Radiation Safety In-service:

For

Healthcare Workers

FLUOROSCOPY

Presented by:

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Radiation Units of Measurement:

- **Roentgen**: (R) Unit of radiation exposure in air
- **Rad**: Energy absorbed per gram of material/tissue
- **Rem**: Biological effect of a rad

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Radiation Units

- Conceptually, the 3 units of radiation described previously are entirely different.
- However, for the energy ranges used in Diagnostic Radiology, they are approximately equal.
  1R ~= 1 Rad ~=1Rem
- The standard unit of radiation protection is usually millirems (mrem).

1 mrem	=	1/1000 of a Rem
1 Rem	=	1000 mrem

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Background Radiation

- Definition: Relatively constant low-level radiation from environmental sources such as the earth (or building materials), cosmic rays, and naturally occurring radionuclide found in the body.
- Level of background radiation will vary depending upon location, altitude and the amount of natural radioactive material in the ground.
- Highest known background levels recorded in mountains of South America - 1000 millirem (1 Rem).

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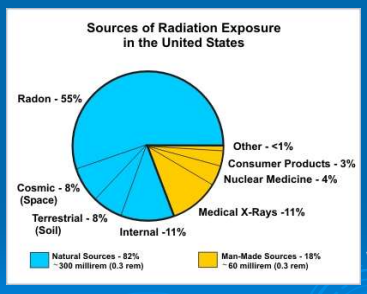
Background Radiation



www.nrc.gov

Approximate natural background ~360mrem/year

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Background Radiation

- No known proven carcinogenic effects from radiation levels in the order of magnitude comparable to background radiation.
- Typically, exposures received from diagnostic procedures fall well within background levels.

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Typical Background Radiation Levels

- New York City ~ 300 mRem/year
- Denver ~ 500 mRem/year
- Grand Central Station > 500 mRem/year
- Andes Mountains ~ 1000 mRem/year or 1 Rem/year
- One banana ~ 0.1 mRem
- Flight from LA to London ~ 5 mRem

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Personnel Monitoring

- Procedure instituted to estimate the amount of radiation received by individuals who work around radiation. It simply measures the amount of radiation to which one was exposed.
- The monitor offers no protection against radiation exposure.

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Personnel Monitoring

- Required when there is a likelihood that an individual will receive more than 1/10th the yearly occupational dose limit (i.e. whole body limit: 1/10th of 5000mRem = 500 mRem).
- Therefore, it is usually not necessary to monitor radiology secretaries, file clerks and operating room personnel.
- Monitors are typically worn on the collar and positioned outside the protective apron during fluoroscopic procedures.
- Pregnant workers are to wear the badge at waist level to monitor fetal exposure.

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Personnel Monitoring - Fluoroscopy

- For individuals consistently working areas of high fluoroscopic exposure (i.e. cardiac cath, EP, Interventional), the institution has the option to monitor their occupational exposure using alternative calculation methods that will drastically reduce the individuals effective dose equivalent (EDE).
- These calculations take into account the use of protective devices such as lead aprons.
- This allows a physician to continue working throughout the year while staying well below annual occupational dose limits.

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Occupational Dose Limits

- Whole Body 5000 mrem/yr
- Lens of Eye 15,000mrem/yr
- Extremities 50,000 mrem/yr
- Fetus 500 mrem for entire gestational period (50 mrem/month)

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Typical Exposure Levels Encountered in Normal Occupational Situations:

- Nuclear Medicine Tech - < 500 mrem/year
- Radiologic Technologist - ≈ 100 mrem/year
- Portable Chest X-Ray - ≈ 0.02 mR @ 1 meter exposure
- Portable abdomen - ≈ 0.5 mR@ 1 meter exposure
- Conventional fluoro - ≈ 2 mR/min @1meter
- Special Procedure - ≈ 10 mR/min @ 1meter

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Known Biological Effects of Radiation at High Doses

Eye cataracts	200 Rad (200,000mRad)
Thyroid cancer	200 Rad
Breast cancer	100 Rad
Sterility	500 Rad
Skin Erythema	200 Rad
Leukemia	100 Rad whole body radiation
Birth defects in human fetus	10 Rad in first trimester

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General Precautions for Occupational Workers

- The three cardinal rules for radiation safety are:
  - Time
  - Distance
  - Shielding

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Time

- Work as fast as possible while x-rays are on.
- In the case of physicians using fluoroscopy, short, quick exposures will drastically reduce exposures to everyone in room, including the patient.
- A pulsed fluoroscopy setting can be a strong tool in reducing exposure.

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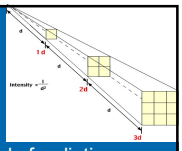
Distance



- Distance offers great protection for any kind of radiation.
- Radiation exposure follows the inverse square law: Move twice as far, the radiation is reduced by a factor of 4.
- Stand next to the source of radiation (the patient in fluoroscopy) as little as possible.
- Standing six feet away from an exam table will significantly reduce your radiation exposure.

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Shielding

- Always stand behind a protective barrier or wear a lead apron when performing x-ray procedures.
- Lead aprons typically attenuate >95% of scattered X-ray radiation.
- Individuals consistently working in areas of high fluoroscopic use should utilize protective eyewear to reduce exposure to the lens of the eye.

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General Fluoroscopy Guidelines

- Physicians and Technologists should only radiate when necessary and for as short a time as possible (i.e. using pulsed fluoroscopy)
- Use automatic dose rate control.
- Collimate as much as possible.
- Stand as far away as possible from the scatter radiation source, the anatomy being imaged.
- Scatter on the X-ray tube side of the patient is much greater than on the II side of the patient.
- Wear aprons and other protective clothing as appropriate.
- The x-ray tube to skin distance should be kept as large as possible to reduce absorbed dose to the patient. This is accomplished by keeping the image intensifier as close to the patient as possible.
- Only necessary personnel are to be in room during procedure.
- Remove all supplementary objects from the primary beam (this includes user hands).
- Place the x-ray source under table for added user safety.

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Radiation Safety Officer

- Any institution that uses radiation for diagnostic and/or therapeutic purposes must name a Radiation Safety Officer (R.S.O.).
- This individual is responsible for the day to day safe use of radiation at the institution.
- All unsafe conditions must be reported to the R.S.O.

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