Nuclear Medicine Radiation Safety

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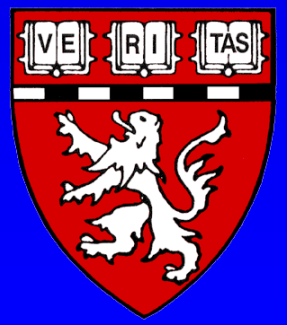
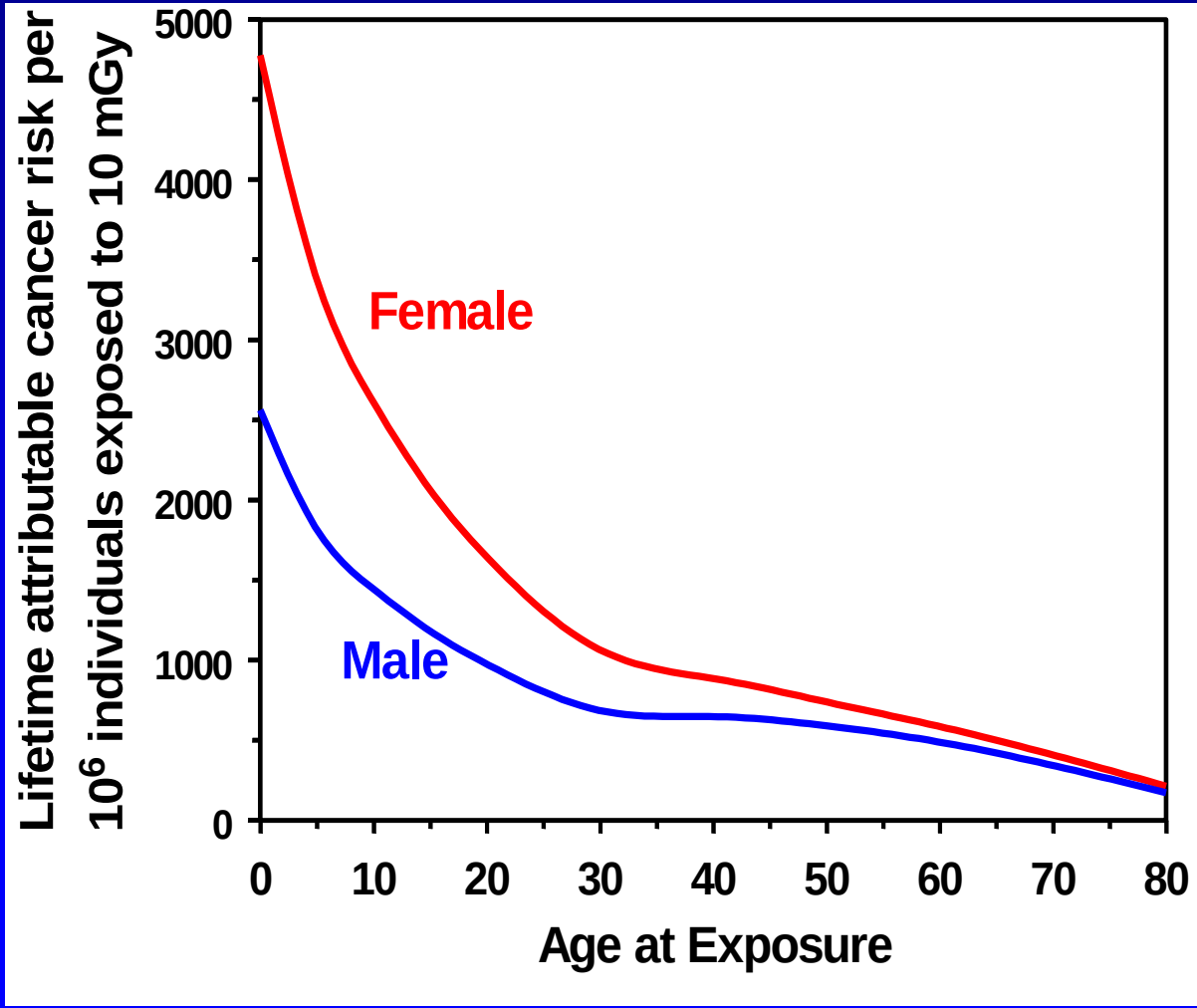


Thanks to
Rusty Lorenzen, RSO at CHB,
Beth Harkness, Henry Ford Hospital

Radiation Health Effects

- Stochastic Effects
  - Carcinogenesis
  - Mutations
  - Teratogenesis
- Deterministic Effects
  - Erythema
  - Cataracts

Lifetime Attributable Risk
10 mGy in 1,000,000 exposed persons
(Based on BEIR VII Phase 2, 2006)



Regulations

- NRC vs Agreement State
- Federal Regulations
  - 10 CFR 20 (Standards for Radiation Protection
  - 10 CFR 35 (Medical Use of By-Product Material)

http://www.nrc.gov/reading-rm/doc-collections/cfr

NRC NUREG Guides

- NUREG 1516 (Management of Radioactive Material Safety Programs at Medical Facilities)
- NUREG 1556, Vol. 9, rev. 2 (Consolidated Guidance about Materials Licenses: Program specific guidance about medical use licenses)

http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/

Annual Dose Limits

- Whole body (external + internal) : 50 mSv (5 rem)
- Lens of eye: 150 mSv (15 rem)
- Skin & extremities: 500 mSv (50 rem)
- Individual Organs: 500 mSv (50 rem)
- Fetus*: 5 mSv (0.5 rem)
- General Public: 1 mSv (0.1 rem)

*For a declared pregnant worker

^{131}I Release Criteria (10 CFR 35.75)

§ 35.75 Release of individuals containing unsealed byproduct material or implants containing byproduct material.

(a) A licensee may authorize the release from its control of any individual who has been administered unsealed byproduct material or implants containing byproduct material if the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 5 mSv (0.5 rem).[1]

(b) A licensee shall provide the released individual, or the individual's parent or guardian, with instructions, including written instructions, on actions recommended to maintain doses to other individuals as low as is reasonably achievable if the total effective dose equivalent to any other individual is likely to exceed 1 mSv (0.1 rem).

[1] The current revision of NUREG–1556, Vol. 9, describes methods for calculating doses to other individuals and contains tables of activities not likely to cause doses exceeding 5 mSv (0.5 rem).

Setting Up Your NM Lab

- Hot Lab
- Imaging Lab
- Other Rooms
- Posting

Hot Lab

- Place were radioactivity is stored and patient doses are prepared
  - Locking Door (Combination Lock)
  - L Block
  - Dose Calibrator
  - Well Counter
  - Survey Meter
  - Calibration Sources
  - Shielded Sharps Container

Hot Lab

Dose Calibrator

- Cylindrical ion chamber running in current mode with the current calibrated to activity (mCi or MBq)
- Used to assay patient administered activities
- Quality control according to national standards or manufacturer's specifications

Dose Calibrator QC

- Geometry
- Accuracy
- Linearity
- Constancy

Geometry Calibration:

- Tests the geometry dependence of the Dose Calibrator.
- Common syringes and vials are tested at various heights in the chamber.
- Done at installation of the Dose Calibrator and whenever the unit is moved.
- Correction needed if outside 10%

Accuracy Calibration:

- Used to test the accuracy of responses to given settings for different nuclides.
- Must use at least two different NIST traceable calibration sources with activity greater than 50 uCi and different nuclides.
- Done at installation and every 12 months thereafter.
- Cannot use if outside 10%

Linearity Calibration:

- Tests the response of the Dose Calibrator and different activities.
- Several points must be tested from 10 uCi up to the highest dose to be assayed.
- Cannot assay doses above the highest tested with the Linearity.
- Done at installation and every 3 months thereafter.
- Correction needed if > 10% variation

Constancy Calibration:

- Tests the relative response of the Dose Calibrator to a dedicated check source.
- Usually done for several settings.
- Done at the beginning of each day of use.
- Response of the Dose Calibrator is compared to historical behavior of the unit.
- Cannot use if outside 10%

Well Counter

- Sodium Iodide cylindrical counter for assaying nCi levels
- Use to evaluate wipe tests from
  - Radioactive packages
  - Weekly surveys
  - Sealed sources
- QC not regulated
  - Energy calibration
  - Sensitivity (MDA)
  - Chi Square

Dose Calibrator vs Well Counter

- Dose Calibrator
  - Gas filled ionization chamber
  - Current Mode
  - 10 μCi – 1 Ci
  - Used to assay activity in vials and syringes
- Well Counter
  - Solid scintillating crystal
  - Pulse mode
  - Less than 0.5 μCi
  - Used for wipe tests and biological samples

Dose Calibrator vs Well Counter

Dose Calibrator

Well Counter

Geiger Müller Survey Meter

- Gas filled detector
- Sensitive to small levels of contamination
- Used for
  - Package surveys
  - Daily area surveys
  - Hands and clothes
- Calibrated Annually

Ion Chamber Survey Meter

- Gas detector operating in current mode
- Measures exposure rate in mR/hr or air KERMA in μGy/hr
- Used to monitor exposure rate in work areas or the from a I-131 patient prior to release

Calibration Sources

- Dose Calibrator (2 sources available for accuracy)
  - ^{57}Co (5 mCi, $T_{1/2}$ = 270 d)
  - ^{137}Cs (0.2 mCi, $T_{1/2}$ = 30 y)
- Well Counter
  - ^{137}Cs (0.2 μCi)
- Survey Meter
  - ^{137}Cs, below allowable limit

Calibration Sources

- Inventory – semi-annually
- Wipe test for removable activity
  - Semi-annually
  - Less than $5x10^{-3}$ μCi

Container for Radioactive Sharps

- Need to store sharps until no longer radioactive
- Measure with a survey meter and assure not above background (>10 $T_{1/2}$s)
- Remove or obliterate any radioactive symbols
- Discard in regular trash

Hot Lab

Imaging Room

- Gamma camera
- Computer
- Quality Control Program

Other Rooms

- Injection Room
- Stress Lab
- Reception and waiting area

Posting

- Caution, Radioactive Materials
- Radiation Area
- NRC Notice to Employees
- Emergency Phone Numbers of RSO
- Spill instructions

Caution, Radioactive Materials

- Posted if amounts of radioactivity used or stored are more than 10 times amount listed in Appendix C of 10 CFR 20

  - ^{99m}Tc - 10 mCi
  - ^{123}I - 1 mCi
  - ^{131}I - 10 μCi
  - ^{67}Ga - 10 mCi
  - ^{137}Cs - 100 μCi
  - ^{57}Co - 1 mCi
  - ^{111}In - 1 mCi
  - ^{201}Tl - 10 mCi

Probably a good idea to post all areas where radioactivity is stored or handled, i.e. hot lab, imaging room, injection room, stress room.

Radiation Area

- An area where an individual could receive more than 5 mrem in 1 hr at 30 cm (10CFR 20)
- Area need not be posted if exposure is from a patient
- Consider posting hot lab and perhaps imaging room when imaging a phantom leading to more than 5 mrem per hour

NRC FORM 3
(10-2008)

UNITED STATES NUCLEAR REGULATORY COMMISSION
Washington, DC 20555-0001

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION (PART 20); NOTICES, INSTRUCTIONS AND REPORTS TO WORKERS; INSPECTIONS (PART 19); EMPLOYEE PROTECTION

WHAT IS THE NUCLEAR REGULATORY COMMISSION?

The Nuclear Regulatory Commission is an independent Federal regulatory agency responsible for licensing and inspecting nuclear power plants and other commercial uses of radioactive materials.

WHAT DOES THE NRC DO?

The NRC's primary responsibility is to ensure that workers and the public are protected from unnecessary or excessive exposure to radiation and that nuclear facilities, including power plants, are constructed to high quality standards and operated in a safe and secure manner. The NRC does this by establishing requirements in Title 10 of the Code of Federal Regulations (10 CFR) and in licenses issued to nuclear users.

WHAT RESPONSIBILITY DOES MY EMPLOYER HAVE?

Any company that conducts activities licensed by the NRC must comply with the NRC's requirements. If a company violates NRC requirements, it can be fined or have its license modified, suspended or revoked.

Your employer must tell you which NRC radiation requirements apply to your work and must post NRC Notices of Violation involving radiological working conditions.

WHAT IS MY RESPONSIBILITY?

For your own protection and the protection of your co-workers, you should know how NRC requirements relate to your work and should follow them. If you observe violations of the requirements or have a safety concern, you should report them.

WHAT IF I CAUSE A VIOLATION?

If you engaged in deliberate misconduct that may cause a violation of the NRC requirements, or would have caused a violation if it had not been detected, or deliberately provided inaccurate or incomplete information to either the NRC or to your employer, you may be subject to enforcement action. If you report such a violation, the NRC will consider the circumstances surrounding your reporting in determining the appropriate enforcement action, if any.

HOW DO I REPORT VIOLATIONS AND SAFETY CONCERNS?

If you believe that violations of NRC rules or the terms of the license have occurred, or if you have a safety concern, you should report them immediately to your supervisor. You may report violations or safety concerns directly to the NRC. However, the NRC encourages you to raise your concerns with the licensee since the licensee has the primary responsibility for, and is most able to ensure, safe operation of nuclear facilities. If you choose to report your concern directly to the NRC, you may report it to an NRC inspector or call or write to the NRC Regional Office serving your area. If you send your concern in writing, it will assist the NRC in protecting your identity if you clearly state in the beginning of your letter that you have a safety concern. The NRC's toll-free SAFETY HOTLINE for reporting safety concerns is listed below. The addresses for the NRC Regional Offices and the toll-free telephone numbers are also listed below. You can also e-mail safety concerns to NRC.Allegation@nrc.gov.

WHAT IF I WORK WITH RADIOACTIVE MATERIAL OR IN THE VICINITY OF A RADIOACTIVE SOURCE?

If you work with radioactive materials or near a radiation source, the amount of radiation exposure that you are permitted to receive may be limited by NRC regulations. The limits on exposure for workers at NRC licensed facilities whose duties involve exposure to radiation are contained in sections 20.1201, 20.1207, and 20.1208 of Title 10 of the Code of Federal Regulations (10 CFR 20) depending on the part of the regulations to which your employer is subject. While these are the maximum allowable limits, your employer should also keep your radiation exposure as far below those limits as is "reasonably achievable."

MAY I GET A RECORD OF MY RADIATION EXPOSURE?

Yes. Your employer is required to make available to you the information in your dose records (as maintained under the provisions of 10 CFR 20.2106). In addition your employer is required to provide you with an annual report of the dose you received in that monitoring year if the dose exceeds 100 millirem, or if you request an annual report.

HOW ARE VIOLATIONS OF NRC REQUIREMENTS IDENTIFIED?

NRC conducts regular inspections at licensed facilities to assure compliance with NRC requirements. In addition, your employer and site contractors may conduct their own inspections to assure compliance. All inspectors are protected by Federal law. Interference with them may result in criminal prosecution for a Federal offense.

MAY I TALK WITH AN NRC INSPECTOR?

Yes. NRC inspectors want to talk to you if you are worried about radiation safety or have other safety concerns about licensed activities, such as the quality of construction or operations at your facility. Your employer may not prevent you from talking with an inspector. The NRC will make all reasonable efforts to protect your identity where appropriate and possible.

MAY I REQUEST AN INSPECTION?

Yes. If you believe that your employer has not corrected violations involving radiological working conditions, you may request an inspection. Your request should be addressed to the nearest NRC Regional Office and must describe the alleged violation in detail. It must be signed by you or your representative.

HOW DO I CONTACT THE NRC?

Talk to an NRC inspector on-site or call or write to the nearest NRC Regional Office in your geographical area (see map below). If you call the NRC's toll-free SAFETY HOTLINE during normal business hours, your call will automatically be directed to the NRC Regional Office for your geographical area. If you call after normal business hours, your call will be directed to the NRC's Headquarters Operations Center, which is manned 24 hours a day. You can also e-mail safety concerns to NRC.Allegation@nrc.gov.

CAN I BE FIRED FOR RAISING A SAFETY CONCERN?

Federal law prohibits an employer from firing or otherwise discriminating against you for bringing safety concerns to the attention of your employer or the NRC. You may not be fired or discriminated against because you engage in certain protected activities, including but not limited to,

- asking the NRC to enforce its rules against your employer;
- refusing to engage in activities which violate NRC requirements;
- providing information or preparing to provide information to the NRC or your employer about violations of requirements or safety concerns; or
- asking for, or testifying, helping, or taking part in an NRC, Congressional, or any Federal or State proceeding.

WHAT FORMS OF DISCRIMINATION ARE PROHIBITED?

It is unlawful for an employer to fire you or discriminate against you with respect to pay, benefits, or working conditions because you help the NRC or raise a safety issue or otherwise engage in protected activities. Violations of Section 211 of the Energy Reorganization Act (ERA) of 1974 (42 U.S.C. 5851) include actions such as harassment, blacklisting, and intimidation by employers of (i) employees who bring safety concerns directly to their employers or to the NRC; (ii) employees who have refused to engage in an unlawful practice, provided that the employee has identified the illegality to the employer; (iii) employees who have testified or are about to testify before Congress or in any Federal or State proceeding regarding any provision (or proposed provision) of the ERA or the Atomic Energy Act (AEA) of 1954; or (iv) employees who have commenced or caused to be commenced a proceeding for the administration or enforcement of any requirement imposed under the ERA or AEA or who have, or are about to, testify, assist, or participate in such a proceeding.

HOW DO I FILE A DISCRIMINATION COMPLAINT?

If you believe that you have been discriminated against for bringing violations or safety concerns to the NRC or your employer, you may file a complaint with the NRC, the U.S. Department of Labor (DOL), or appropriate state entities. If you desire a personal remedy, a complaint may be filed with the DOL pursuant to Section 211 of the ERA or with appropriate state entities. Your complaint to the DOL must describe in detail the basis for your belief that the employer discriminated against you on the basis of your protected activity, and it must be filed in writing either in person or by mail within 180 days of the date of the alleged discriminatory action or the date you received any notice, in writing or otherwise, of an adverse personnel action, whichever occured first. Additional information is available at the DOL web site at www.osha.gov. Filing an allegation, complaint, or request for action with the NRC does not extend the requirement to file a complaint with the DOL within 180 days. To do so, you may contact the Allegation Coordinator in the appropriate NRC Region, as listed below, who will provide you with the address and telephone number of the correct OSHA Regional office to receive your complaint. You may also check your local telephone directory under the U.S. Government listings for the address and telephone number of the appropriate OSHA Regional office.

WHAT CAN THE DEPARTMENT OF LABOR DO?

If your complaint involves a violation of Section 211 of the ERA by your employer, the DOL provides a process for obtaining a personal remedy. The DOL will notify your employer that a complaint has been filed and will investigate your complaint.

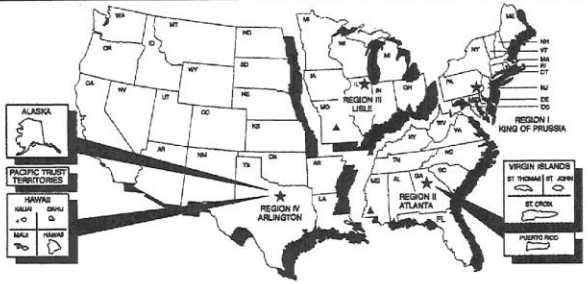
If the DOL finds that your employer has unlawfully discriminated against you, it may order that you be reinstated, receive back pay, or be compensated for any injury suffered as a result of the discrimination and be paid attorney's fees and costs.

Relief will not be awarded to employees who engage in deliberate violations of the Energy Reorganization Act or the Atomic Energy Act.

WHAT WILL THE NRC DO?

The NRC will evaluate each allegation of harassment, intimidation, or discrimination to determine whether sufficient information exists to initiate an investigation. Following this evaluation, an investigator from the NRC's Office of Investigations may interview you and review available documentation. Based on the evaluation, and, if applicable, the interview, the NRC will assign a priority and a decision will be made whether to pursue the matter further through an investigation. The assigned priority is based on the specifics of the case. The NRC may not pursue an investigation of low priority cases to the point that a conclusion can be made whether the harassment, intimidation, or discrimination actually occurred. Even if NRC decides not to pursue an investigation, if you have filed a complaint with the DOL, the NRC will monitor the results of the DOL investigation.

If the NRC or the DOL finds that unlawful discrimination has occurred, the NRC may issue a Notice of Violation to your employer, impose a fine, or suspend, modify, or revoke your employer's NRC license.



▲ - Callaway Plant Site in Missouri and Grand Gulf Plant Site in Mississippi are under the purview of Region IV. The Portsmouth Gaseous Diffusion Plant in Ohio is under the purview of Region II.

UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICE LOCATIONS

A representative of the Nuclear Regulatory Commission can be contacted by employees who wish to register complaints or concerns about radiological working conditions or other matters regarding compliance with Commission rules and regulations at the following addresses and telephone numbers.

REGIONAL OFFICES

REGION	ADDRESS	TELEPHONE
I	U.S. Nuclear Regulatory Commission, Region I 475 Allendale Road King of Prussia, PA 19406-1415	(800) 432-1156
II	U.S. Nuclear Regulatory Commission, Region II Sam Nunn Atlanta Federal Center 61 Forsyth Street, S.W., Suite 23T85 Atlanta, GA 30303-8931	(800) 577-8510
III	U.S. Nuclear Regulatory Commission, Region III 2443 Warrenville Road, Suite 210 Lisle, IL 60532-4352	(800) 522-3025
IV	U.S. Nuclear Regulatory Commission, Region IV 612 East Lamar Blvd., Suite 400 Arlington, TX 76011-4125	(800) 952-9677

To report safety concerns or violations of NRC requirements by your employer,

telephone:

NRC SAFETY HOTLINE

1-800-695-7403

To report incidents involving fraud, waste, or abuse by an NRC employee or NRC contractor,

telephone:

OFFICE OF THE INSPECTOR GENERAL HOTLINE

1-800-233-3497

Accepting Packages of Radioactive Materials

- Note DOT labeling
  - White I (0.5 mR/hr at surface, 0 mR/hr at 1 m)
  - Yellow II (50 mR/hr at surface, 1 mR/hr at 1 m)
  - Yellow III (200 mR/hr at surface, 10 mR/hr at 1 m)
- Monitor with survey meter
  - 200 mR/hr at surface, 10 mR/hr at 1 m
- Wipe test for removable activity
  - 2200 dpm (10^{-3} μCi) over 100 cm^2

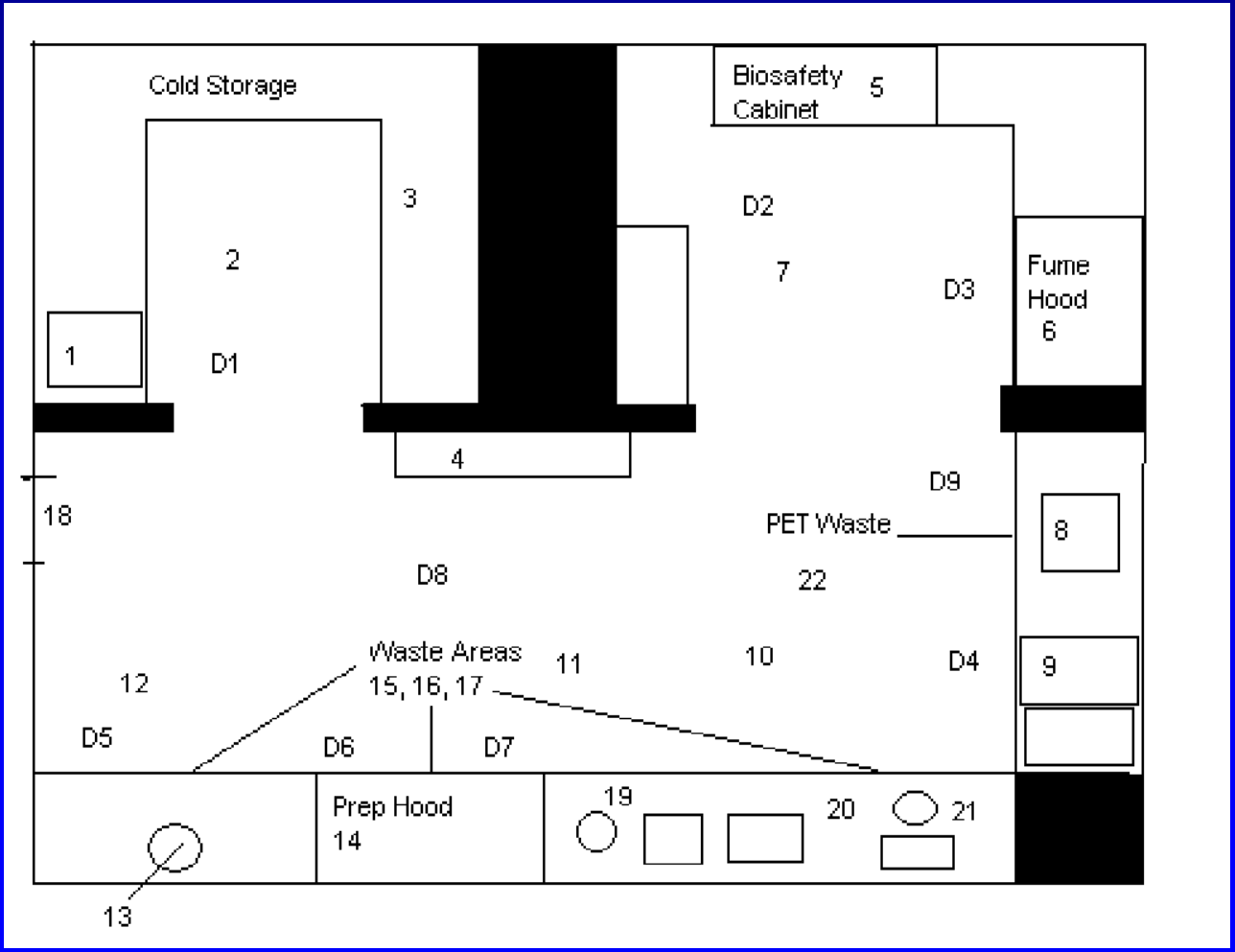
Administering Radioactivity

- From a multi-dose vial or unit dose syringe?
- If from multi-dose vial or activity in syringe is altered, need to assay dose in dose calibrator
- Patient Dose Log
  - Date
  - Patient's Name
  - Administered Activity
  - Technologist's initials

Workspace Radiation Control

- Daily surveys with a meter
- Weekly wipe surveys
- Spill instructions

Daily Surveys



Daily Surveys

- Measure background exposure on survey meter
- Record survey meter readings for each designated point on the room schematic
- Action level must be established
  - 0.1 mrem/hr in unrestricted areas
  - 5.0 mrem/hr in restricted areas

Daily Surveys

Weekly Wipe Surveys

- To evaluate the level of removable radioactivity
- Use filter paper to monitor surfaces where radioactivity has been handled.
- Survey 100 cm^2 area with each wipe
- Action Levels must be established
  - 2200 dpm for $^{123}I/^{131}I$
  - 22000 dpm for ^{99m}Tc

Note: Some states may be eliminating the need for weekly wipes in NM

Spill Instructions

Minor Spills of Liquids and Solids

1. Notify persons in the area that a spill has occurred.

2. Prevent the spread of contamination by covering the spill with absorbent paper.

3. Wearing gloves and protective clothing such as a lab coat and booties, clean up the spill using absorbent paper. Carefully fold the absorbent paper with the clean side out and place in a "caution radioactive material" labeled bag for transfer to a radioactive waste container. Also put contaminated gloves and any other contaminated disposable material in the bag.

4. Survey the area with a low-range radiation detection survey instrument sufficiently sensitive to detect the radionuclide. Check for removable contamination to ensure contamination levels are below trigger levels. Check the area around the spill. Also check hands, clothing, and shoes for contamination.

5. Report the incident to the RSO.

Spill Instructions

Major Spills of Liquids and Solids

1. Clear the area. Notify all persons not involved in the spill to vacate the room.

2. Prevent the spread of contamination by covering the spill with "caution radioactive material" labeled absorbent paper, but do not attempt to clean it up. To prevent the spread of contamination, clearly indicate the boundaries of the spill and limit the movement of all personnel who may be contaminated.

3. Shield the source if possible. Do this only if it can be done without further contamination or a significant increase in radiation exposure.

4. Close the room and lock or otherwise secure the area to prevent entry.

5. Notify the RSO immediately.

6. Decontaminate personnel by removing contaminated clothing and flushing contaminated skin with lukewarm water, then washing with mild soap. If contamination remains, the RSO may consider inducing perspiration. Then wash the affected area again to remove any contamination that was released by the perspiration.

Spill Instructions

Table N.1 Relative Hazards of Common Radionuclides			
Radionuclide	**Millicurie**	**Radionuclide**	**Millicurie**
P-32	1	Tc-99m	100
Cr-51	100	In-111	10
Co-57	10	I-123	10
Co-58	10	I-125	1
Fe-59	1	I-131	1
Co-60	1	Sm-153	10
Ga-67	10	Yb-169	10
Se-75	1	Hg-197	10
Sr-85	10	Au-198	10
Sr-89	1	Tl-201	100

Spill Instructions

Spill Kit

Assemble a spill kit that may contain the following items:

- Disposable gloves and housekeeping gloves;
- Disposable lab coats;
- Disposable head coverings;
- Disposable shoe covers;
- Roll of absorbent paper with plastic backing;
- Masking tape;
- Plastic trash bags with twist ties;
- "Radioactive Material" labeling tape;
- Marking pen;
- Pre-strung "Radioactive Material" labeling tags;
- Contamination wipes;
- Instructions for "Emergency Procedures";
- Clipboard with copy of Radioactive Spill Report Form;

Personnel Radiation Safety

- Personnel dosimeters
- ALARA Levels
- Time - distance - shielding
- Good lab practices
- Pregnant worker

Personnel Dosimeters

- All personnel who may receive 10% of the maximum permissible dose (MPD) need to be monitored
- Ring badges needed for those who manually handle radioactivity

ALARA Levels

- “As Low As Reasonably Achievable”
- Need to set ALARA trigger levels
  - ALARA 1 (2.5% of MPD per quarter)
  - ALARA 2 (10% of MPD per quarter)

How do we reduce our exposure?

- Time
  - Minimize time near source
- Distance
  - Maximize distance from source
- Shielding
  - Use shielding when appropriate

Time

- Dry run
- Rotate staff
- Obtain and maintain IV
- Reduce time next to pt.
- Practice makes perfect
- Facility design

Exposure Rate Constants

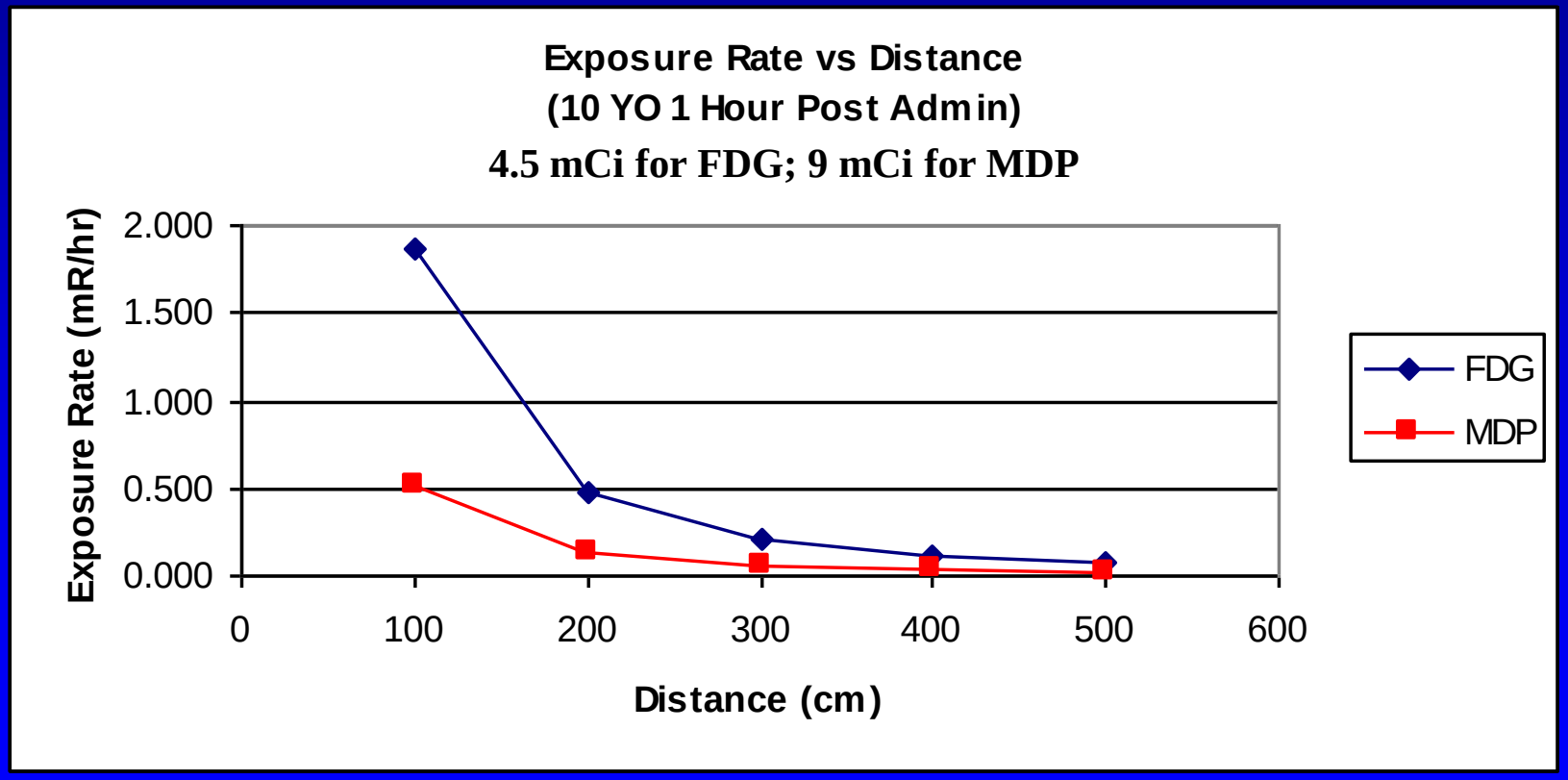
Radionuclide	ERC (R/hr/mCi at 1 cm)
Fluorine-18	6.0
Indium-111	3.4
Gallium-67	1.1
Technetium-99m	0.6
Thallium-201	0.4

Exposure Rates

Radionuclide	Admin. Act. (mCi)	Exp. Rate (mR/hr at 1 m)
Fluorine-18	12.0	4.0
Technetium-99m	30.0	0.6
Gallium-67	10.0	0.4
Indium-111	0.5	0.06
Thallium-201	4.0	0.05

Exposure Rate Constant $(R\text{-}cm^2)/(mCi\text{-}hr)$

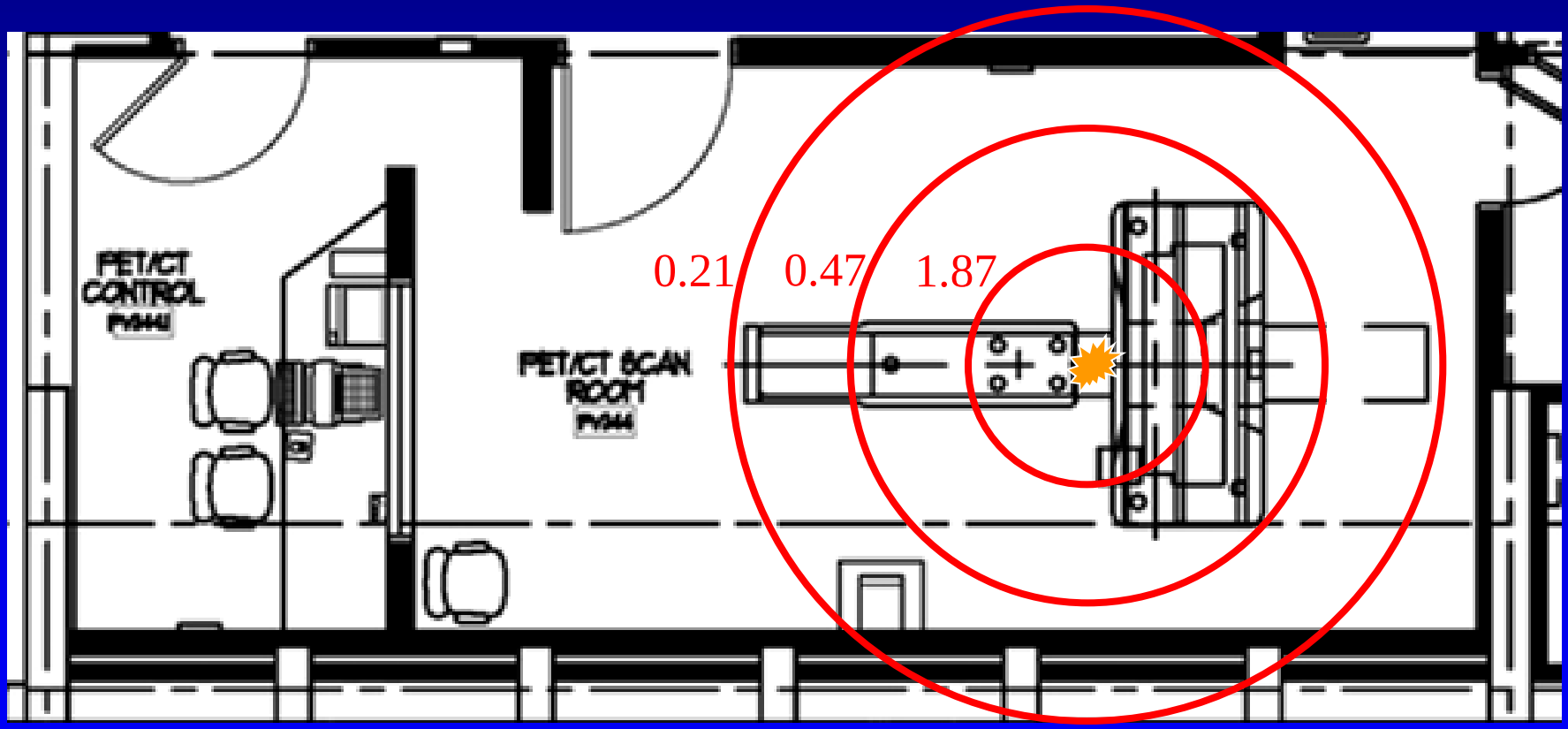
5.7 for ^{18}F and 0.60 for ^{99m}Tc



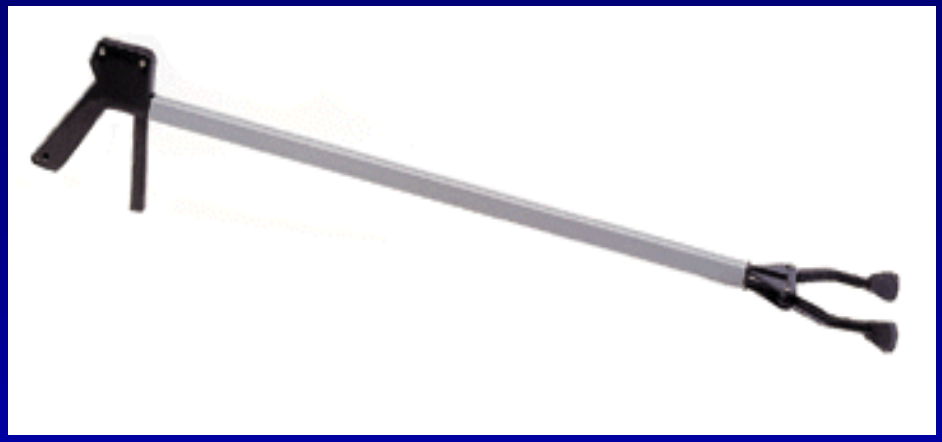
1 mR leads to ~ 1 mrem = 10 μSv (0.010 mSv)

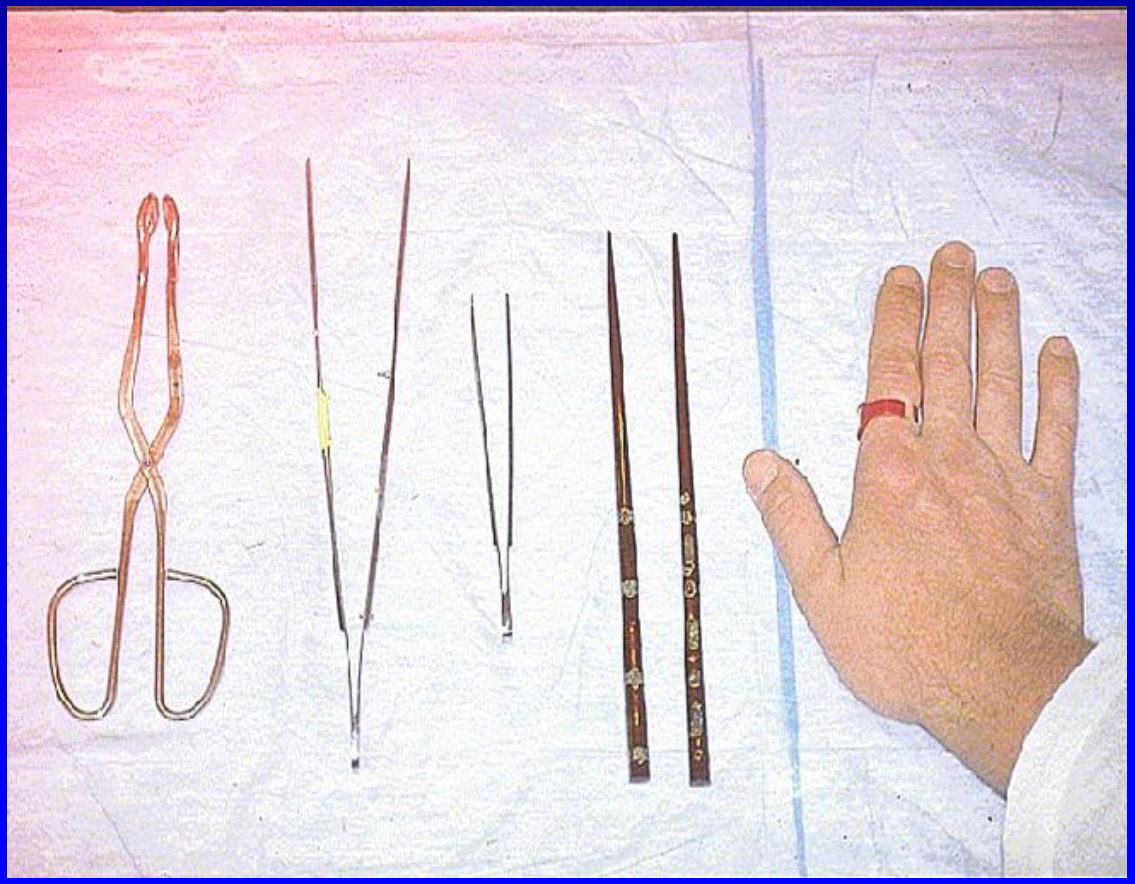
FDG PET

Exposure rates (mR/hr) 1 hr post injection of 4.5 mCi in 10 YO



Total exposure for uptake and scan at 1 m
0.77, 1.48, 2.46 mR, for 1, 5, 10 YO, respectively





Photon Energy & Shielding for Lead

Radionuclide	TVL (mm)
Fluorine-18	13.7
Gallium-67	4.7
Indium-111	2.2
Technetium-99m	0.9
Thallium-201	0.9

Shielding

Mobile Shields

Syringe Shields (Tungsten and Lead Glass)

Hot Lab

Shielding Doses

Good Lab Practices

APPENDIX T

Model Procedures for Safe Use of Unsealed Licensed Material

This model provides acceptable procedures for safe use of unsealed licensed material. You may either adopt this model procedure or develop your own procedure. (Some of the health physics practices listed below may also apply to sealed sources.)

- Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used.
- Wear disposable gloves at all times while handling radioactive materials.
- Either after each procedure or before leaving the area, monitor your hands for contamination in a low-background area using an appropriate survey instrument.
- Use syringe shields for reconstitution of radiopharmaceutical kits and administration of radiopharmaceuticals to patients, except when their use is contraindicated (e.g., recessed veins, infants). In these and other exceptional cases, use other protective methods, such as remote delivery of the dose (e.g., use a butterfly needle.)
- Do not eat, store food, drink, smoke, or apply cosmetics in any area where licensed material is stored or used.

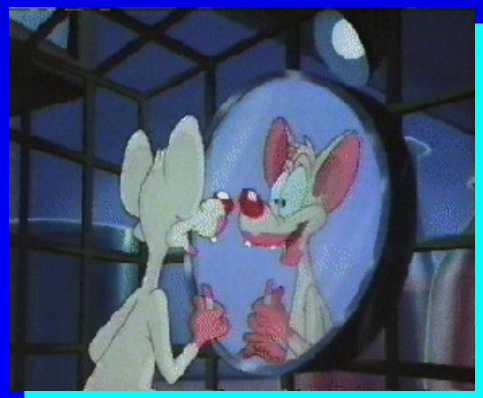
Good Lab Practices

- Wear personnel monitoring devices, if required, at all times while in areas where radioactive materials are used or stored. These devices shall be worn as prescribed by the RSO. When not being worn to monitor occupational exposures, personnel monitoring devices shall be stored in the work place in a designated low-background area.
- Wear extremity dosimeters, if required, when handling radioactive material.
- Dispose of radioactive waste only in designated, labeled, and properly shielded receptacles.
- Never pipette by mouth.
- Wipe-test unsealed byproduct material storage, preparation, and administration areas weekly for contamination. If necessary, decontaminate the area.
- Survey with a radiation detection survey meter all areas of licensed material use, including the generator storage, kit preparation, and injection areas daily for contamination. If necessary, decontaminate the area. Areas used to prepare and administer therapy quantities of radiopharmaceuticals must be surveyed daily in accordance with 10 CFR 35.70 (except when administering therapy dosages in patients' rooms when patients are confined).
- Store radioactive solutions in shielded containers that are clearly labeled.
- Radiopharmaceutical multi-dose diagnostic and therapy vials must be labeled in accordance with 10 CFR 35.69 and 10 CFR 20.1904.

Good Lab Practices

- Syringes and unit dosages must be labeled in accordance with 10 CFR 35.69 and 10 CFR 20.1904. Mark the label with the radionuclide, the activity, the date for which the activity is estimated, and the kind of materials (i.e., radiopharmaceutical). If the container is holding less than the quantities listed in Appendix C to Part 20, the syringe or vial need only be labeled to identify the radioactive drug (10 CFR 35.69). To avoid mistaking patient dosages, label the syringe with the type of study and the patient's name.
- For prepared dosages, assay each patient dosage in the dose calibrator (or instrument) before administering it (10 CFR 35.63).
- Do not use a dosage if it does not fall within the prescribed dosage range or if it varies more than ±20% from the prescribed dosage, except as approved by an authorized user.
- When measuring the dosage, you need not consider the radioactivity that adheres to the syringe wall or remains in the needle.
- Check the patient's name and identification number and the prescribed radionuclide, chemical form, and dosage before administering. If the prescribed dosage requires a written directive, the patient's identity must be verified and the administration must be in accordance with the written directive (10 CFR 35.41).
- Always keep flood sources, syringes, waste, and other radioactive material in shielded containers.
- Secure all licensed material when not under the constant surveillance and immediate control of an individual authorized under the NRC license (or such individual's designee).

Things ***NOT*** To Do in the Lab



- Don’t Drink
- Don’t Eat
- Don’t Smoke
- No cosmetics
- Don’t visit in the hot lab

Good Lab Practices

- Wear proper PPE
- Cover work surfaces
- Use correct pipetting technique
- Wash & check hands frequently

Dose Limit to Embryo/Fetus

- The NRC requires that the dose equivalent to an embryo/fetus of an occupational exposed declared pregnant woman not exceed 0.5 rem (5 mSv)

- Effort shall be made to keep the exposure at a uniform monthly rate. The NCRP recommends less than 0.05 rem per month).

Declared Pregnant Woman

- Means a woman who has voluntarily informed the licensee, in writing, of her pregnancy and the estimated date of conception
- A licensee is required to keep the dose to the embryo/fetus of a declared pregnant woman below 0.5 rem (5 mSv)

New from snmmi.org/dose!!

- snmmi.org/pedactivitytool
  - Provides recommended admin activity for children of different sizes
- snmmi.org/dosetool
  - Provides estimates of effective dose and critical organ dose. Also fetal dose for pregnant patients

Questions?