Radiation Safety In-service:

For

Healthcare Workers

FLUOROSCOPY

Presented by:

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General Information about Radiation

- Often depicted by books, movies and news media as mysterious, deadly force.
- In truth:
  - Nothing mysterious at all
  - Radiation has been studied for over 100 years
  - Detection, measurement and radiation control are extremely common events
  - The more the public understands, the less frightening it becomes
  - A very beneficial diagnostic tool

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

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).

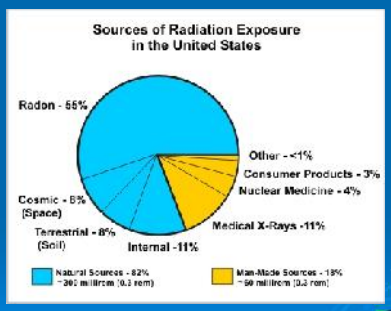
  1 mrem = 1/1000 of a Rem

  1 Rem = 1000 mrem

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).

Background Radiation



www.nrc.gov

Approximate natural background ~360mrem/year

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.

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

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.

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.

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.

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)

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

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

Exposure from Nuclear Medicine Patients

- Patients injected with radiopharmaceuticals emit relatively small amounts of radiation.
- The activity for diagnostic procedures is extremely low and poses no real danger.
- The table on the next slide will demonstrate that exposure to anyone in the proximity of a patient injected with a radiopharmaceutical is quite minimal in most cases.

Common Nuclear Medicine Procedures

Procedure	Agent	Dose (mCi)	Exposure @ patient skin (mR/hr)	mR/hr @ 1 meter	Half life
Bone	Tc-MDP	25	9.6	0.9	6 hrs
Liver / spleen	Tc-Sc	5	5.9	0.3	6 hrs
GI Bleed	Tc-04	10	7.2	1.2	6 hrs
Renal	Tc-DTPA	15	5.9	0.7	6 hrs
Lung	Tc-MAA	4	5.2	0.4	6 hrs
Myocardial MUGA	Tc-PYP	25	19.8	1.4	6 hrs
Myocardial	Tl-Cl	3	1.3	0.1	73 hrs

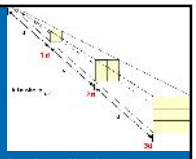
General Precautions for Occupational Workers

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

Time

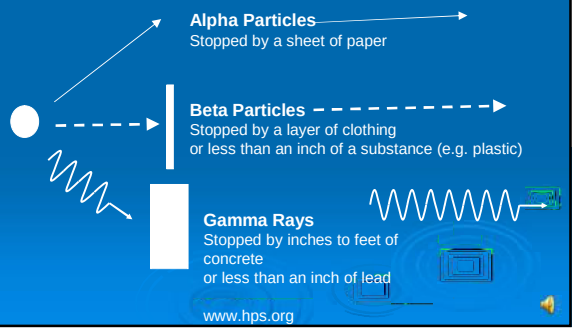
- Work as fast as possible while x-rays are on.
- In the case of physicians using fluoroscopy, short, quick exposures will drastically reduce exposures to everyone in room, including the patient.
- A pulsed fluoroscopy setting can be a strong tool in reducing exposure.

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.

Shielding



www.hps.org

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.

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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General Nuclear Medicine Guidelines

- Only physicians listed on the license may order and interpret Nuclear Medicine exams.
- Radioactive material should be used in designated areas.
- No eating/drinking in radioactive material areas.
- Lab coats, syringe shields and gloves must be utilized when handling radioactive material.
- Survey and wipe test areas for potential contamination. Restricted Area Action Levels: 1mR/hr & 1000dpm per 100cm^2.
- Unsafe conditions must be reported to the Radiation Safety Officer.

General Environmental Services Guidelines

- Clean in authorized areas only
- Do not enter hot lab unless authorized to do so or under direct supervision
- Do not empty containers with radioactive label
- Conventional cleaning solvents are appropriate
- Mounted waste monitors
  - Designed to detect small quantities of radioactive material in waste/linen
  - Must walk slowly through detectors – 6 seconds is ideal
  - When alarm is sounded, store waste in designated area

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.