

NMED-1604: NUCLEAR RADIOPHARMACY

Cuyahoga Community College

Viewing: NMED-1604 : Nuclear Radiopharmacy

Board of Trustees:

January 2024

Academic Term:

Fall 2024

Subject Code

NMED - Nuclear Medicine Technology

Course Number:

1604

Title:

Nuclear Radiopharmacy

Catalog Description:

Theory and practice of radiopharmacy including non-radioactive interventional drugs and contrast media. Addresses the routes of administration, bio-distribution mechanisms, interfering agents, contraindications, and adverse effects for all administered materials. Preparation and calculation of the dose to be administered, quality control, radiation safety, and applicable regulations are also covered.

Credit Hour(s):

2

Lecture Hour(s):

2

Requisites

Prerequisite and Corequisite

Departmental approval: admission to the program.

Outcomes

Course Outcome(s):

Explain the creation, preparation, storage, quality control, and administration of radiopharmaceuticals in accordance with state and federal regulations.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Demonstrate radiation emergency procedures in the event of a spill, including radioactive waste material storage and evacuation of personnel and patients.
 2. Identify and list the characteristics of the ideal radiopharmaceutical.
 3. Determine and calculate appropriate patient doses.
 4. Demonstrate proper compounding of radionuclide-labeled kits.
 5. Determine acceptable dose ranges and what to do if provided unacceptable data.
 6. Describe generator kinetics in the production of radionuclides.
 7. Demonstrate appropriate generator elution techniques.
 8. Describe quality control procedures, including radionuclide purity, radiochemical purity, and chemical impurities.
 9. Demonstrate proper storage of reconstituted and radionuclide labelled kits.
-

Course Outcome(s):

Explain the concepts of radionuclides and radiopharmaceuticals.

Objective(s):

1. Discuss the production and characteristics of positron emitters and positron-labeled radiopharmaceuticals.
2. Describe the basic concepts of radiochemistry.
3. Explain the normal and altered biodistribution properties of radiopharmaceuticals.
4. Describe the characteristics, proper use, and pharmacokinetics of radiopharmaceuticals and contrast media.
5. Describe the Food and Drug Administration and US Pharmacopeia control of radiopharmaceuticals.

Course Outcome(s):

Analyze patient information to determine adverse reactions, interfering drugs, and contraindications for administration of radiopharmaceuticals and contrast media.

Objective(s):

1. Describe protocols and drugs to respond to adverse reactions and proper administration techniques.
2. Describe what to do in the event of a contrast media reaction.
3. Identify drugs that may interfere with the administration of radiopharmaceuticals and contrast media.
4. Discuss precautions and contraindications for the use of radiopharmaceuticals and contrast media.

Methods of Evaluation:

1. Class participation
2. Worksheets
3. Quizzes
4. Midterm examination
5. Final examination

Course Content Outline:

1. Basics of radiation physics and radiochemistry
 - a. Atomic structure
 - b. Forces affecting the atom
 - c. Nomenclature
 - d. Chemical bonding
2. Radioactive decay
 - a. Methods of decay
 - b. Interactions of radiation with matter
 - c. Decay modes and schemes
3. Radiation detection instruments
 - a. Gas detectors
 - b. Scintillation detectors
 - c. Quality control techniques and performance
4. Methods of production
 - a. Reactors
 - b. Generator
 - i. Components and configuration
 - ii. Parent-daughter relationships
 - iii. Transient versus secular equilibrium
 - iv. Elution efficiency
 - v. Yield calculation
 - vi. Elution technique
 - vii. Wet versus dry
 - c. Moly-Tech
 - ix. Strontium-Rubidium
 - x. Quality control and problems affecting labeling yield
- c. Cyclotron

5. Radioactive Decay formula
 - a. Units of radioactivity
 - b. Physical half-life
 - c. Decay formula
 - d. Decay factors
 - e. Pre-calibration factors
6. Calculation of Patient Dose
 - a. Specific concentration
 - b. Dose-volume determination
 - c. Unit dose adjustment
 - d. Dilution of doses
 - e. Consideration for decay
 - f. Pediatric dose adjustments
7. Radiation Safety
 - a. Nuclear Regulatory Commission
 - b. As low as reasonably achievable (ALARA)
 - c. Nuclear pharmacy
 - d. Radioactive spills
 - e. Posting and trigger limits
8. Desirable characteristics of a radiopharmaceutical
 - a. Diagnostic versus therapeutic radionuclide
 - b. Desirable energy
 - c. Biologic and effective half-life
 - d. Target to non-target ratio
 - e. Availability and shelf life
 - f. Methods of localization
 - g. Limiting agents
 - h. Photon flux
 - i. ALARA
 - ii. Instrument limitations
9. Radiolabeling
 - a. Important factors of labeling
 - i. Stoichiometry
 - ii. Clearance time
 - iii. Stability/Compatibility
 - iv. Protein binding
 - v. Biodistribution
 - b. Clearance and uptake times
 - c. Plasma clearance
 - d. Organ/tissue uptake and retention
 - e. Organ clearance and redistribution
 - f. Excretion routes
 - g. Biological half-life
10. Design of a radiopharmaceutical
 - a. Investigational New Drug
 - b. Research and investigation
 - c. New drug application and approval
 - d. Food and Drug Administration
 - e. United States Pharmacopeia
11. Radiochemistry
 - a. Aqueous solutions
 - b. Reactivity
 - i. Valence state
 - ii. Oxidation
12. Kit Preparation
 - a. Oxidation/Reduction states
 - b. Quality Control
 - i. Radionuclide purity
 - ii. Radiochemical purity and thin-layer chromatography

1. Chemical purity
 2. Sterility and biological testing
 3. pH
 - iii. Particle size
 - iv. Visual appearance
 - v. Aseptic technique
13. Individual radiopharmaceuticals
- a. ^{99m}Techneium labeled
 - b. Iodine labeled
 - i. Special considerations for radioiodine
 - c. Indium labeled
 - d. Therapeutic radiopharmaceuticals
14. For each radiopharmaceutical on the Nuclear Medicine Technology Certification Board Pharmacy List (NMTCB) and the American Radiologic Registry Technology (ARRT) Nuclear Medicine radionuclide list, the following elements will be examined:
- a. Alternate names
 - b. Specific chemical and physical properties
 - c. Volatile gases
 - i. Storage requirements
 - ii. Room clearance times
 - iii. Negative pressure requirements and postings
 - d. Indications for use
 - e. Method of localization and biodistribution
 - f. Dose to critical organs
 - g. Adverse reactions and precautions
 - h. Contraindications and interfering agents
 - i. Route of administration and dose ranges
 - j. Method of preparation
 - k. Quality control consideration and limits
15. Record keeping
- a. Proper charting and documentation
 - b. Legal ramifications of improper charting and documentation
 - c. Ownership and release of medical information
 - d. Radiopharmacy Information System/Unit Dose Management Systems

Resources

Wells, Patricia. (2011) *Practical Mathematics in Nuclear Medicine*, Elsevier.

Waterstram-Rich & Gilmore. (2016) *Nuclear Medicine and PET/CT Technology and Techniques*, Elsevier.

Mettler. (2018) *Essentials of Nuclear Medicine Imaging*, Elsevier.

Tri-C Program Manual. *Nuclear Medicine Lab Manual*. Cuyahoga Community College, 2019.

Thrail & Zeisman. (2018) *Nuclear Medicine: The Requisites*, Elsevier.

Bolus & Glasgow. (2018) *Review of Nuclear Medicine Technology*, Elsevier.

Key: 5187