

**READING HOSPITAL SCHOOL OF HEALTH SCIENCES
MEDICAL IMAGING PROGRAM
RADIATION PROTECTION—2021**

LIMITS FOR EXPOSURE

I. Organizations for Radiation Protection

-Evaluates the relationship of dose and biologic effects

a. International Commission on Radiological Protection (ICRP)

1. International authority on the safe uses of ionizing radiation for the public and occupational

2. Established in 1928

3. Provides guidance for public and occupational dose limits

4. Only makes recommendations, does not enforce them

5. Has several subcommittees

b. National Council on Radiation Protection and Measurements (NCRP)

1. Nongovernmental, nonprofit

2. Started in 1964

3. Reviews recommendations from _____ and makes recommendations to the US

4. Not an enforcement agency- must be enforced through the state and federal agencies

c. United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

1. Started in 1955

2. Evaluates human and environmental exposures from a variety of sources

- _____
- _____
- _____

3. Assesses radiation induced cancer and genetic effects

- Mainly studies Japanese atomic bomb survivors

d. Biological Effects of Ionizing Radiation Committee (BEIR)

1. Formed by National Research Council

2. Organized by US National Academy of Sciences

3. Reviews biologic effects of radiation and risk assessments

4. Groups examined

- Early radiation workers
- Atomic bomb survivors
- Chernobyl
- Fukushima

e. Next step- based on recommendations, radiation exposure limits are set by congressional act or mandated by the state. National and state agencies enforce the standards.

II. US Regulatory Agencies

- Enforcers of protection standards for the general public, patients and personnel

a. Nuclear Regulatory Commission (NRC)

1. Formerly known as Atomic Energy Commission

2. Controls the possession use and production of atomic energy in the interest of national security

3. Can enforce radiation protection standards

4. Does not regulate or inspect x-ray facilities

5. Manufacturing of prostate seeds and thyroid seeds fall under their jurisdiction

6. Can have written contracts with state governments

7. Mainly oversees nuclear energy industry

b. Agreement State

1. States that agree to abide by NRC regulations through their state departments

2. Non-agreement states will have the NRC come into the facilities

3. States can have their own regulations above what the NRC has

4. What year did PA become an agreement state? _____

5. Nuclear reactors must be inspected by NRC

c. Environmental Protection Agency (EPA)

1. Started in 1970

2. Responsible for protecting the health of humans and safeguarding the environment

3. Oversees development and enforcement of regulations for radiation in the environment

4. Determines levels of _____

d. Food and Drug Administration (FDA)

1. Regulates design and manufacturing of electronic products like diagnostic x-ray equipment

2. Does onsite inspections for equipment, especially

- MQSA

3. Compliance ensures protection to the user and the patient from faulty equipment

4. Radiopharmaceuticals fall under FDA

5. CDRH- Centers for Devices and Radiologic Health

- Protects and promotes public health
- CFR 21:

e. Occupational Safety and Health Administration (OSHA)

1. Monitoring agency

2. Regulates occupational exposures

3. Right to know of employees examples:

f. State Agencies

1. Department of Environmental Protection (DEP)

- Bureau of Radiation Protection
 - Department of Health
 - a. Radiation and nuclear departments
 - b. Does onsite inspections
 - PA Patient Safety Authority
-

- Department of Transportation
 - a. Controls the transportation of radioactive material
 - i. _____
 - ii. _____
 - iii. _____

III. Radiation Safety Program

a. Requirements

1. Must have effective and detailed program

2. Begins with administration

- Delegate funds
- Oversee development of policies
- Provide equipment

b. Radiation Safety Committee (RSC)

1. Helps develop safety programs that are NRC mandated

2. Provides guidance and operations

3. PA state law: _____

c. Radiation Safety Officer (RSO)

1. Responsibilities

- Develop and oversee program
- Ensure everyone is protected
- Maintains radiation records and counsels after high readings
- Day to day supervision
- Identify problems and make corrections as needed
- Annual reviews information
- Who is RH's RSO? _____

2. Qualifications

- Usually a medical or health physicist, radiologist or individual deemed qualified
- Is approved by: _____

3. Authority

- Able to stop operations if needed
- Corrective actions taken
- Identify problems
- Has sufficient time to perform duties

IV. Acts/ Bills/ Reports

a. Radiation Control for Health & Safety Act of 1968

1. Also known as Public Law 90-602

2. Protect the public from unnecessary exposure from equipment like:

3. Restrict the equipment, not the user

b. Consumer Patient Radiation Health & Safety Act of 1981

1. Also known as Public Law 97-35

2. Sets guidelines requiring minimum standards for radiology programs and persons administering procedures and the certification of those people
3. Under the discretion of the Secretary of the Health and Human Services
4. Ensures safety of medical and dental procedures
5. There is no legal penalty for non-compliance

c. CARE Bill

1. Ensures accreditation of education program and licensure of persons performing x-ray and radiation therapy
2. Demonstrates competency by experience, education and examination
3. Stands for:

d. ALARA

1. Started in 1954
2. Adopted by NCRP
3. Accepted by regulatory agencies
4. Joint effort from technologist and physicians
5. ICRP refers to it as: _____
6. Linear, _____
7. Achieved by: _____

e. Effective Dose Limiting System (Efd)

1. Assesses exposure and risk of biologic damage to workers and the public
2. Can result bodily injury and genetic damage
3. Can be expressed in

- _____
- _____

- _____

f. NCRP Reports

1.NCRP Report #102

- 1989
- Recommendations on design, performance and use of equipment
- Guidelines for
 - a. Lead (Pb) equivalent for shields
 - b. Minimum filtration
 - c. Exposure rates

2.NCRP Report #116

- 1993
- Limitation of Exposure to Ionizing Radiation. Examples:
 - a. _____
 - b. _____
 - c. _____
 - d. _____
- Somatic and genetic effects kept to a minimum
- Goal of radiation protection
- Makes recommendations for risk-benefit analysis of radiation exposures

3.NCRP Report #160

- 2009
- 7X times more exposure to ionizing radiation since 1980's
- Provides a review of ionizing radiation exposure to the population of the US

4.NCRP Report #180

- 2018
- Management of exposure in US

- a. Prevent deterministic effects and reduce stochastic effects

V. Radiation Induced Responses

- a. Non-Stochastic (deterministic or sometimes called tissue response)

1. Cell killing effects
2. Does not occur below a threshold
3. Severity increase as dose increases
4. Usually higher than diagnostic x-ray
5. Examples

- Early (occurs within a few hours or days) examples:

- Late examples:

- b. Stochastic (probabilistic)

1. Mutational
2. No threshold
3. Chance of occurrence increases with each exposure, probability increases
4. Random effects
5. No dose is safe
6. Examples

- Cancer

- Genetic alterations

a. Teratogenesis radiation of the fetus _____

b. Mutagenesis radiation of reproductive cells before

c. Radiation induced malignancy

1.Chance increases with an increased _____ to the
_____ cells

2.Severity is not _____ related but chance increases as
_____ increases.

VI. Objective of Radiation Protection

a. Prevent _____ effects from happening by keeping doses
below threshold

b. Limit _____ effects to a conservative level as compared
to the benefit of the exposure

c. Radiation protection

1. _____ non threshold

- Chance of occurrence increases with each exposure and so does probability

2.ALARA

VII. Philosophy

a. Chance of biologic damage and amount of damage are directly proportional

b. Smallest dose has potential to cause harm

c. Radiation has _____ but also potential for

d. Must weigh the benefit of exposure against the risk

VIII. Organ Sensitivity Examples

- a. Critical organs
 1. Gonads
 2. Blood forming organs
 3. Lung
 4. Thyroid
- b. Medium sensitivity
 1. Osteoblast
 2. Fibroblast
- c. Low sensitivity
 1. Muscle cells
 2. Nerve cells

IX. Law of Bergonie and Tribondeau

- a. Definition:

X. NCRP Recommendations

- a. Occupational dose limits
 1. Effective dose _____
 2. Eye _____
 3. Localize area of skin _____
 4. ICRP has lowered the effective dose to _____ but it has not been adopted by the US
 5. Cumulative Effective Dose (CumEfD)
 - _____
 - Pertains to the whole body

- Also known as cumulative dose formula

6. Non- occupational dose limits

- Public exposed
 - a. Continuous exposed _____
 - b. Infrequent exposed _____
- These limits are set for people accompanying a patient to the department
 - a. spouse
 - b. parent
 - c. guardian
- Non radiology hospital workers exposed _____
- Patient dose limits _____

7. Embryo- Fetus limits

- Entire gestational period _____
- Not exceeding in any one month _____

8. Students under the age of 18

- _____

9. Additional Terms

- NIRL- negligible individual risk level

- NID- negligible individual dose

