cancer and sterilize medical instruments. Similarly, x-rays are typically used to provide static images of body parts (such as teeth and bones), and are also used in industry to find defects in welds.

IONIZING RADIATION

There are four different but interrelated units for measuring radioactivity, exposure, absorbed dose, and dose equivalent. These can be remembered by the mnemonic **R-E-A-D**, as follows, with both common (British, e.g., Ci) and international (metric, e.g., Bq) units in use:

- Radioactivity
- Exposure
- Absorbed Dose
- Dose Equivalent

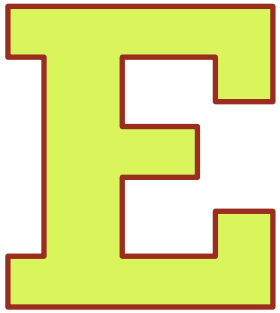
IONIZING RADIATION

CURIE (CI) – RADIOACTIVITY

- Radioactivity - the amount of ionizing radiation released by a material
- a quantity of radioactive material is expressed in terms of its radioactivity (or simply its activity), which represents how many atoms in the material decay in a given time period.
- The units of measure for radioactivity are the curie (Ci) and becquerel (Bq).

IONIZING RADIATION

R (ROENTGEN) – EXPOSURE



- Exposure describes the amount of radiation traveling through the air
- Many radiation monitors measure exposure. The units for exposure are the roentgen (R) and coulomb/kilogram (C/kg).

IONIZING RADIATION

RAD – RADIATION ABSORBED DOSE

- Absorbed dose describes the amount of radiation absorbed by an object or person (that is, the amount of energy that radioactive sources deposit in materials through which they pass)
- The quantity of radiation received by the patient
- The units for absorbed dose are the radiation absorbed dose (rad) and gray (Gy).

IONIZING RADIATION

REM OR Sv – RADIATION DOSE EQUIVALENT OR EFFECTIVE DOSE

D

- Dose equivalent (or effective dose) combines the amount of radiation absorbed and the medical effects of that type of radiation
- Different types of ionizing radiation cause different biological effects even when the same dose was transferred
- REM and Sv is used to express the quantity of radiation received by radiation workers and populations
- Dosimetry is used to measure REM

Dose Quantities

Absorbed Dose

Radiation energy absorbed per unit mass of a substance (Gy)

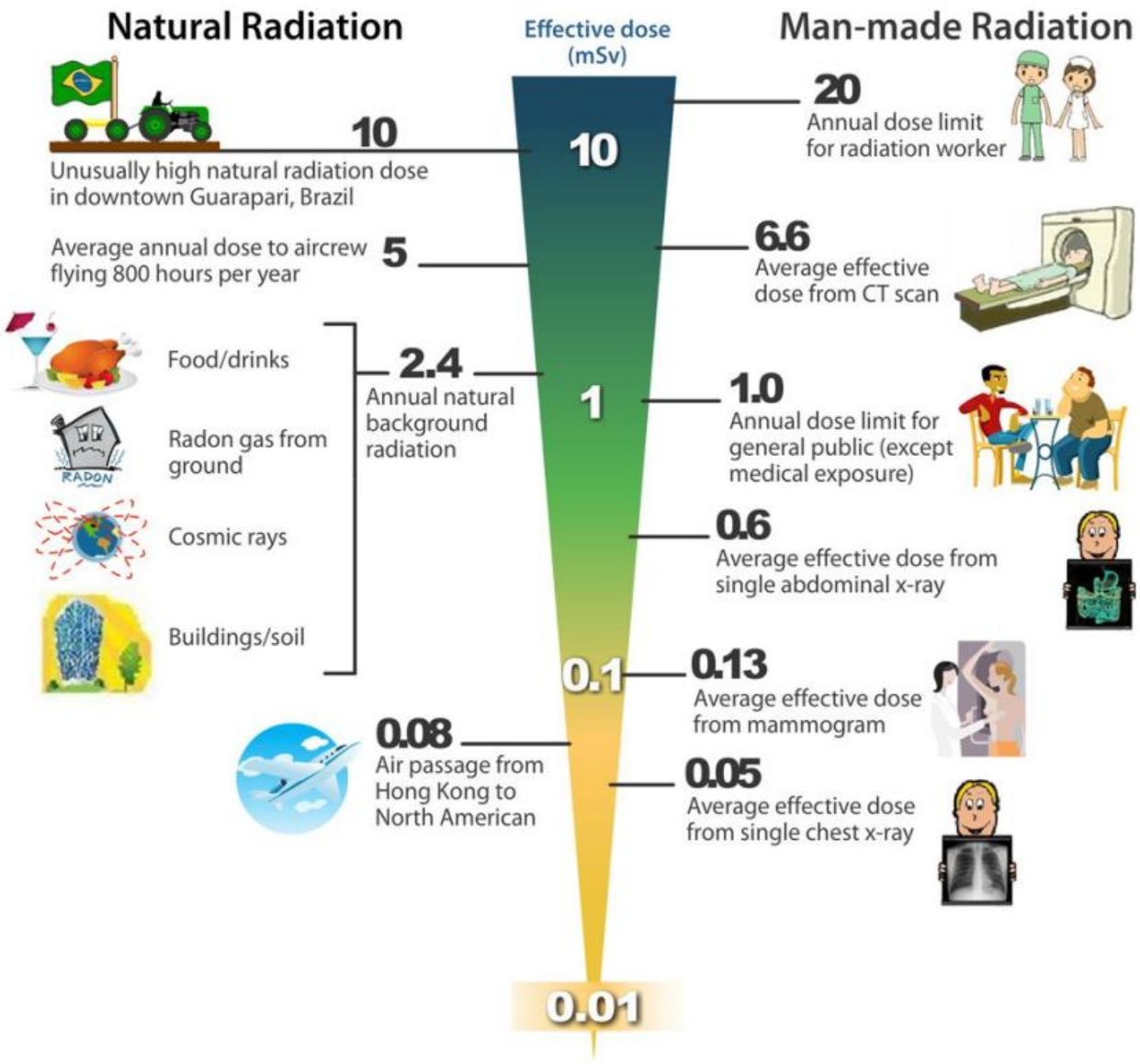
Equivalent dose

The concept of equivalent dose allows different types of ionizing radiation to be considered equally with respect to their potential to cause harm

Effective dose

Different tissues and organs may vary in how they respond biologically to a given type of radiation

Radiation in Daily Life



U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

ANNUAL RADIATION DOSE LIMITS

- Title 10, Part 20, of the *Code of Federal Regulations* (10 CFR Part 20), "Standards for Protection Against Radiation," establishes the dose limits for radiation workers. Although the limits vary, depending on the affected part of the body, the annual total effective dose equivalent (TEDE) for the whole body is 5,000 mrem (5 rem).
- Among the NRC licensees that are subject to the reporting requirements of 10 CFR Part 20, certain classes of licensees are required to provide the NRC with an annual report of their workers' individual exposures. The NRC, in turn, maintains such radiation exposure data in its Radiation Exposure Information and Reporting System (REIRS). As a result, the REIRS database represents a resource for use in responding to workers' requests for exposure information and dose histories.

IONIZING RADIATION

EMPLOYEE EXPOSURE LIMITS

5,000 mSv
Half of people exposed to this level in a single dose will die within a month.

1,000 mSv
Causes acute radiation sickness in people exposed to this amount in a single dose.

100 mSv / year
Lowest level that causes a documented increase in cancer risk.

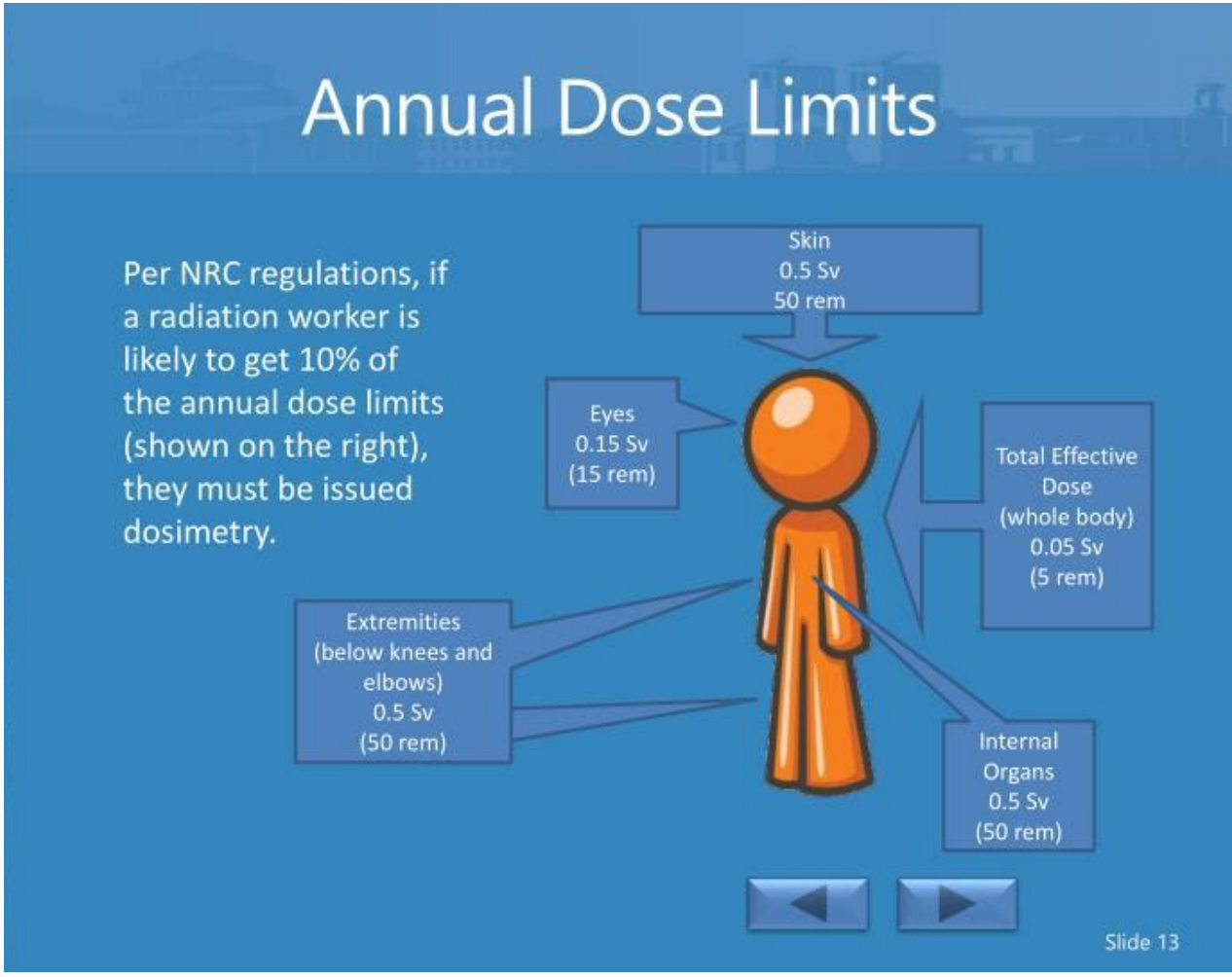
10-15 mSv
CT scan

9 mSv / year
Typical exposure by airline crew flying New York/Tokyo polar route.

2-3 mSv / year
Amount of background radiation people are generally exposed to each year.

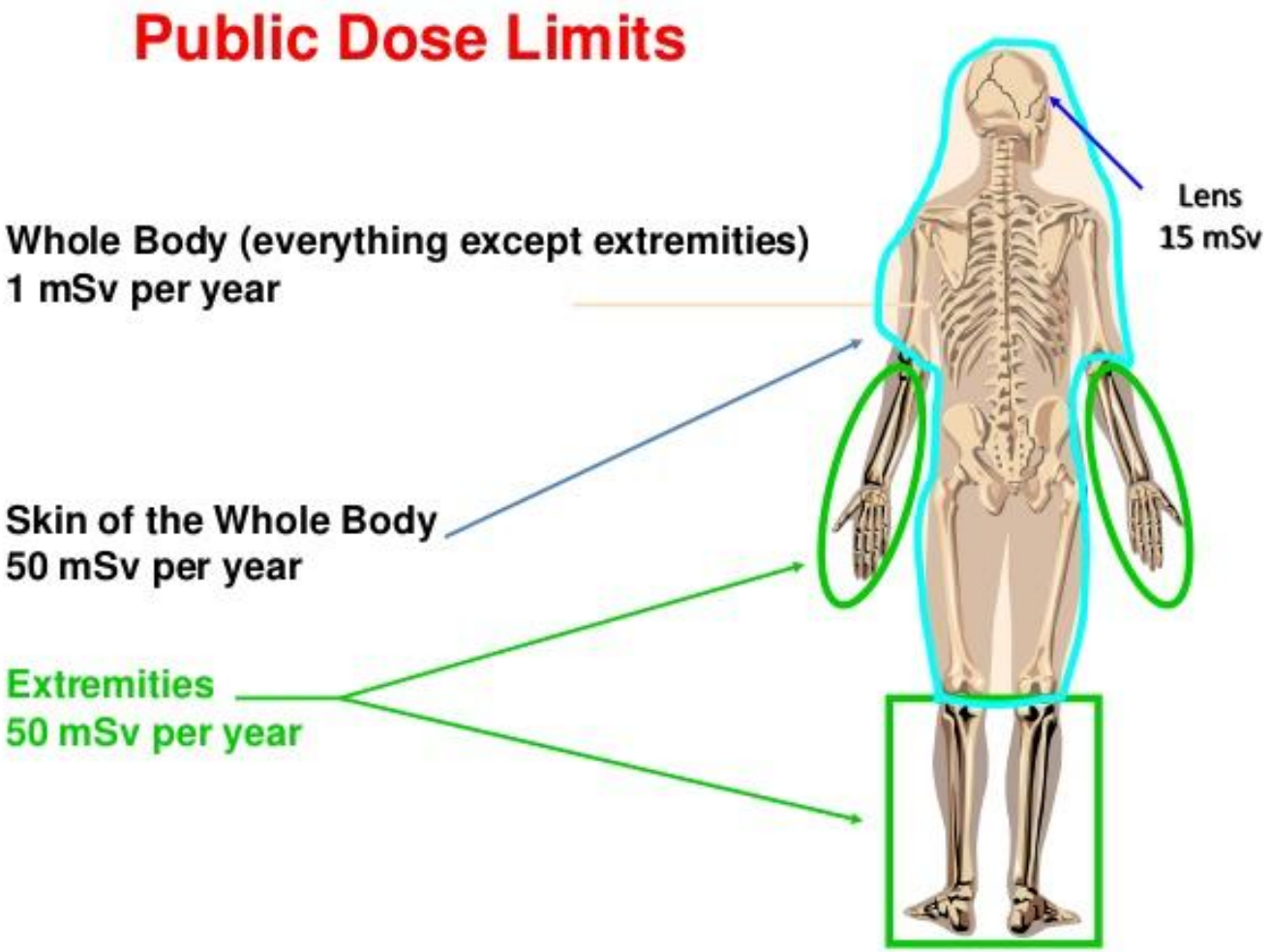
.2 mSv
Chest x-ray

.01 mSv
Dental x-ray



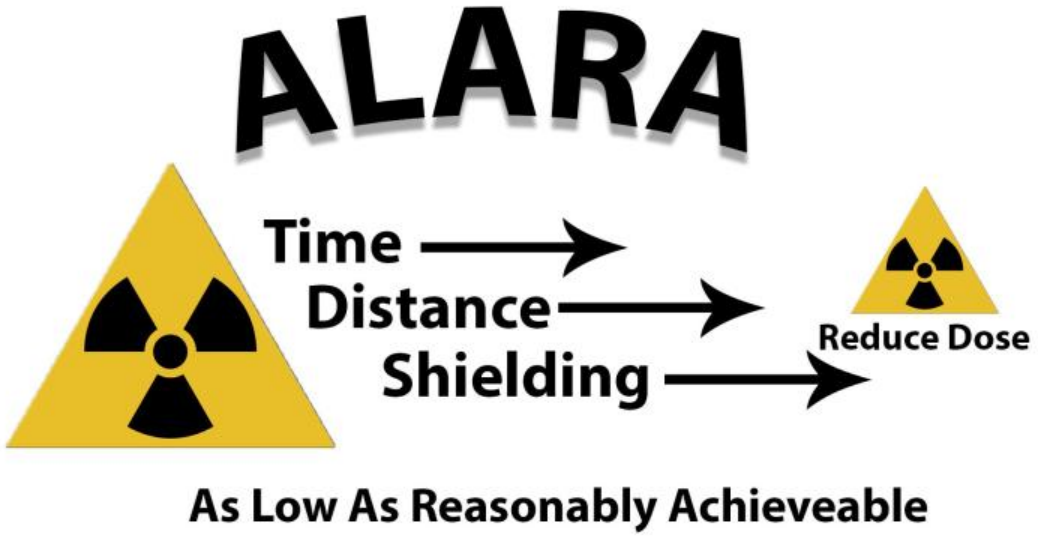
IONIZING RADIATION

PUBLIC EXPOSURE LIMITS

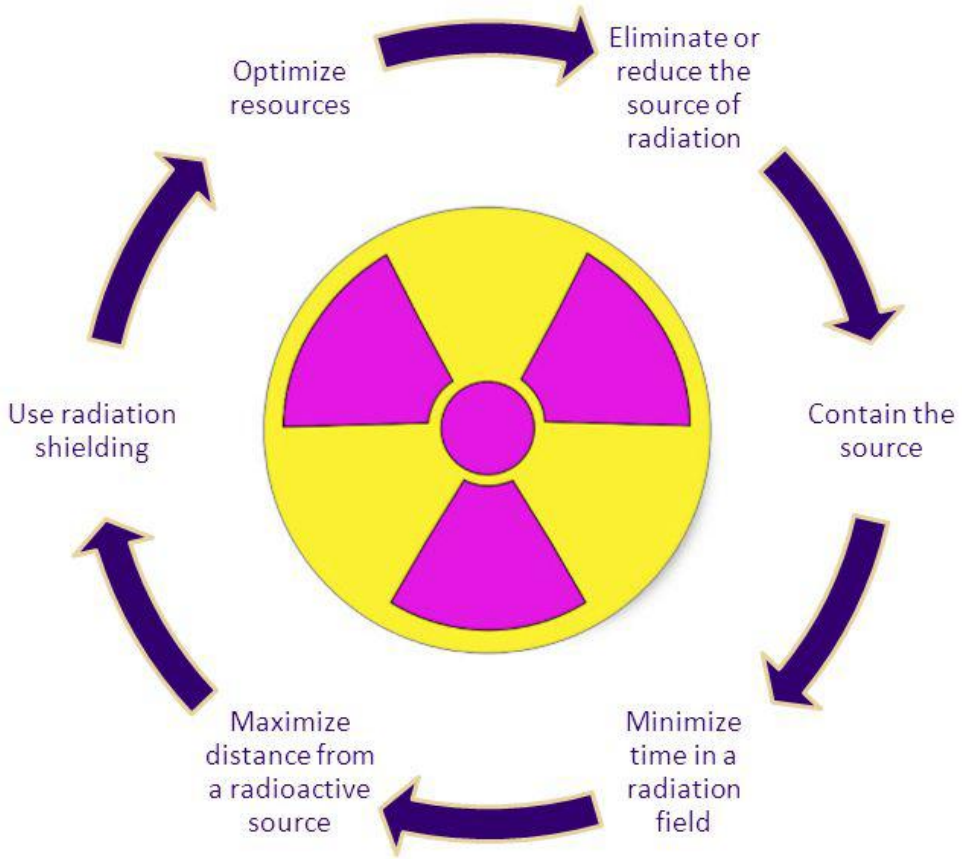


ALARA

- **A**s **L**ow **A**s **R**easonably **A**chievable
- HOW?
  - Time
  - Distance
  - Shielding
- WHY?
  - Minimize dose



Six Fundamental Principles of ALARA



ALARA

- **TIME:**
  - Less time = less radiation exposure
- **DISTANCE:**
  - More distance = less radiation exposure
  - Effective & easy
  - By doubling distance from source you decrease dose by a factor of 4
  - Tripling distance decreases dose 9 – fold
- **SHIELDING:**
  - Proper shielding = less radiation exposure
  - Certain materials absorb radiation

BASIC RADIATION PROTECTION GUIDELINES

- TIME - Limit your time around radiation.
- DISTANCE - Stay as far away as possible from radiation.
- SHIELDING - Use shielding whenever possible.
- Do not modify or disable any device safety features.

BIOLOGICAL EFFECTS OF RADIATION

- May be prompt and appear quickly or delayed which may take years to appear.
- Radiation can:
  - Deposit energy in the body
  - Cause DNA damage
  - Create ionizations in body leading to free radicals
- These effects may lead to biological damage
- Cells sensitive to radiation are those that have a:
  - High division rate
  - Long dividing future
  - unspecialized

BIOLOGICAL EFFECTS OF RADIATION

- Response to radiation depends on:
  - Total dose received
  - Dose rate received
  - Radiation quality received
  - Stage of development when exposed

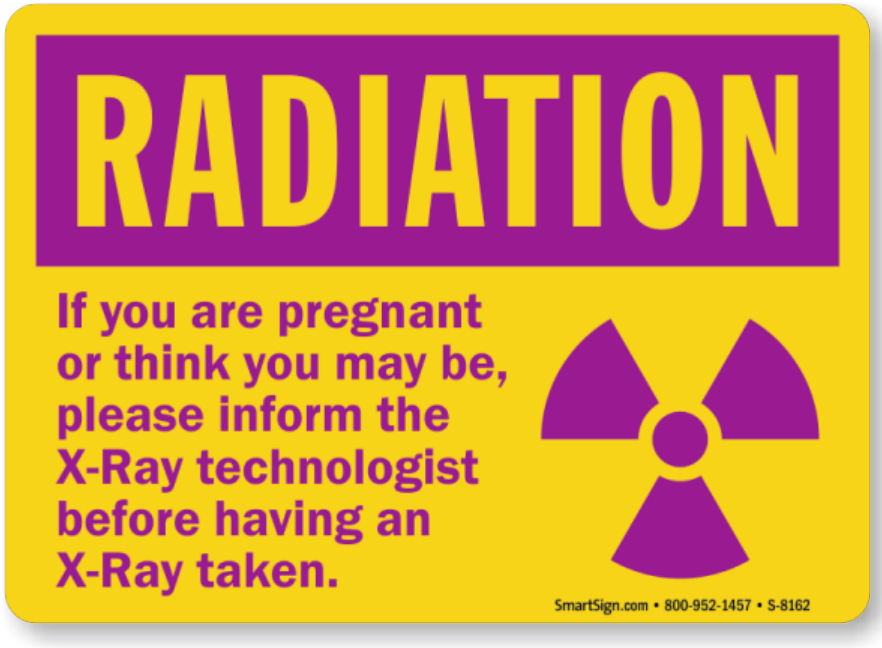
BIOLOGICAL EFFECTS OF RADIATION

- Somatic effects:
  - Physical effects
  - Immediate & Delayed
- Geneteic Effects:
  - Birth defects (radiation given to reproductive cells befire conception)
- Teratogenic Effects:
  - Cancer or congenital malformations due to radiation exposure to fetus in utero

BIOLOGICAL EFFECTS OF RADIATION

Prenatal Exposure

- Very hazardous because the rapidly dividing cells are very radiosensitive. Potential adverse effects include low birth weight, retardation and increased risk of cancer.

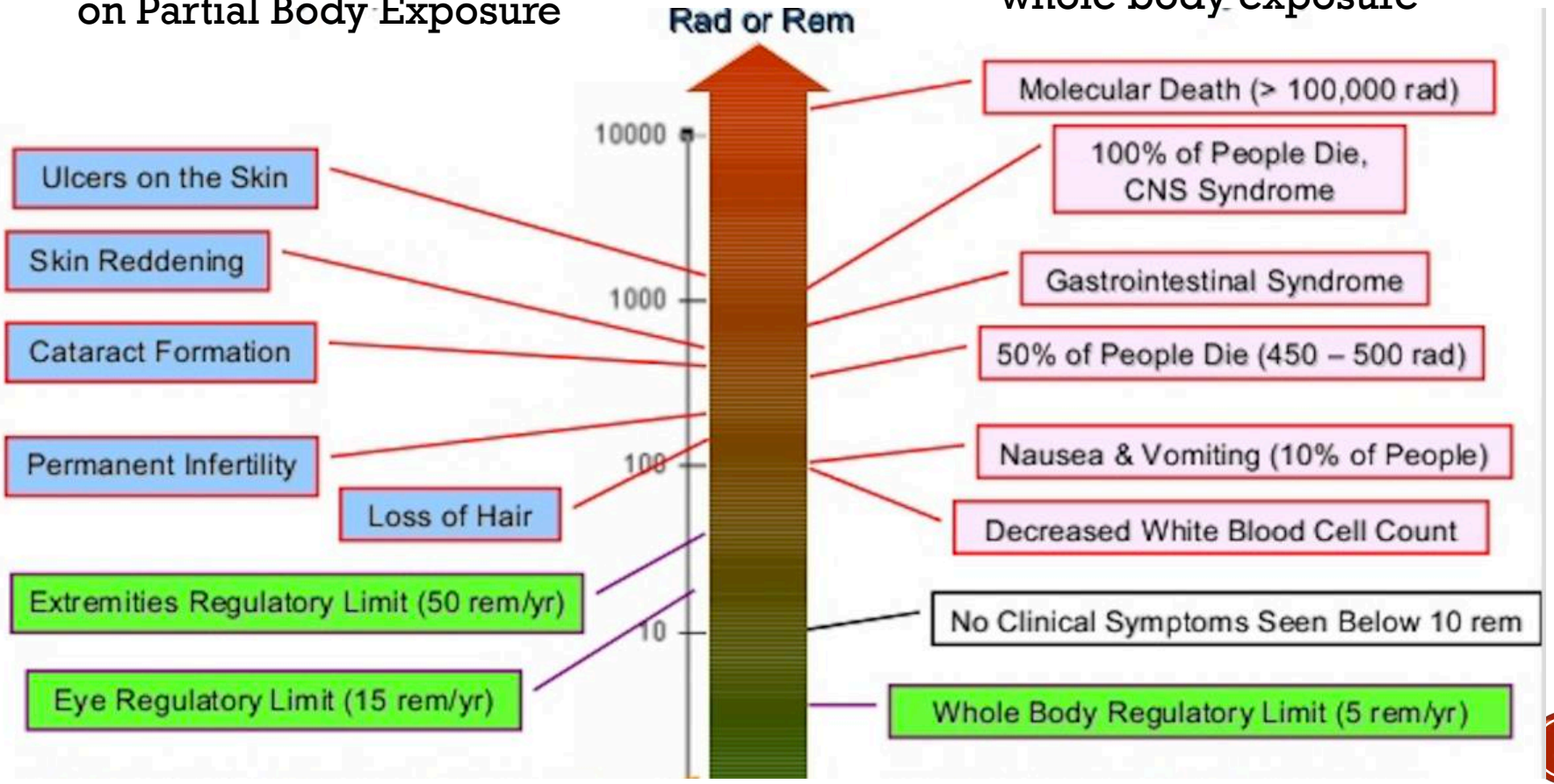


BIOLOGICAL EFFECTS OF RADIATION

BIOLOGICAL EFFECTS OF RADIATION

Impact of Radiation Dose on Partial Body Exposure

Impact of radiation dose on whole body exposure



SYMPTOMS OF RADIATION INJURY

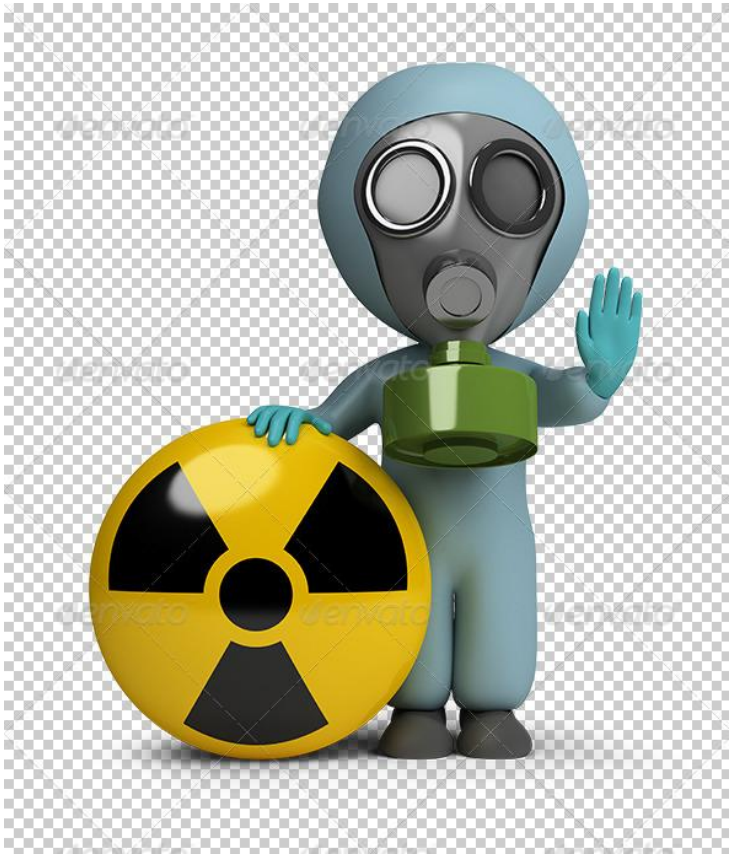
Erythema: reddening of the skin

- Mild or transient, doses over 2 Gy
- Necrosis, doses over 12 Gy

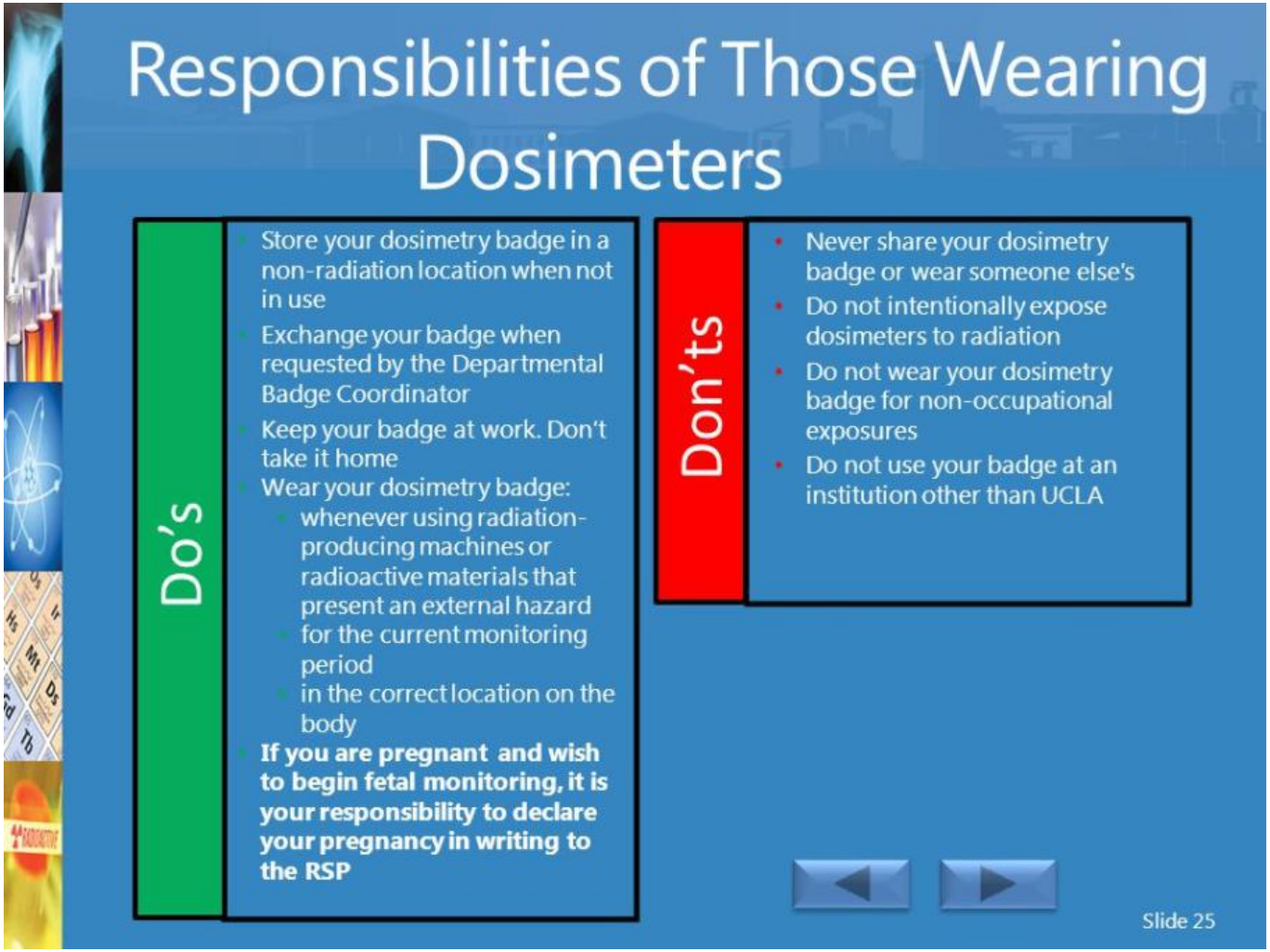
- Epilation: hair lose
  - Temporary, doses over 3 Gy
  - Permanent, doses over 7 Gy
  -
- Acute radiation syndrome
  - doses over 100 R
  - Nausea ,Vomiting, Diarrhea

RADIATION DOSIMETRY

- Dosimetry is the measurement of radiation dose received
- Dosimeters (badges) measure the amount of radiation received by radiation workers.
- Dosimeters help monitor radiation dose to be sure workers do not exceed annual limits.
- Dosimeters are given to employees based on the type of radiation they work with



RADIATION DOSIMETRY



RADIATION SAFETY PROTECTION

Do You Image Wisely®?

Now With **Fluoroscopy**

Comprehensive information on radiation protection in fluoroscopic imaging:

- Protocols and techniques
- Personnel and teamwork
- Safety culture and environment
- Monitoring and management
- Patient/procedure interface
- Alternative imaging methods

At RSNA 2014, also learn about Image Wisely® with:

- **COMPUTED TOMOGRAPHY**
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Earn credit with an Image Wisely Radiation Safety Case* and obtain a ribbon by taking the pledge.

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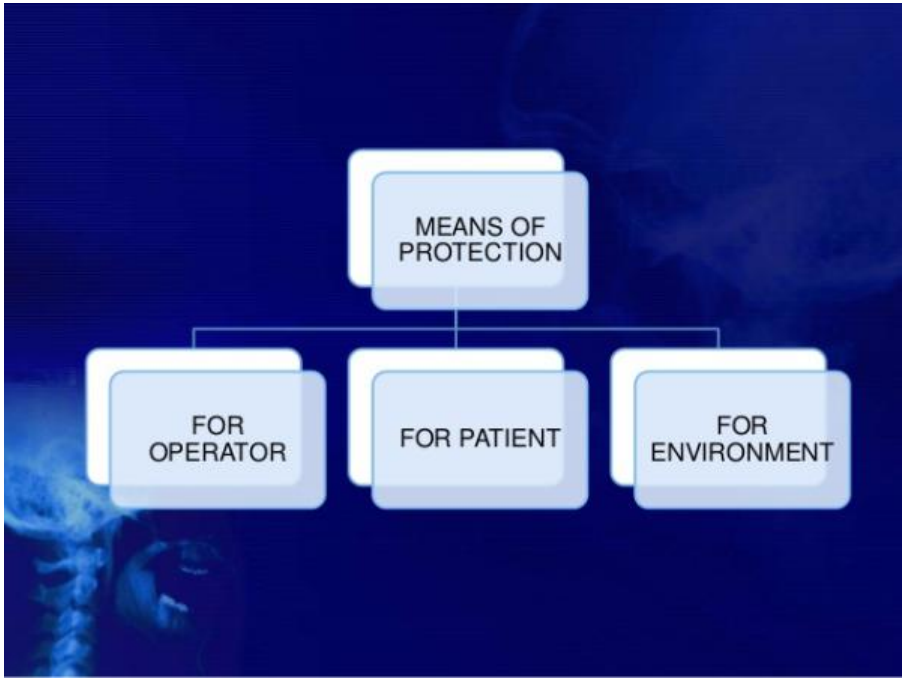
RADIATION SAFETY - PROTECTION



RADIATION SAFETY OPERATOR

RADIATION SAFETY – OPERATOR

LEAD APRONS

- Lead aprons are lined with lead.
- The Lead in the aprons measures 0.25 mm to 0.5 mm thick
- Lead Aprons blocks X-Rays, and protect employees and patients from radiation exposure
- The manufacturer's recommendations regarding the handling and storage of protective clothing must be strictly observed.
- Except for the patient, only the staff and ancillary personnel required for the medical procedure or training shall be in the room during the radiation exposure.

RADIATION SAFETY – OPERATOR

LEAD APRONS

AVAILABLE ARE:

- Lead aprons
- Wrap around skirt
- Gloves
- Gonadal shield and
- thyroid shields

RADIATION SAFETY – OPERATOR

LEAD APRONS

#3 - Do Properly Store Aprons

Follow apron manufacturer's recommendations

- Store aprons on hangers when not in-use
- Avoid storing aprons on a flat surface
- Aprons should be hung by the shoulder
- Never fold or crease aprons
- Always store with fasteners secured

UNIVERSAL MEDICAL

RADIATION SAFETY - OPERATOR

Shielding: Hang Lead Aprons Properly

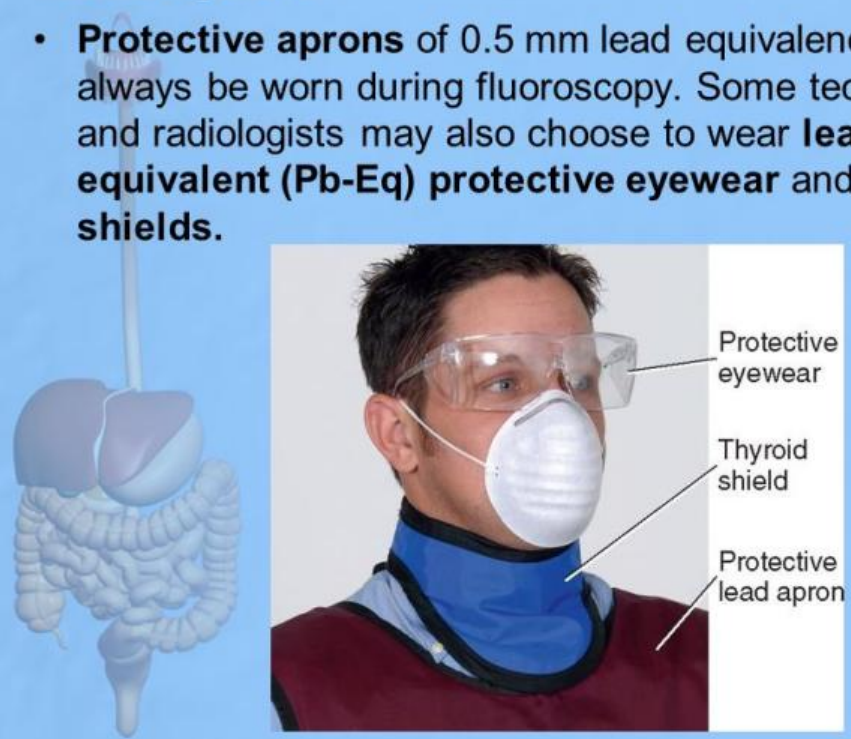
Hanging lead aprons on hangers/hooks prevents the lead from cracking and tearing.

This is for your safety, so please be sure to take care of your lead.

RADIATION SAFETY - OPERATOR

Lead Aprons

- **Protective aprons** of 0.5 mm lead equivalency must always be worn during fluoroscopy. Some technologists and radiologists may also choose to wear **lead-equivalent (Pb-Eq) protective eyewear** and **thyroid shields.**



RADIATION SAFETY - OPERATOR

THE BASICS 101

- **TIME:** do not stand in a radiation area any longer than necessary
- **DISTANCE:** if you go from 1 foot from the tube to 2 feet from the tube your exposure goes to 1/4 of the original amount.

  Step Back!

- **SHIELDING:** Get behind a barrier

RADIATION SAFETY – OPERATOR

LEAD APRON – MAINTENANCE

At least annually or per manufacturers recommendations Lead Apron INTEGRITY is checked

Equipment: Lead aprons, gloves, gonadal and thyroid shields.

STEPS:

- Option 1: image intensified fluoroscopy unit
  - 1. Lay out the item on the table.
  - 2. Examine the entire item using the fluoroscope.
  - 3. Record results on the Annual Quality Control Checklist.
- Option 2: image intensified fluoroscopy unit is not available:
  - 1. Closely inspect each item for kinks and irregularities.
  - 2. Take a radiograph of suspect areas.
  - 3. Process the film and look for breaks in the lead lining.
  - 4. Record results on the Annual QC Checklist.

CORRECTIVE ACTION: Any item displaying breaks in the lead lining should be replaced.

RADIATION SAFETY - OPERATOR

- Lead aprons must be worn when not behind another barrier
- Lead aprons are not primary barriers , Never stand in the x-ray beam
- Use lead gloves, lead aprons, and thyroid shields while in a radiation area.
- Always stand behind the primary barrier

RADIATION SAFETY - OPERATOR

- Minimize occupational exposure
- Utilize the cardinal rules of radiation protection
- Demonstrate safety, during portables & fluoroscopy
- Use cassette holding devices.

RADIATION SAFETY - OPERATOR

- Do not hold a patient unless there is no other choice
- Ask family member to help hold the patient
- Use devices like a pig-o-stat, compression bands to immobilize the patient
- Don't hold the IR. Use cassette holders
- "You held the last patient. I will hold this one."
- Annual radiation safety training

RADIATION SAFETY – OPERATOR

- Get back! Use the 6 foot exposure cord
- Stand behind the machine
- Get all non mandatory people out
- Reduce repeat exams

RADIATION SAFETY – OPERATOR

DOSIMETRY BADGES

- Change quarterly
- Don't loose your badge
- Don't wear another's badge
- Your badge is for occupational exposure. Do not wear it while getting a diagnostic x-ray yourself.
- Do not wear it to the dentist, etc.

RADIATION SAFETY – OPERATOR

DOSIMETRY BADGE

Wear personal monitoring devices appropriately
At the collar, outside the lead apron, not on the apron
When you are pregnant wear 2nd badge inside apron on belly

RADIATION SAFETY – OPERATOR

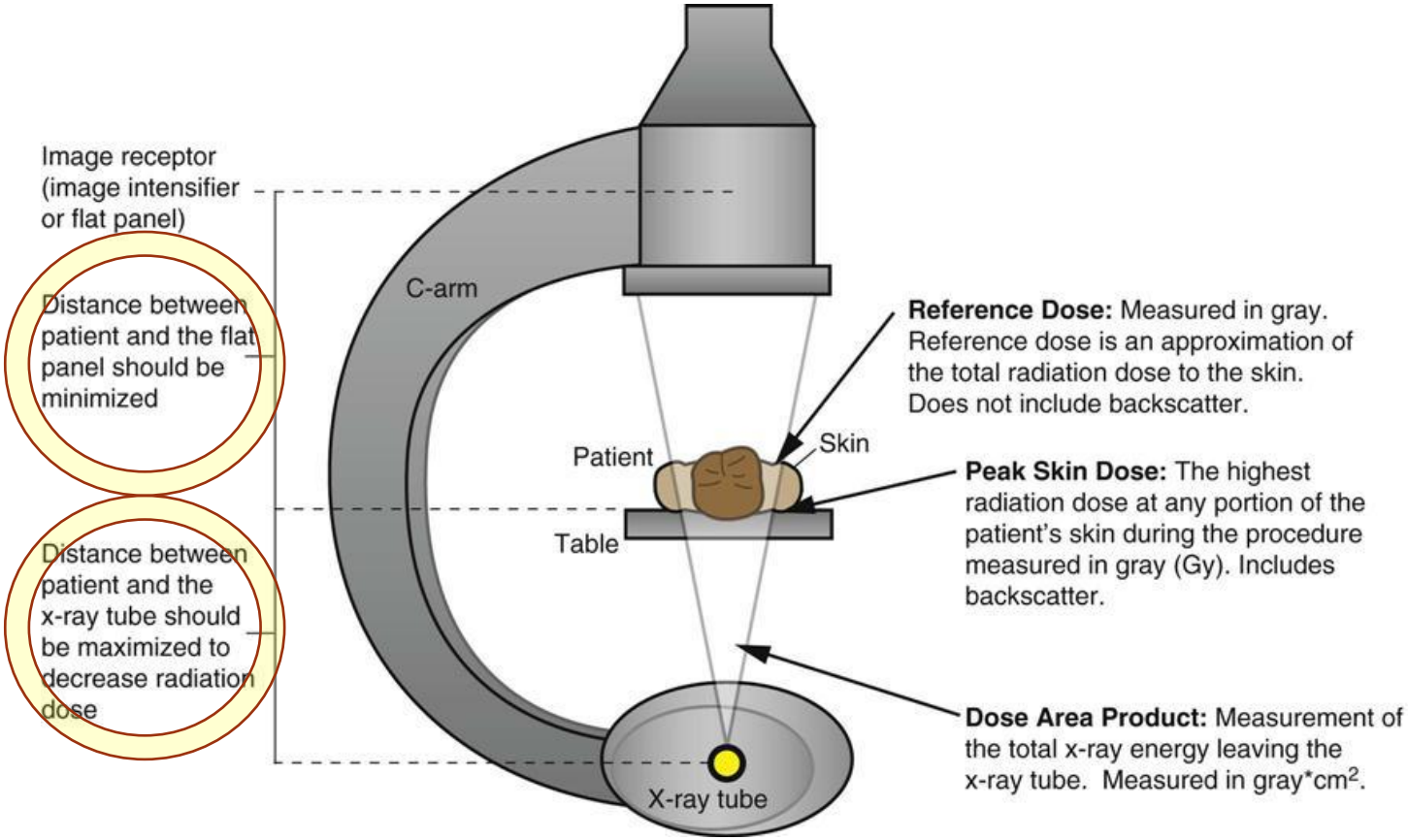
I THINK I'M PREGNANT.

- Declaration of pregnancy is voluntary.
- If you do declare yourself pregnant,

  the employer is responsible to keep the exposure to the fetus at > 500 mrem for the pregnancy or 50 mrem in any one month
- If your exposure exceeds the limit you will be required to take special work assignment

RADIATION SAFETY – OPERATOR

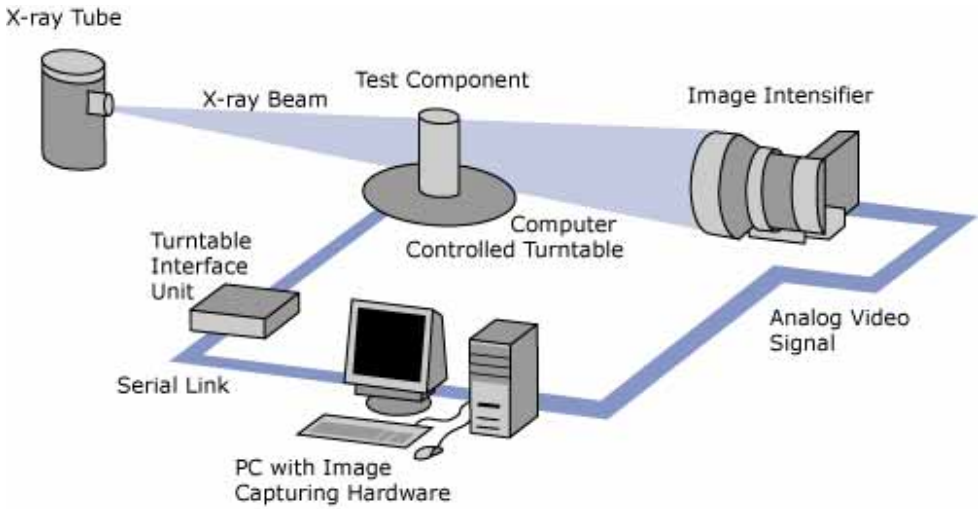
C-ARM FLUOROSCOPY



RADIATION SAFETY – OPERATOR

C-ARM FLUOROSCOPY - BASICS

- X-ray tube generates the radiation beam
- Collimation system shapes the beam
- Image receptor captures x-rays exiting the patient
  - Image intensifier- converts x-rays into light that can be viewed by TV
  - Flat panel detector- converts x-rays directly to digital signals that are computer analyzed



RADIATION SAFETY – OPERATOR

C-ARM FLUOROSCOPY - OPERATOR CONTROLS

Field of View (FOV)

- •Collimator shutters can be adjusted to shape the beam
  - • Decrease FOV, decreases patient dose, increases image quality

Magnification Mode

- •Image is magnified by projecting smaller beam over image receptor
- •Yields less "bright" image
- •ABC adjusts to normal brightness by increasing kV/mA

Fluoroscopy Modes

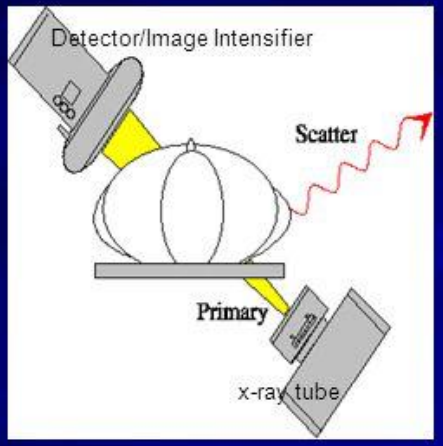
- •High dose modes are available on some systems (may involve 15x more radiation vs. standard mode)

Digital Pulse Mode

- • On newer digital systems the radiation beam is emitted in pulses or "frames"
- •Lower frame rates may yield acceptable images while lowering patient dose

RADIATION SAFETY - OPERATOR

Distance: Scattered Radiation



During fluoroscopy, radiation is scattered from the surface of the patient where the x-ray beam enters.

Scattered radiation is the main source of radiation dose to staff. It also decreases image contrast and degrades image quality.

RADIATION SAFETY - OPERATOR

Primary Beam

SHOULD BE LIMITED TO THE PATIENT

Highest radiation level

Scatter Radiation

Occurs from interactions of the primary beam with the patient

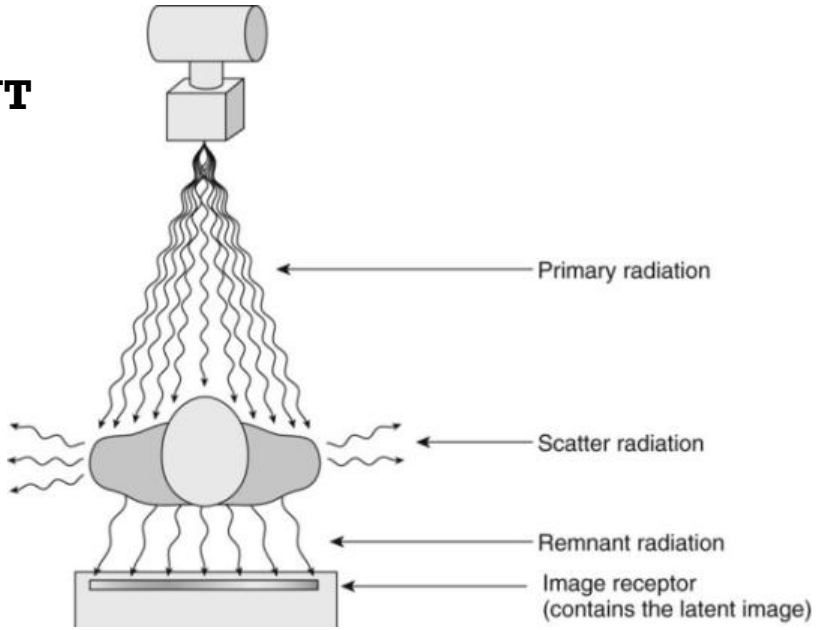
PRIMARY source of staff exposure

Leakage Radiation

X-rays leaking through the tube housing

Leakage rates are regulated by the FDA

Minor source of exposure



RADIATION SAFETY - OPERATOR

FATE OF X-RAYS DURING IMAGING

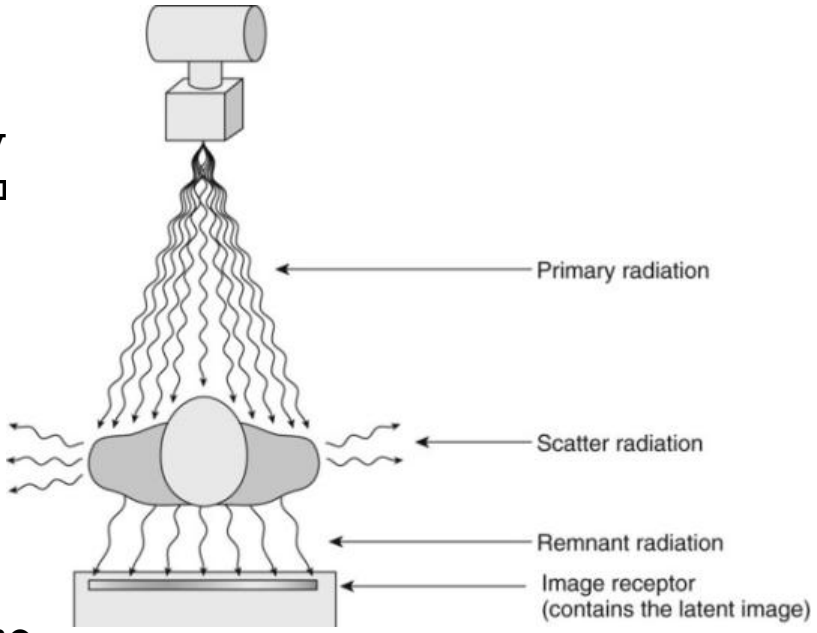
Partial absorption with scatter:

Scattering involves a partial transfer of energy tissue, with the remaining scattered x-ray havi less energy

Scattered radiation decreases image quality

Primary source of exposure to staff

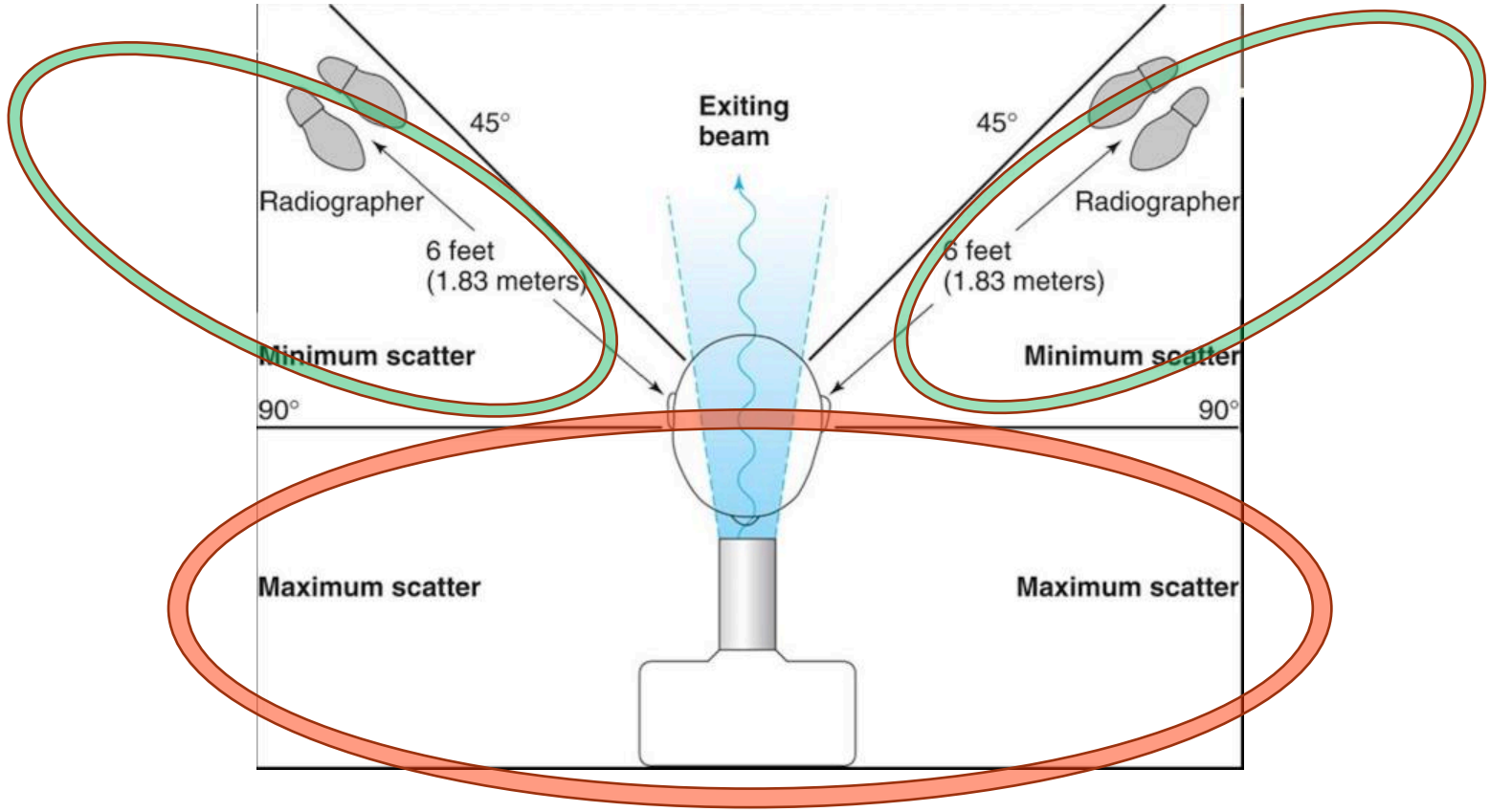
- 1% of all x-rays reach the image recording device, yielding useful information
- 99% are either absorbed within the patient (patient dose) or are scattered throughout the exam room (staff exposure)



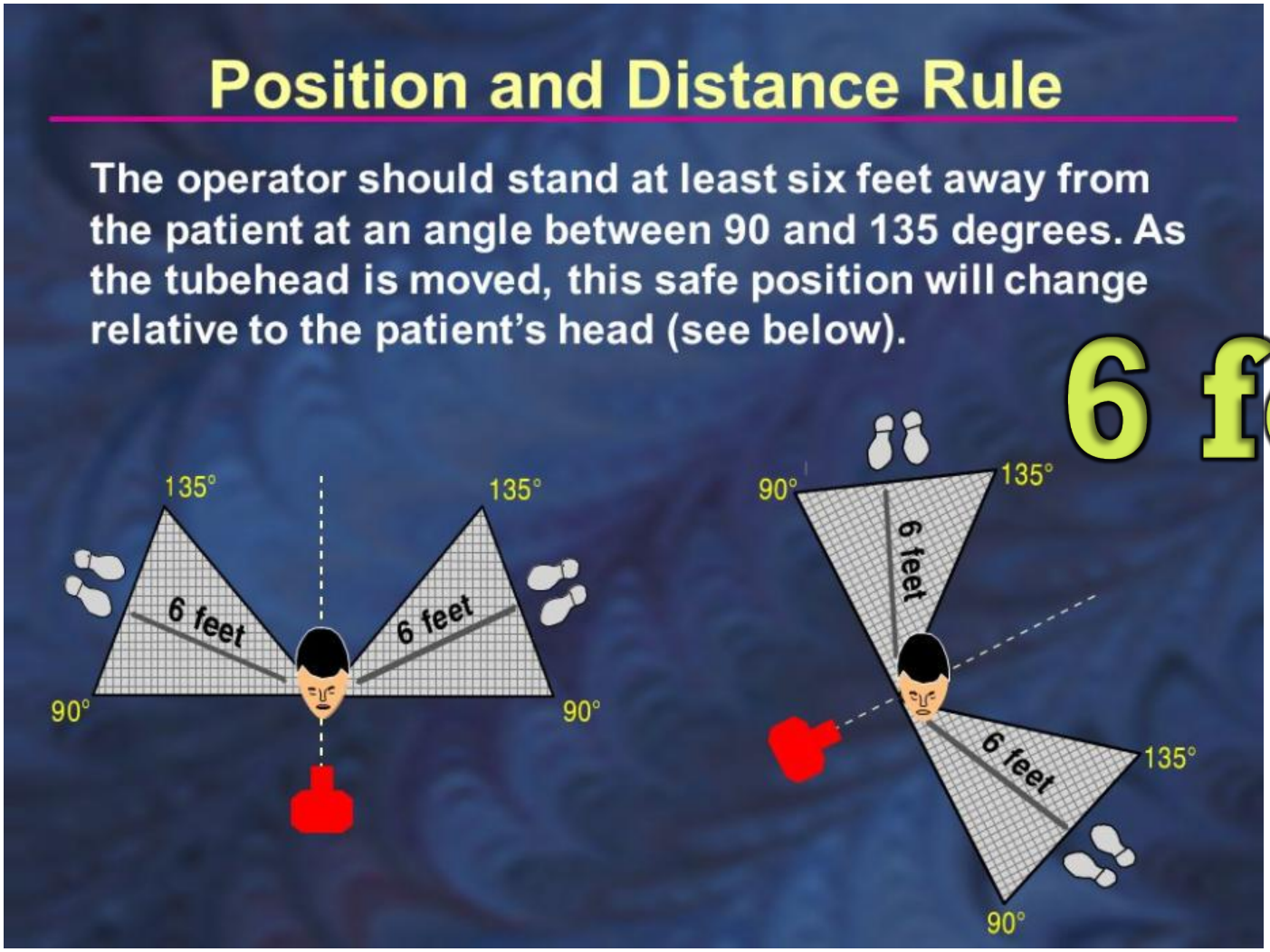
RADIATION SAFETY - OPERATOR

POSITION & DISTANCE RULE

6 feet



RADIATION SAFETY - OPERATOR



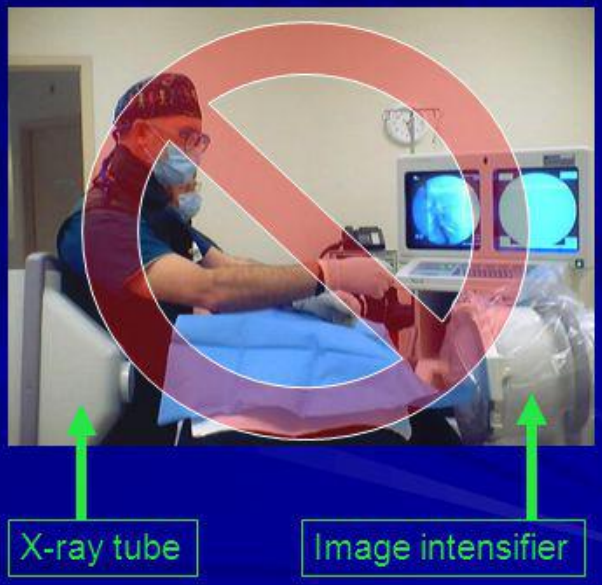
RADIATION SAFETY - OPERATOR

Distance: C-Arm Position

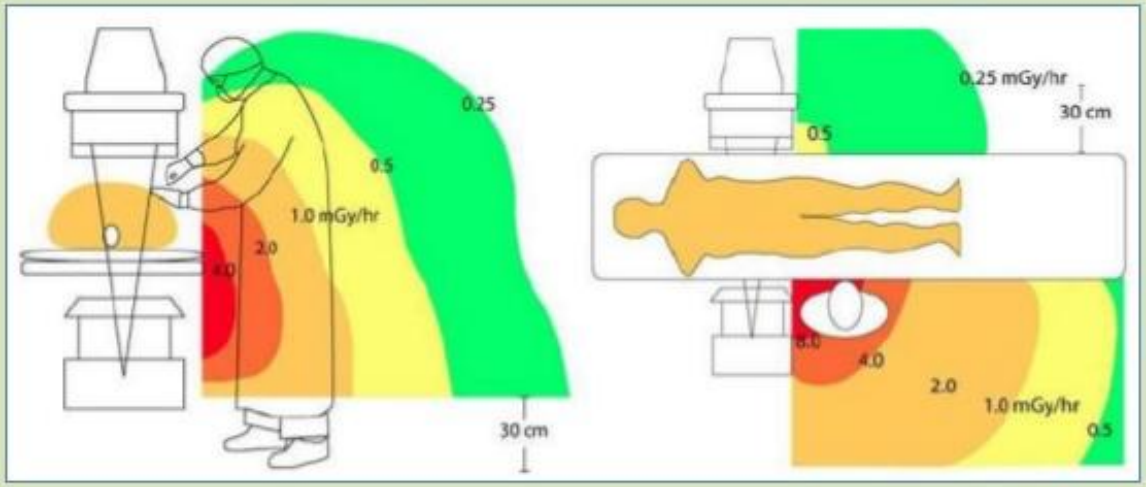
Position the x-ray tube and image intensifier so you are working on the image intensifier side of the patient.

Position the x-ray tube as far from the patient as possible.

Position the Image intensifier as close to the patient as possible.



RADIATION SAFETY - OPERATOR



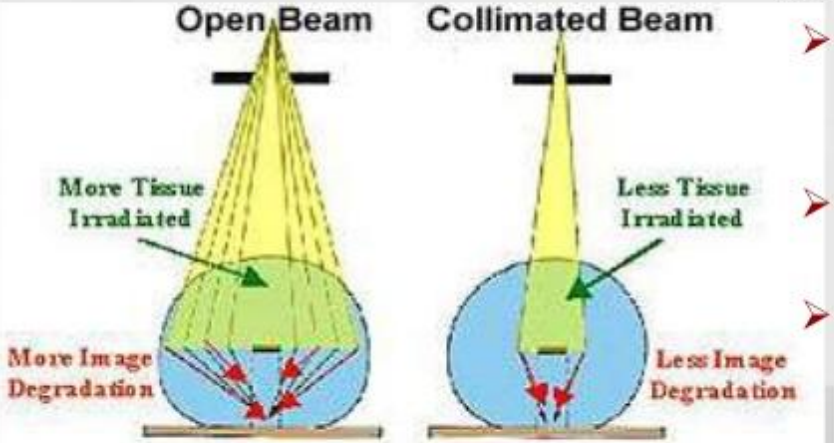
The diagrams depict scatter radiation for a C-arm fluoroscopy system with the x-ray tube under the table (left) and in lateral projection on the same side as the operator (right).

- Note the **high dose to the operator** when standing on the same side of the patient as the tube.
- If the operator **stands upright**, scattered radiation to the face is perhaps one-fourth as great as when the operator is **leaning down** toward the patient.
- Short operators receive more radiation to the face than do tall operators. They may wish to stand on a platform.

RADIATION SAFETY - OPERATOR

Collimation

Collimate tightly to the area of interest.

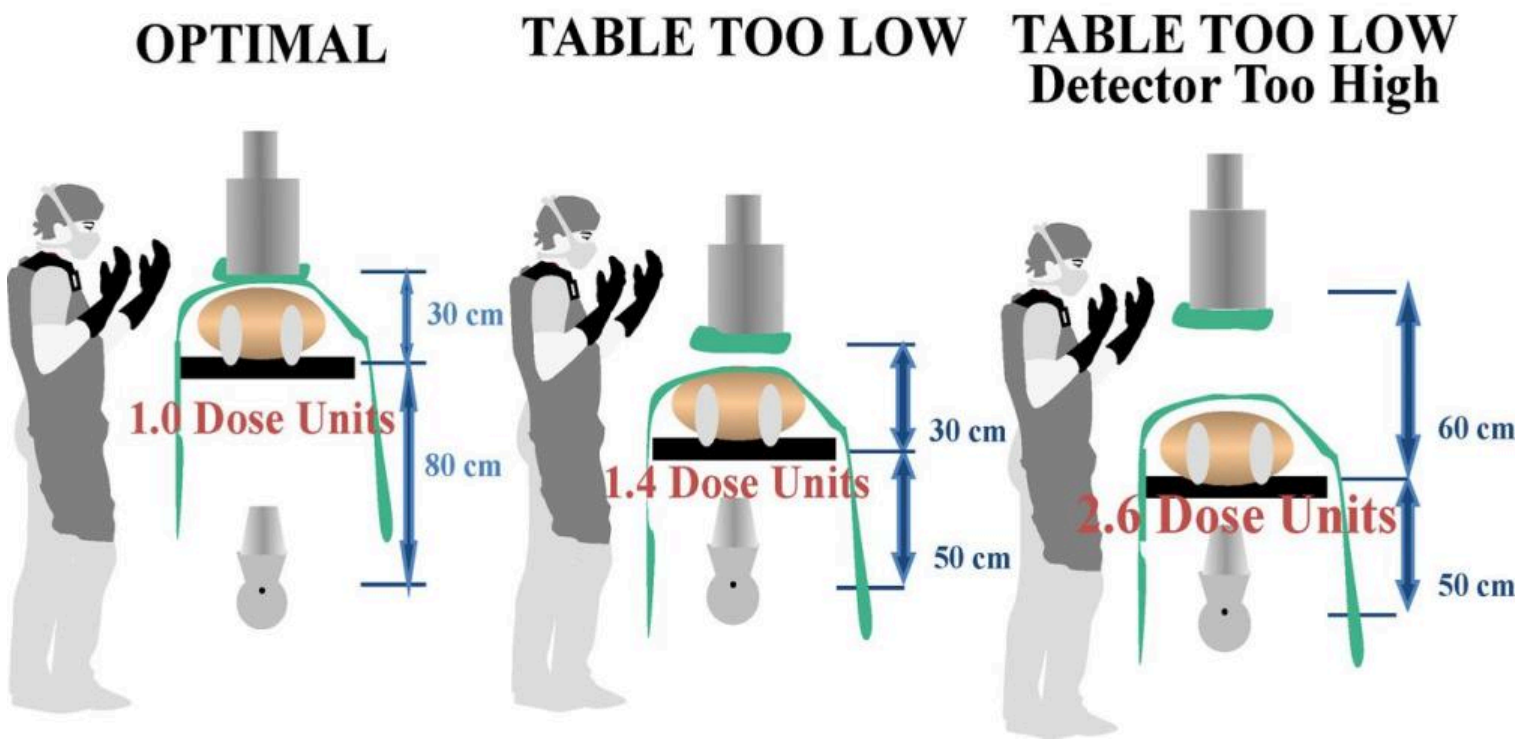


- Reduces the patient's total entrance skin exposure.
- Improves image contrast.
- Scatter radiation to the operator will also decrease.

RADIATION SAFETY – OPERATOR

DOSE REDUCTION TECHNIQUES

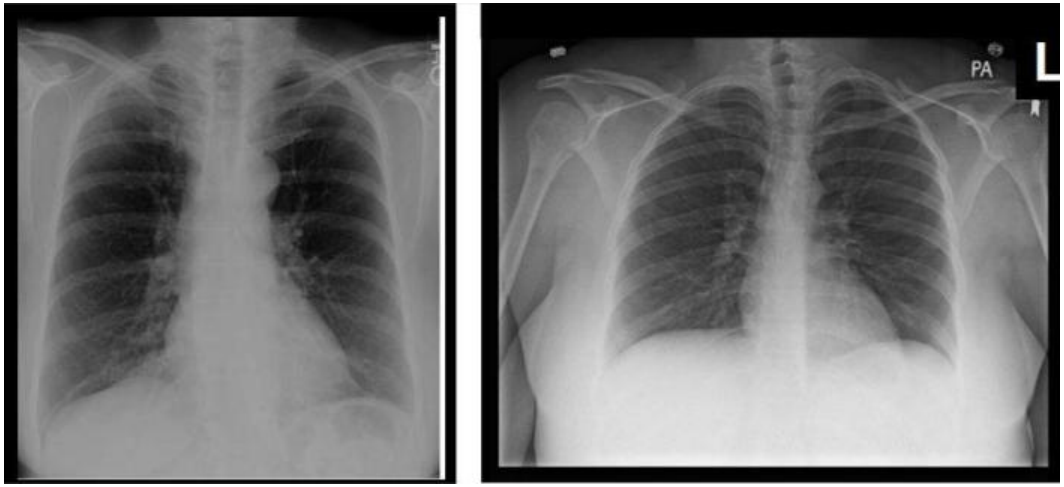
System Positioning Affects the Dose to Both the Patient and the Operator



RADIATION SAFETY – OPERATOR

DOSE REDUCTION TECHNIQUES - USE COLLIMATION

- Field size can be reduced by closing collimators
- Field size should not exceed the area of clinical interest
- Closing collimators reduces patient volume being radiated and enhances image quality
    - Less volume imaged reduces scatter or "noise"
    - Reduces staff dose



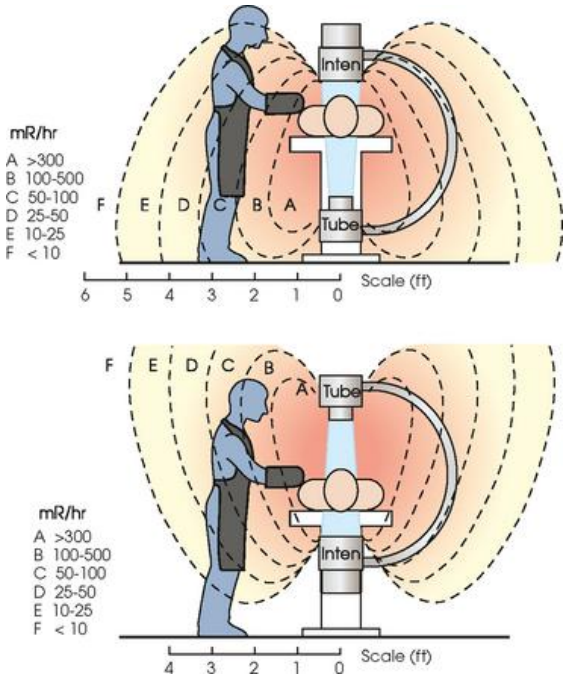
RADIATION SAFETY – OPERATOR

DOSE REDUCTION TECHNIQUES STAFF

Staff exposure comes from the patient
TIME, DISTANCE, AND SHIELDING

- Alert the staff when the beam is ON
- Allows them to increase their distance
- Avoid placing hands within the beam

Scatter radiation is higher on the x-ray tube side of the C-arm
Keep the x-ray tube below the table whenever possible



RADIATION SAFETY – OPERATOR

DOSE REDUCTION TECHNIQUES

- Make use of available shielding
- Over-head shields provide substantial reduction to head/eye exposure
- Lead drapes can provide substantial reduction to staff exposure

RADIATION SAFETY
PATIENT

RADIATION SAFETY – ENVIRONMENT

PROTECT THE PUBLIC

- Rooms have appropriate shielding
- Signage postage to prevent accidental exposure
- Unnecessary persons are restricted from remaining in the area by asking visitors to leave the room.
- Use shielding for everyone in the radiation area
- Close the door
- Warn others about the exposure
- Screen helpers for chance of pregnancy

RADIATION SAFETY – PATIENT

EXPOSURE TECHNIQUES AND POSITIONING

- Make sure you have the correct patient
- Make sure you are doing the exam ordered at the correct time
- Use technique chart
- Position patient carefully
- Mark films with lead markers
- Control motion by stabilizing the patient
- Remove clothing and other objects that will obstruct the image

RADIATION SAFETY – PATIENT

- Avoid Errors
- Question about pregnancy
- Avoid repeat radiographs
- Utilize Proper Exposure Techniques for the correct density or correct exposure index value
- Use the correct client positioning
- Demonstrate appropriate collimation
- Use highest kVp possible for each exam
- Use at least 40" SID when possible
- Shield the patient

RADIATION SAFETY - PATIENT

Important steps to minimize patient dose and to avoid radiation-induced skin injuries during fluoroscopy

Keep image receptor as close as possible to the patient
Maximize distance between patient and X-ray tube
Adapt tube settings (tube current, focal spot, filtration, exposure time and tube voltage) to patient size (usually done by automatic exposure control)
Use pulsed fluoroscopy, reduce frame rate and/or dose whenever possible
Use collimation, preferably virtual (off fluoroscopy)
Avoid direct magnification
Avoid angled views (remember that only 3 cm increase in body diameter doubles the skin dose)
Use road map or stored fluoroscopy loops instead of runs
Use last image hold instead of single shot
Avoid unnecessary cone beam CT, long fluoroscopy and multiple runs
Change beam entrance fields in long procedures if possible
Reduce to the minimum overlapping beam entrance fields in sequential FGI

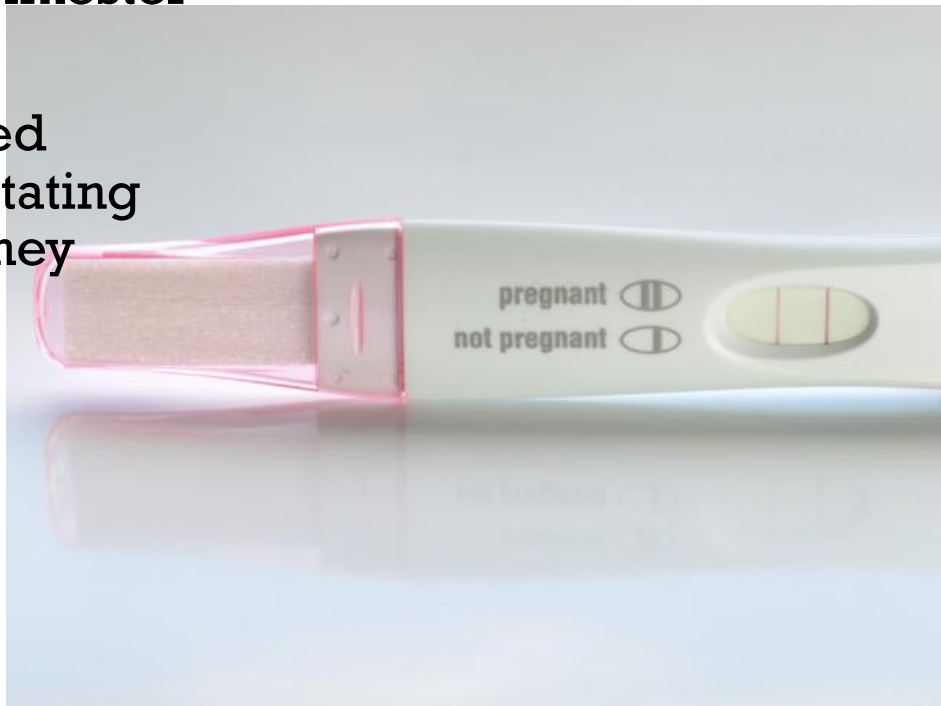
RADIATION SAFETY – PATIENT

I THINK I'M PREGNANT.

- All female patients are screened for pregnancy
- Greatest risk during organogenesis

  (greatest risk) 1st trimester > 2nd Trimester > 3rd Trimester (least risk)

- If urine pregnancy not performed patient must sign release form stating that they are not pregnant and they understand the risks



RADIATION SAFETY – PATIENT

RADIATION RISKS AND INJURY

WHY INJURIES ARE OCCURING

-Growth in the number and types of procedures using fluoroscopy

-More overweight and obese patient

-Require higher radiation output for imaging

-Highest risk of injury noted during:

Cardiac Catheterization

Interventional Radiology

Any Fluoroscopy procedure has potential to cause injury!

RADIATION SAFETY – PATIENT

RADIATION INJURIES

Arm injury: Patient was draped for procedure and staff did not realize that she had moved her arm so that it was resting on the port of the x-ray tube during the procedure

49 yr old man 22 months after 2 completed and 1 attempted TIPS placements within 1 week – resulted in a non healing ulcer

Most radiation-induced injury is not apparent (effects often appear days to weeks after exposure)

Radiation injury may not be directly observable by the patient

Follow-up care when exposure was greater than 15 minutes is required.

Successful law suits have resulted from radiation injury cases

RADIATION SAFETY – PATIENT

DOSE REDUCTION TECHNIQUES

- Most effective method to reduce dose
  - Do not turn beam on when not viewing image display
  - Pre-plan image will reduce unnecessary fluoroscopy time
  - Avoid redundant static images
- Use "Last Image Hold"
  - Freezes last static image for viewing
  - Allows images to be viewed at your leisure without radiating patient
- Use brief "looks" during fluoroscopy
  - Versus continuous "lead-foot" technique
  - Prolonged imaging does NOT improve image brightness or resolution
  - Room lighting should be dim to help

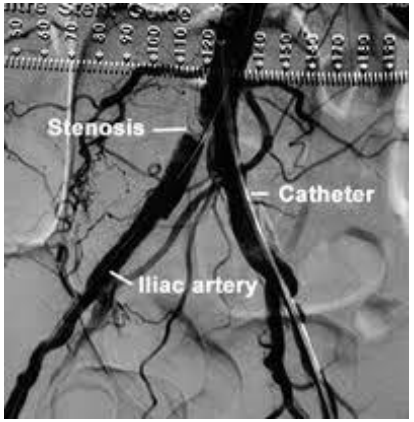
RADIATION SAFETY – Patient

Dose Reduction Techniques

- Keep the patient close to the image intensifier
  - Maximize patient distance from the x-ray tube
  - Improves image quality
  - Reduces scatter radiation that contributes to noise on image
- Digital "run-offs" are the highest source of patient radiation
  - High radiation dose needed for high resolution recorded images (15x greater than standard fluoroscopy)

- C-arm boost mode
  - Appropriate when patient's body habitus causes poor image quality
  - Not intended for routine use

- Use magnification ONLY when small detail resolution is needed
  - Patient dose increases with each level of magnification



RADIATION SAFETY – PATIENT

DOSE REDUCTION TECHNIQUES - REVIEW

- Minimize beam "ON" time
- Maximize use of "last-image hold" features
- Use good imaging geometries
  - Keep patient close to image intensifier (away from x-ray tube)
- Select the lowest dose mode that provides acceptable image quality
  - Use low detail mode or lower frame rates when possible
- Minimize use of "Boost" modes and magnification
- Always collimate until only the area of interest is seen
- Beware of x-ray tube location
- Increase distance from patient
  - Time, distance, and shielding
- Beware of staff position before turning the beam "ON"
- Always wear a lead apron when using fluoroscopy

RADIATION SAFETY – PATIENT

DOSE REDUCTION TECHNIQUES - REVIEW

- Make use of available shielding
  - Overhead "pull-down" shields, lead drapes

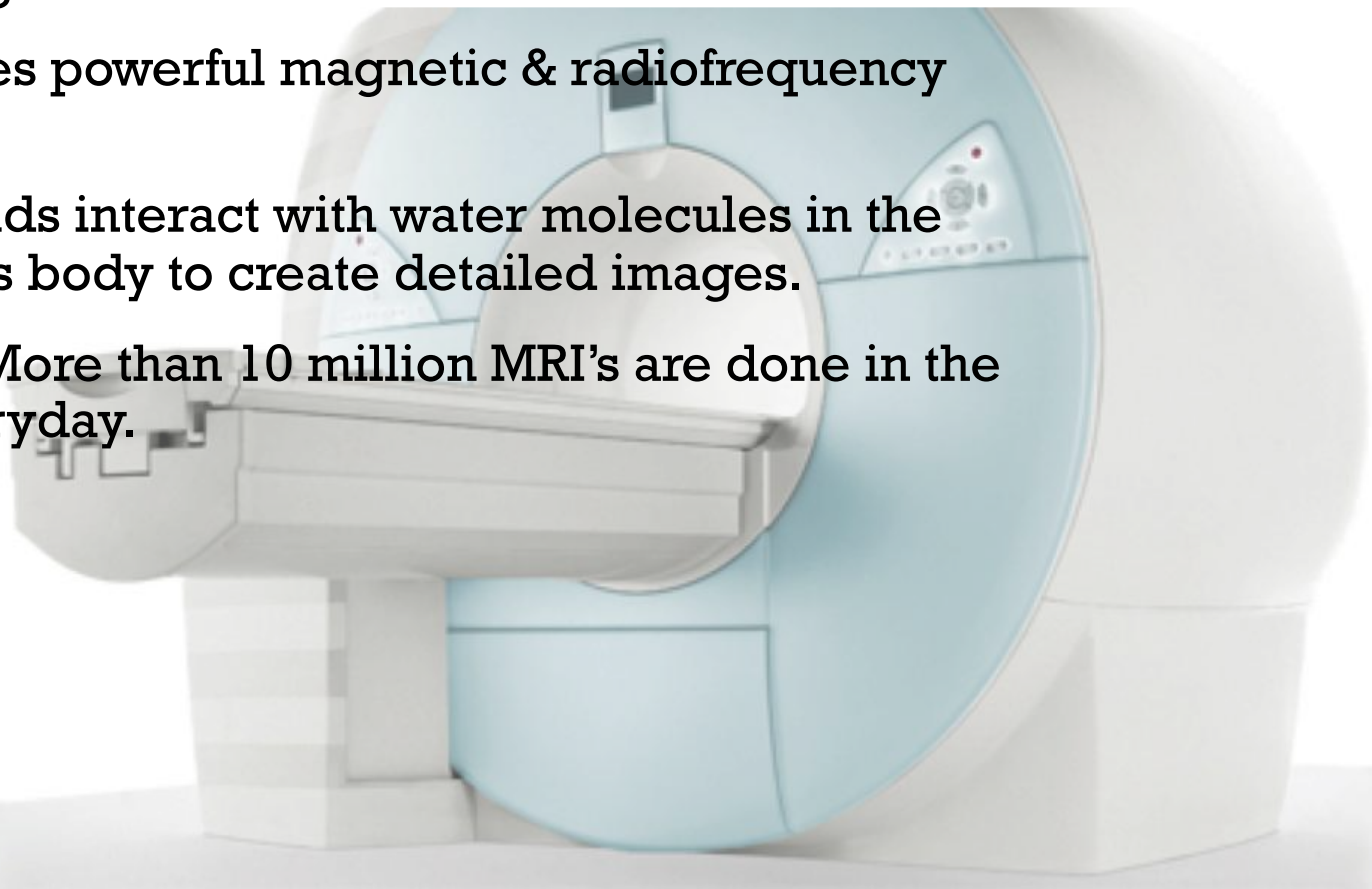
- Always wear radiation badge
- When anticipating heavy fluoroscopy use:
  - Review patient history for prior fluoro to avoid irradiating same skin regions
  - Vary beam angulations throughout procedure to minimize patient "hot spots" at beam entry
  - Be aware of accumulated beam use

MRI SAFETY


MRI SAFETY
Danger! The Magnet is always on!
DO NOT ENTER WITHOUT PERMISSION
FROM AUTHORIZED MRI PERSONNEL
Objects containing metal are prohibited in the MRI suite.
These objects include:
Pens
Coins
Shoes
Belt buckle
Dentures
Cell phone
Keys
Credit cards
Watch
Hair clips
Jewelry
Hearing aids
Wheel chair
Oxygen tank
IV pole

MAGNETIC RESONANCE IMAGING (MRI)

- Is a form of imaging that does NOT involve ionizing radiation.
- MRI uses powerful magnetic & radiofrequency fields.
- The fields interact with water molecules in the patients body to create detailed images.
- FACT: More than 10 million MRI's are done in the US everyday.



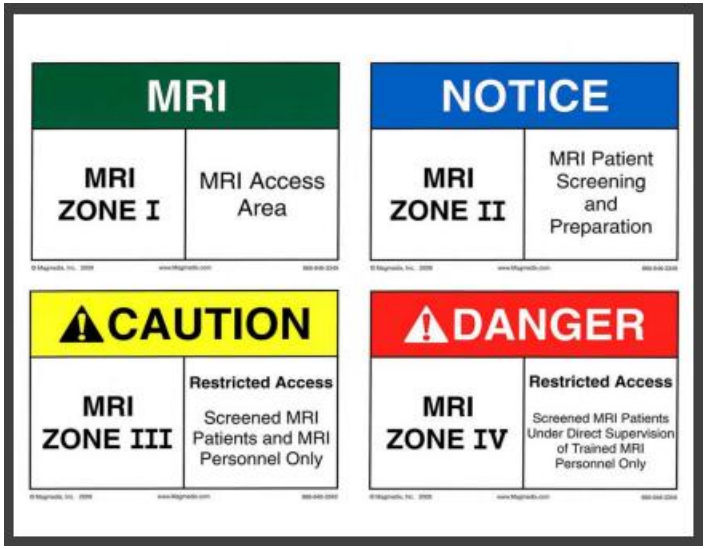
MRI

- Remember MAGNET IS ALWAYS ON
- 24/7, 365 days a year
- The magnet is very strong it can suck a bed into it.

MRI

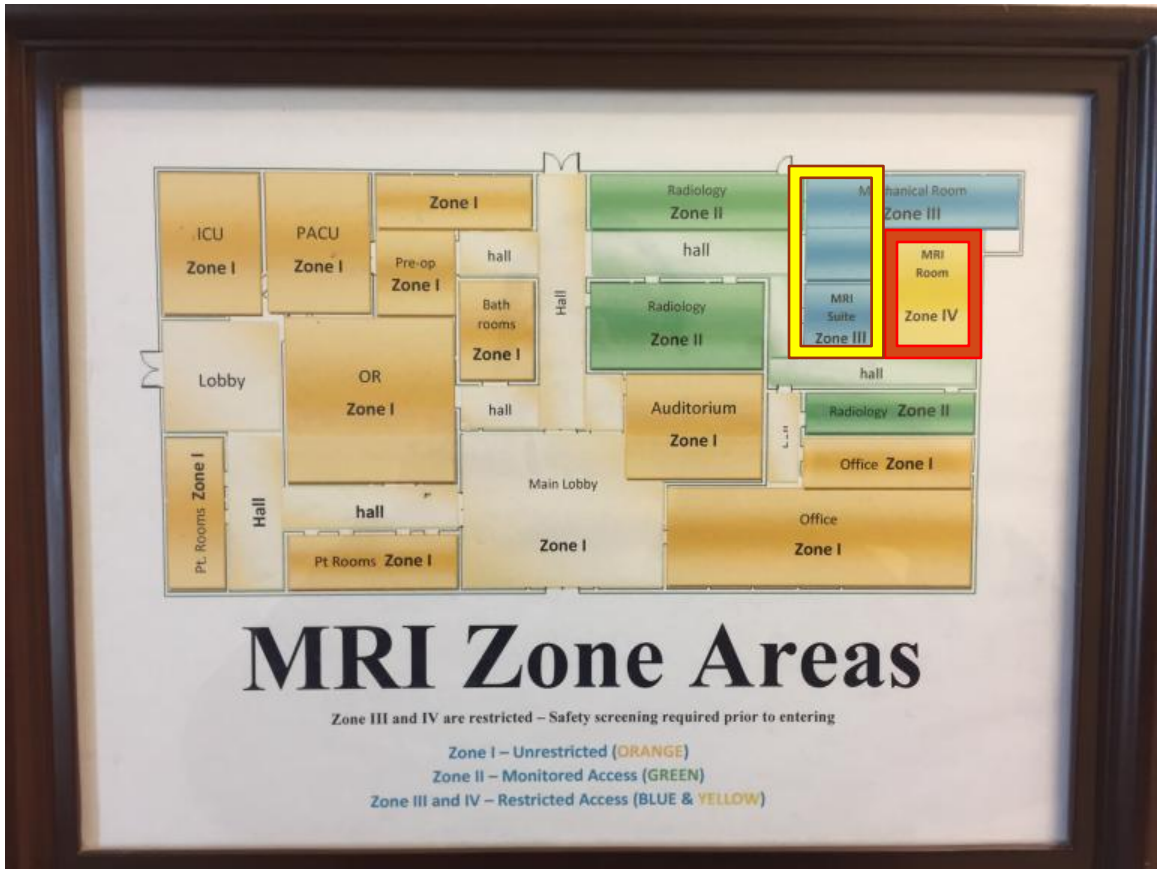
MRI ZONES

- There is a progressive restriction of entry and increased supervision for the higher access zones III, IV.
  - **Zone 1** = free access to general public
  - **Zone 2** = Interface between unrestricted and restricted zone 3
  - **Zone 3** = Locked access. Access limited to people accompanied by a MRI tech. MRI lobby.
  - **Zone 4** = Locked access. Access limited to screened patients under direct supervision of trained MRI Tech. MRI scanner.



FIRE

MRI ZONES



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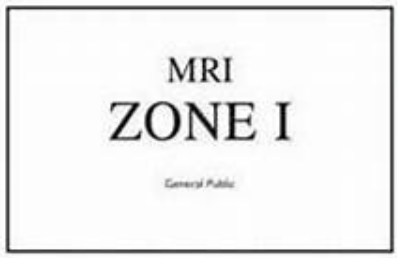
MRI
ZONES

- Signs will explain access with zoning and warning specifications.
- All staff must be alert and follow all recommendations and strategies to prevent MRI accidents and injuries from occurring.



MRI

EMERGENCY POWER SHUT OFF

Pressing the button will disable electrical power to the MRI room

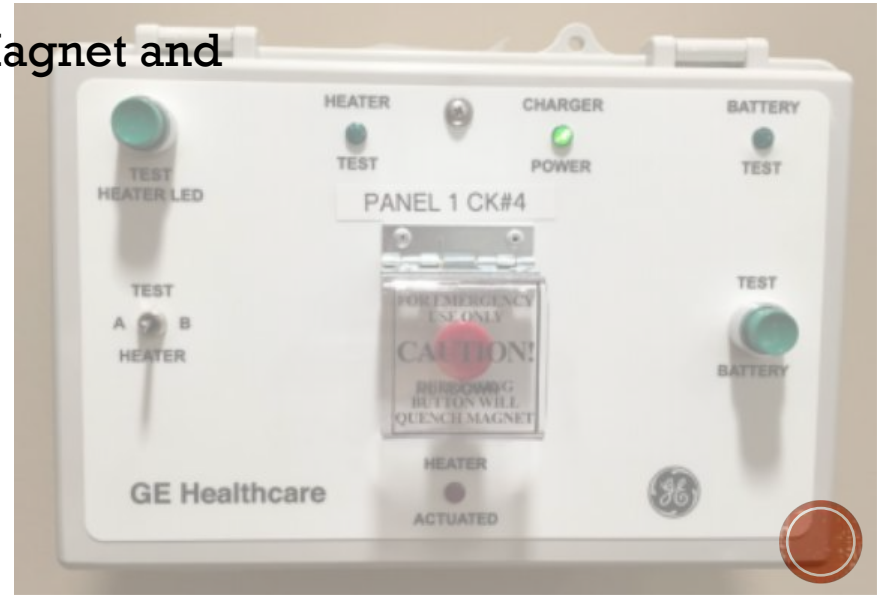
- BUT the MRI magnet will still work
- Press this button incase of:
  - Fire
  - Sparks, smoke from MRI
  - Flooding or Sprinkler Activation
  - Catastrophic Equipment Failure

MRI

EMERGENCY QUENCHING OF THE MRI

Quenching is the disabling of the Magnet
Pressing the button will disable the magnet.
The button is located in the MRI room.
Quenching causes severe damage to the Magnet – ONLY performed in extreme cases.
Press this button incase of:

- Fire in MRI
- A person is pinned to the Magnet and being crushed



MRI

PATIENT IN MRI

If a patient needs to be removed from the MRI:

- Remember only trained staff may enter
- DO NOT bring in a Code cart, defibrillator or oxygen tank into the MRI room
- ONLY MRI compatible equipment can be used in the MRI room.
- If patient can not walk out on their own, wheel the patient out on the MRI table. The MRI table is mobile, and has wheels.
- Once out of Zone IV, preferably also zone III – a patient can be transferred to any other stretcher/bed, or can be attended to on the MRI table.
- NEVER attempt to resuscitate a patient in the MRI Room.

MRI
DANGERS

- The actual magnetic field is not harmful.
- The hazards of MRI relate to its effects on objects and electronic devices in or near the magnetic field.
- Most injuries result from:
  - Objects that heat during MRI
  - Ferromagnetic objects attracted to magnet
  - Electronic device malfunctions because of the magnet

MRI
DANGERS

- **BURNS** are the most common injury in the MRI suite.
  - Examples: metal implants, cables (ECG leads), pulse oximeter sensor, metal clamps, surgical staples, drug delivery patches, safety pins, tattoos containing metallic ink.
- **FERROMAGNETIC OBJECTS** are attracted to the magnetic field of the MRI system. These objects can become dangerous projectiles "MISSILE EFFECT".
  - Examples of ferromagnetic objects: oxygen tanks, fire extinguishers, wheelchairs, stethoscopes, patient transport carts. ONLY MRI approved supplies will be allowed in the MRI suite.
  - Both patients and staff should also remove all metal objects before entering the MRI suite including: coins, pens/pencils, earrings, car keys, watches, tape measures, credit cards, hearing aides, hair pens

THE MAGNET IS <u>ALWAYS ON.</u> FERROMAGNETIC OBJECTS WILL BE ATTRACTED TO THE MAGNET EVEN IF IT IS NOT IN USE.

MRI

DANGERS

Ferromagnetic objects contd.:

- Tearing of soft tissue in the brain due to movement of aneurysm clip
- Blindness due to movement of metallic fragments in or near the eye
- Injury to patient when IV pole slid and struck the patient
- Injury to patient when scissors were pulled from nurses hand and struck patient
- Death of pediatric patient when a metal oxygen tank fractured skull

MRI

DANGERS

Electronic device malfunction:

- Pacemakers may not function properly. Patients with pacemakers have died during, or shortly after, MRI exams.
- Other devices may suddenly fail to operate.

MRI
SAFETY

- MRI is a very safe test as long as precautions are taken.
- Faromagnetic objects and devices MUST remain outside the magnetic field of the MRI system at all times.
- Remember, the magnet is ALWAYS on.

FIRE IN MRI

FIGHTING THE FIRE

Even in case of a FIRE DO NOT BRING ANY METALLIC fire fighting equipment into the MRI room – unless the magnet has been quenched (turned off).

Can NOT enter the MRI room (zone IV) unless you are metal free.

MRI compatible extinguishers a located in Zone II and Zone III.

MRI
SAFETY

SAFETY STRATEGIES:

- Controlling Access
- Posting Warning Signs/Zone Signs
- Screening for and removing Ferromagnetic/Metallic Objects
- Thorough Screening of patients prior to performing testing
- Patient Positioning
- MRI compatible Equipment

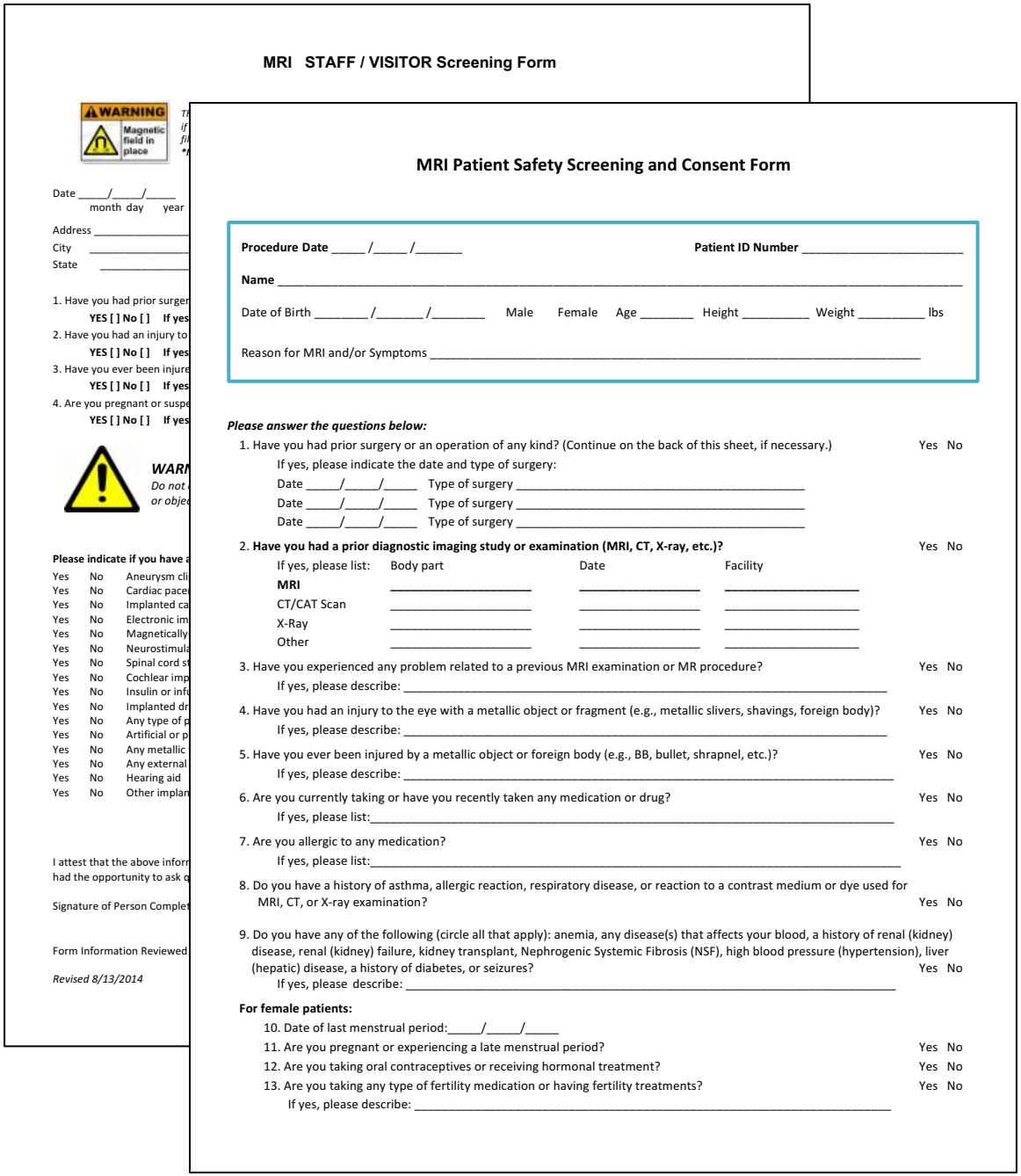
MRI
SAFETY

- To prevent patient and staff injury because of the powerful magnetic field:
  - access is restricted
  - Patients and staff are screened prior to entering Zone III

MRI

ACCESS SCREENING

- **TO enter Zone III** - staff, visitors and patients must be screened to avoid injury



MRI STAFF / VISITOR Screening Form

WARNING Magnetic field in place

Date ____/____/____
month day year

Address _____
City _____
State _____

1. Have you had prior surger
YES [ ] No [ ] If yes
2. Have you had an injury to
YES [ ] No [ ] If yes
3. Have you ever been injure
YES [ ] No [ ] If yes
4. Are you pregnant or suspe
YES [ ] No [ ] If yes

WARN
Do not
or objec

Please indicate if you have a

Yes	No	Aneurysm cli
Yes	No	Cardiac pace
Yes	No	Implanted ca
Yes	No	Electronic im
Yes	No	Magnetically
Yes	No	Neurostimula
Yes	No	Spinal cord st
Yes	No	Cochlear imp
Yes	No	Insulin or infu
Yes	No	Implanted dr
Yes	No	Any type of p
Yes	No	Artificial or p
Yes	No	Any metallic
Yes	No	Any external
Yes	No	Hearing aid
Yes	No	Other implan

I attest that the above inform
had the opportunity to ask q

Signature of Person Complet

Form Information Reviewed

Revised 8/13/2014

MRI Patient Safety Screening and Consent Form

Procedure Date _____ /_____ /_____ **Patient ID Number** _____

Name _____

Date of Birth _____ /_____ /_____ Male Female Age _____ Height _____ Weight _____ lbs

Reason for MRI and/or Symptoms _____

Please answer the questions below:

1. Have you had prior surgery or an operation of any kind? (Continue on the back of this sheet, if necessary.) Yes No
   If yes, please indicate the date and type of surgery:
   Date _____/_____/_____ Type of surgery _____
   Date _____/_____/_____ Type of surgery _____
   Date _____/_____/_____ Type of surgery _____
2. **Have you had a prior diagnostic imaging study or examination (MRI, CT, X-ray, etc.)?** Yes No

If yes, please list:	Body part	Date	Facility
MRI	_____	_____	_____
CT/CAT Scan	_____	_____	_____
X-Ray	_____	_____	_____
Other	_____	_____	_____

3. Have you experienced any problem related to a previous MRI examination or MR procedure? Yes No
   If yes, please describe: _____
4. Have you had an injury to the eye with a metallic object or fragment (e.g., metallic slivers, shavings, foreign body)? Yes No
   If yes, please describe: _____
5. Have you ever been injured by a metallic object or foreign body (e.g., BB, bullet, shrapnel, etc.)? Yes No
   If yes, please describe: _____
6. Are you currently taking or have you recently taken any medication or drug? Yes No
   If yes, please list:_____
7. Are you allergic to any medication? Yes No
   If yes, please list:_____
8. Do you have a history of asthma, allergic reaction, respiratory disease, or reaction to a contrast medium or dye used for MRI, CT, or X-ray examination? Yes No
9. Do you have any of the following (circle all that apply): anemia, any disease(s) that affects your blood, a history of renal (kidney) disease, renal (kidney) failure, kidney transplant, Nephrogenic Systemic Fibrosis (NSF), high blood pressure (hypertension), liver (hepatic) disease, a history of diabetes, or seizures? Yes No
   If yes, please describe: _____

For female patients:

10. Date of last menstrual period:_____/_____/_____
11. Are you pregnant or experiencing a late menstrual period? Yes No
12. Are you taking oral contraceptives or receiving hormonal treatment? Yes No
13. Are you taking any type of fertility medication or having fertility treatments? Yes No
    If yes, please describe: _____

MRI

ACCESS SCREENING

IMPLANTS

- If implants are identified, device compatibility with the MRI is verified prior to entering Zone III

MR Implants-Devices-Materials Documentation Form

Patient Name: _____ **DOB:** _____

Investigator(s) Name(s): _____

If you discover the patient has had a surgical implant-device or an accident involving potential metal, your questioning should start with:

1. What was the procedure or nature of the accident? _____
2. What kind of implant is it? _____
   a. Name of the manufacturer? _____
   b. What does it do? _____
   c. What is it used for?_____
2. When was the procedure/accident? _____/_____/_____
3. Where was the procedure/accident? (hospital-ER) _____
4. Who did the procedure (surgeon..)? _____
5. If accident, were x-rays done and was metal removed?_____
6. Have you had an MRI since implant or accident? Yes No _____
7. Have you been refused for an MRI before? Yes No _____
8. Have you had x-rays since implant - accident? Yes No, Where?_____
9. Does the patient have an ID card for the implant-device-material ? Yes No _____

Once you have all of the answers to these questions, proceed with the following:

1. Look up the item in the current ***Reference Manual for Magnetic Resonance Safety, Implants, and Devices*** by Frank G. Shellock, Ph.D. or on the web site: **http://www.mrisafety.com**
2. Take the information to the Lead Technician and director of radiology and/or safety officer. They will be able to assist you.
3. You may need to:
   - contact the surgeon who placed the implant and request a copy of the operating room report
   - contact the hospital and get a copy of operative report
   - contact the hospital and get a copy and/or reports of x-rays/CT scans/MRI if applicable
   - contact referring physician or other physician(s) for possible information in office medical record
   - perform an x-ray and/or CT as per radiologist
4. The final responsibility of canceling or proceeding with the exam lies with the radiologist who should make an informed decision based on the information provided by the MR technician.

ACTIONS:

- Implant-Device-Material Name: _____
- Implant-Device-Material Manufacturer Name: _____
- Object category/purpose: _____
- Manufacturer contact information: _____
- Manufacturer contacted - documentation attached? yes no _____
- Implant-Device-Material ID card copied? yes no _____
- Is It safe in a 3.0 Tesla magnetic Field? yes no _____

Final Decision: [ ] DO NOT PROCEED with MRI, [ ] PROCEED with MRI

Decision approved by radiologist: _____ Date: _____

Signature(s) of Investigator(s): _____

This Form will be attached to the patients MR safety screening form for permanent record.

MRI

ACCESS SCREENING

ANXIETY

Anxiety in the MRI is a common occurrence. Patients with claustrophobia, anxiety and such disorders as PTSD may not tolerate the confinement that they experience in the MRI

Mild sedation, and possibly anesthesia may be required to complete study.

Out-Patient MRI Orders

Anxiety Relief Protocol Orders

Anxiety definition: anxiety is such that it is preventing the patient from going into or staying in the MRI.

Protocol 1

[ ] Ativan 1mg IV once

[ ] May repeat Ativan 1 mg IV once after 20 minutes if first dose not effective. Maximum 2 doses total.

OR

Protocol 2

[ ] Versed 2 mg IV once

LIP Signature: ***Date:*** ***Time:***

Pharmacist Signature: ***Date:*** ***Time:***

Tech/RN Signature: ***Date:*** ***Time:***

Sedation Protocol Orders

Anxiety is such that they will not or cannot tolerate lying in the MRI for any prolonged period of time to complete MRI

[ ] IV Sedation – as per CRNA (anesthesia type discussed).

IV sedation can only be administered by anesthesia providers.

LIP Signature: ***Date:*** ***Time:***

Tech/RN Signature: ***Date:*** ***Time:***

Medication Administration Record

ALLERGIES:

[ ] Verified Responsible Driver Available

Pre-Vitals: BP:_____/_____ HR:_____ RR:_____ O_2 Sat:_____ on RA

Medication	dose	Route	Freq		Date	Time	Initials
Ativan	1 mg	IV	once				
Ativan *May give 20 min after 1st dose if not effective*	1 mg	IV	once				
Versed	2 mg	IV	once				

Tech/RN Signature: _____

Post MRI Vitals: BP:_____/_____ HR:_____ RR:_____ O_2 Sat:_____ on RA

Call for: BP greater than 190/95 or less than 90/50; HR greater than 130,less than 50; RR greater than 22,or less than 8; O_2Sat less 93% RA

OMISH HOSPITAL AND CLINICS

Out-Patient MRI Anxiety-Relief Orders

MRI
CONTRAINDICATIONS

- MRI CANNOT be performed if screening reveals:
  - An active electronic device in the body
  - Cerebral aneurysm clip
  - Metal fragments in the eyes
  - Ferromagnetic foreign bodies
  - Any unfamiliar device
- However, some metallic implants may be safe during an MRI. Qualified Staff will screen and verify if it is safe to perform MRI.

MRI
ACCESS SCREENING

MRI

MRI COMPATIBLE EQUIPMENT

- Only equipment and devices that have been approved for MRI use are allowed in zone IV..
  - Some examples are: fire extinguishers, wheelchairs, oxygen tanks, medical monitor devices, stethoscopes

NEVER RESUSCITATE A PATIENT OR RUN A CARDIAC ARREST CODE IN ZONE IV OF THE MRI SUITE.