



BROWARD COMMUNITY COLLEGE COURSE OUTLINE

LAST REVIEW: 2008-2009 **NEXT REVIEW:** 2013-2014 **STATUS:** A
(i.e. 2003-2004) *(i.e. 2008-2009)* *(A, I, D)*

COURSE TITLE: Nuclear Medicine Clinical Education VI

COMMON COURSE NUMBER: NMT 2854

CREDIT HOURS: 3

CONTACT HOUR BREAKDOWN
(per 16 week term)

CLOCK HOURS:
(Voc. Course ONLY)

Lecture: Lab: 0

Clinic: 384 Other: 0

PREREQUISITE(S): NMT 2102, NMT 2573 and NMT 2706L

COREQUISITE(S):

PRE/COREQUISITE(S): NMT 2061

COURSE DESCRIPTION:

Fifth in a five-course sequence of supervised clinical instruction in nuclear medicine technology. This final clinical education experience focuses on all of the clinical objectives in prior clinicals with students expected to perform patient examinations and unassisted routine procedures. Students will apply all didactic competencies and are expected to perform all procedures with minimal supervision.

UNIT TITLES

- 1.0 Introduction to the Nuclear Medicine Facility
- 2.0 Non-emergency Patient Care and Preparation for
- 3.0 Emergency Patient Care
- 4.0 Professional Behavior and Concern for the Patient
- 5.0 Administrative/Management Functions
- 6.0 In Vivo Imaging Procedures
- 7.0 Nuclear Instrumentation
- 8.0 Scintillation Counters and Probes
- 9.0 Gas-Filled Detectors
- 10.0 Dose Calculations and Administration
- 11.0 Radiopharmacy
- 12.0 Radiation Safety and Protection
- 13.0 In Vivo Non-Imaging Procedures
- 14.0 In Vitro Testing
- 15.0 Radionuclide Therapy Procedures



BROWARD COMMUNITY COLLEGE COURSE OUTLINE

ASSESSMENT:

Please provide a brief description (250 characters maximum) that details how students will be assessed on the course outcomes.

1. Complete clinical evaluation forms at midterm and end of term
2. Achieve 80 points out of a possible 100 points to successfully challenge a procedure
3. Clinical Conferences with instructors on site

**** Complete the following only if course is seeking general education status ****

GENERAL EDUCATION Competencies and Skills *:

Please highlight in green font all Competencies/Skills from the list below that apply to this course. In the box to the right of the Competency/Skill, enter all specific learning outcome numbers (i.e. 1.1, 2.7, 5.12) that apply.

1. Read with critical comprehension	
2. Speak and listen effectively	
3. Speak and listen effectively	
4. Think creatively, logically, critically, and reflectively (analyze, synthesize, apply, and evaluate)	
5. Demonstrate and apply literacy in its various forms: (highlight in green <u>ALL</u> that apply)	
6. Apply problem solving techniques to real-world experiences	
7. Apply methods of scientific inquiry	
8. Demonstrate an understanding of the physical and biological environment and how it is impacted by human beings	
9. Demonstrate an understanding of and appreciation for human diversities and commonalities	
10. Collaborate with others to achieve common goals.	
11. Research, synthesize and produce original work	
12. Practice ethical behavior	
13. Demonstrate self-direction and self motivation	
14. Assume responsibility for and understand the impact of personal behaviors on self and society	
15. Contribute to the welfare of the community	

** General Education Competencies and Skills endorsed by '05-'06 General Education Task Force*



Common Course Number: NMT 2854

Unit 1 Introduction to the Nuclear Medicine Facility

General Outcome:

1.0 The student shall be able to demonstrate an awareness of general clinical site operation and function.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 1.1 Describe the position of the nuclear medicine service in the overall table of organization of the institution.
- 1.2 Name the major divisions within the department and describe their function and location.
- 1.3 Describe the personnel policies of the institution relevant to students.
- 1.4 Quote the "code" numbers used in the hospital and state the emergency dialing procedures for fire, cardiac arrest, radiation safety officer, security and other numbers of significance.
- 1.5 Locate and demonstrate the operation of emergency equipment within the nuclear medicine department.
- 1.6 Describe departmental procedures for patient scheduling, dose administration, room assignments, image, data, and report processing, patient record filing systems and retrieval of previous reports/films.
- 1.7 Describe the physical layout of the entire hospital and the system used to locate patient rooms, wards, offices and patient holding areas.
- 1.8 Describe the departmental daily survey routines and regulations for storage, waste disposal and general supplies access.
- 1.9 Describe how to use the telephone system in the department.



Common Course Number: NMT 2854

Unit 2 Non Emergency Patient Care and Preparation for Procedures

General Outcome:

2.0 The student shall be able to demonstrate an understanding of non emergency procedures.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 2.1 Use correct body mechanics and support holds when moving or assisting patients.
- 2.2 Use side rails or stretcher/wheelchair straps on patients as appropriate.
- 2.3 Monitor the disoriented, unconscious, sedated, or pediatric patient.
- 2.4 Provide for patient comfort before, during and after the nuclear medicine procedure.
- 2.5 Use correct medical asepsis techniques during venipuncture procedures.
- 2.6 Use correct isolation procedures when indicated.
- 2.6 Correctly observe and maintain intravenous tubing, nasogastric tubing chest tubes, urinary retention catheters, surgical dressing, CVP lines, T-tube colostomy and oxygen administration, as appropriate.
- 2.7 Assist patients with use of bedpans/urinals or emesis basins, as needed.



Common Course Number: NMT 2854

Unit 3 Emergency Patient Care

General Outcome:

3.0 The student shall be able to demonstrate an understanding of Emergency Patient Care.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 3.1 Determine vital signs as needed, including blood pressure, pulse, respiratory rate and temperature.
- 3.2 Recognize an emergency that requires immediate notification of a physician and make the proper notification.
- 3.3 Recognize an emergency that requires immediate notification of the hospital "code" team and make the proper notification.
- 3.4 Perform Cardiopulmonary resuscitation techniques appropriately, if necessary.
- 3.5 Find and assist with the use of the emergency cart as appropriate.
- 3.6 Maintain life support equipment as appropriate.
- 3.7 Provide appropriate care in response to patient seizures, hemorrhage and/or fainting.



Common Course Number: NMT 2854

Unit 4 Professional Behavior and Concern for the Patient

General Outcome:

4.0 The student shall be able to demonstrate an understanding of professional behavior.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 4.1 Welcome the patient to the department, introducing yourself and addressing the patient by name.
- 4.2 Address patients, families, co-workers and hospital personnel by appropriate names or titles.
- 4.3 Demonstrate no ridiculing, degrading, or discriminatory attitudes, comments or behaviors in the clinical facility.
- 4.4 Avoid the display of emotional reactions such as distaste, disgust and/or surprise.
- 4.5 Do not discuss anything confidential or potentially alarming to the patient within the patient's hearing.
- 4.6 Refrain from discussion of patients with colleagues in patient areas and/or in any way that is not pertinent for relevant to the procedure or patient care.
- 4.7 Prevent unnecessary exposure of the patient's body.
- 4.8 Work proficiently and schedule carefully in order to minimize patient waiting periods as much as possible.
- 4.9 Provide the patient who must wait before or during a procedure with as much comfort and pleasantness as conditions allow.
- 4.10 Provide an explanation and apology when a patient must be kept waiting and assure the patient he (she) has not been forgotten.
- 4.11 Make certain the patient is comfortably warm and not exposed to drafts.
- 4.12 Provide body support such as pillows, etc. in order to position the patient as comfortably as possible.
- 4.13 Display understanding, cheerfulness and interest in the patient.



Common Course Number: NMT 2854

Unit 4 Professional Behavior and Concern for the Patient continued

- 4.14 Provide safe storage for the patient's personal belongings during the examination.
- 4.15 Hold in confidence any information offered by the patient, unless it is understood by the patient that it will become a part of the medical record.
- 4.16 Report any changes in the patient's condition to the appropriate person.
- 4.17 Recognize personal limits and responsibilities in the work situation, seeking assistance, suggestions and approval as appropriate.
- 4.18 Prior to the examination, discuss with the patient what the examination involves, what the patient will feel and what the patient will be required to do.
- 4.19 Explain procedures to the patient, taking into consideration age, degree of illness, intelligence and possible language difficulties of the patient.
- 4.20 Communicate with the patient throughout the procedure to ensure patient comfort and cooperation.
- 4.21 Demonstrate sensitivity to the feelings, fears, doubts and embarrassment of the patient.
- 4.22 Provide comfort through a constant presence, a gentle touch and a calm approach, as needed by the patient.



Common Course Number: NMT 2854

Unit 5 Administrative/Management Functions

General Outcome:

5.0 The student shall be able to demonstrate an understanding of management within a nuclear medicine department.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 5.1 Inventory supplies and determine when to restock routine items as well as radiopharmaceuticals and/or radioassay kits that have specific shelf lives.
- 5.2 Assist with completing purchase orders and interacting with suppliers of various materials
- 5.3 Interact with hospital and departmental staff to schedule patients studies effectively, including determination of the correct sequence for multiple procedures, both in nuclear medicine and in radiology.
- 5.4 Maintain appropriate records of patient doses, quality control procedures, radioactive waste disposal, patient reports, film reports and all other records required by the hospital, JCAHO, NRC or licensing bodies.
- 5.5 Maintain and update a departmental procedure manual.
- 5.6 Develop a personal procedure manual to reflect the level of knowledge of procedures performed in the facility.



Common Course Number: NMT 2854

Unit 6 In Vivo Imaging Procedures

General Outcome:

6.0 The student shall be able to demonstrate an understanding of In Vivo imaging procedures.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 6.1 Perform the following tasks associated with routine imaging procedures:
 - a. review requisition for completeness of information
 - b. retrieve and/or prepare patient file
 - c. identify relevant data from medical records and records on requisition as appropriate
 - d. obtain positive patient identification, conduct patient interview and explain study (obtain formal consent when needed)
 - e. establish whether the patient has undergone the necessary pre-examination procedures when appropriate
 - f. determine whether the patient has received any medication or had any examination that would interfere with or contraindicate the nuclear medicine study
 - g. take appropriate corrective action or make appropriate notation on requisition if patient has either not undergone necessary pre-examination procedures for has had any medication or examination that would interfere with the nuclear medicine study
 - h. prepare patient and/or instruct patient as to any particular preparation necessary for the imaging procedure
 - i. calculate the correct radiopharmaceutical dose to be administered
 - j. determine radiopharmaceutical administration time and time at which imaging should be performed post-administration
 - k. set up administration tray and prepare the correct radiopharmaceutical in the appropriate dosage.
 - l. correctly administer the radiopharmaceutical according to procedure protocol where permitted by law or policy
 - m. select instrument, collimator and auxiliary equipment for the study and determine that all equipment is functioning properly
 - n. correctly select and adjust instrument parameters for the images as each vie is performed
 - o. correctly select and adjust the photodisplay unit for the study
 - p. select correct parameters for computer data acquisition as appropriate
 - q. use correct body mechanics to move the patient on and off the imaging table
 - r. correctly position the patient for all views normally performed with the study, considering specific patient conditions
 - s. correctly develop all films and reload cassettes



Common Course Number: NMT 2854

Unit 6 In Vivo Imaging Procedures continued

- t. correctly label and assemble all films for presentation to the physician or supervisor, including notation of anatomical landmarks as appropriate
 - u. correctly complete all departmental forms/paperwork
 - v. objectively evaluate study for technical mistakes, and identify additional or repeat images that may be needed
- 6.2 When preparing for cisternography, set up the injection tray and assist in preparing and maintaining a sterile field for intrathecal injection by the physician.
- 6.3 When performing a lung ventilation study, set up and determine the functional status of the trap or special ventilatory system to be used and use it correctly during the procedure.
- 6.4 When performing a cystography procedure, explain the study to the patient and/or parents of a pediatric patient at a level that can be understood, administer the appropriate dosage and perform the study according to department criteria.
- 6.5 When performing cardiac stress testing, correctly place ECG leads and use and calibrate auxiliary equipment, including ECG machine and exercise/stress equipment.
- 6.6 When performing cardiac stress testing, recognize and correctly respond to signs and symptoms of patient stress. Note: student should not be expected to participate in stress testing without the presence/assistance/supervision of a physician.
- 6.7 When performing cardiac stress testing with drugs, properly calculate and prepare stressor and antidote rugs and recognize symptoms indicating need for an antidote to the stressor.
- 6.8 Correctly label each view in an imaging study with images that are unlabeled.
- 6.9 Given a set of images from a routine imaging study, describe the image and identify the anatomy.
- 6.10 Given a set of images with certain types of abnormalities, state whether the abnormalities might be attributed to artifacts from radiopharmaceutical problems, imager malfunction, technically induced artifacts from incorrect administration of the radiopharmaceutical, positioning/movement of patient, prostheses or radiation therapy portals or an abnormality of the patient.



Common Course Number: NMT 2854

Unit 6 In Vivo Imaging Procedures continued

- 6.11 Maintain technical quality through consistency in the following:
 - a. use identified departmental protocol
 - b. evaluate images for artifacts and repeat as necessary
 - c. present to the physician any information relative to the study that might assist in diagnosis
 - d. maintain a professional approach to all patients, peers, and other hospital personnel

- 6.12 Acquire data on the computer for all appropriate studies, including the following tasks:
 - a. perform startup procedure
 - b. select and enable work area for acquisition
 - c. enter patient data, creating a patient file
 - d. select/enter program for acquisition
 - e. set up special program for acquisition where applicable
 - f. select/enter parameters for acquisition
 - g. check accuracy of previously selected parameters
 - h. acquire study
 - i. verify that the study has been stored on computer

- 6.13 Demonstrate routine computer analysis of dynamic data, including the following tasks where indicated
 - a. select the appropriate study for analysis
 - b. generate output study, if applicable
 - c. select appropriate images for regions of interest
 - d. select appropriate regions of interest for data analysis
 - e. generate images, curves or data



Common Course Number: NMT 2854

Unit 7 Nuclear Instrumentation

General Outcome:

7.0 The student shall demonstrate an understanding of instrumentation.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 7.1 Prepare the scintillation camera (planar or SPECT) for a procedure:
 - a. select and attach proper collimator
 - b. select and adjust imaging parameters

- 7.2 Recognize imaging artifacts that reflect malfunctioning or incorrectly adjusted instrument, e.g., off-peak pulse-height analyzer, damaged scintillation crystal or malfunctioning photo-multiplier tubes.

- 7.3 Perform and analyze a field uniformity check:
 - a. select a radionuclide source of appropriate quantity and energy
 - b. adjust pulse-height analyzer photopeak
 - c. obtain uniformity images using standardized technique
 - d. compare current field uniformity image with previous images and identify any nonuniformities

- 7.4 Given a scintillation camera field uniformity image that demonstrates nonuniformity, determine the source of nonuniformity through the following quality control checks:
 - a. presence of foreign objects on collimator
 - b. inhomogeneous distribution of activity from flood or point source
 - c. off peak
 - d. cracked crystal or loss of hermetic seal
 - e. cathode ray tube malfunction
 - f. lens cleanliness and function

- 7.5 Given abnormal quality control results for a scintillation camera, evaluate the results and determine whether service is necessary or adjustments can be made to correct for an abnormality.

- 7.6 Perform and analyze a detector linearity check, including the following:
 - a. parallel line phantom and uniformity check source
 - b. two images at 90 degrees to each other
 - c. evaluate images and identify line distortion

- 7.7 Given detector linearity, check images on a scintillation camera which demonstrate line distortion to determine the source of nonlinearity.



Common Course Number: NMT 2854

Unit 7 Nuclear Instrumentation

- 7.8 Perform and analyze a spatial resolution check to include:
- a. use of a field uniformity check source and high-resolution phantom compatible with the specified resolution of the camera
 - b. obtaining resolution images at 90 degrees to each other using standardized imaging parameters according to departmental protocol
 - c. comparing images with prior resolution image and evaluate for changes in resolution
- 7.9 Perform a sensitivity check according to the established protocol and procedures on the departmental camera:
- a. perform each exam within the expected frequency
 - b. use standardized protocol
 - c. maintain proper records of each exam
 - d. compare each result with a series of previous results to determine whether significant variations occur
 - e. consult the supervisor if any questionable results are obtained



Common Course Number: NMT 2854

Unit 8 Scintillation Counters and Probes

General Outcome:

8.0 The student shall be able to demonstrate an understanding of scintillation counters and probes.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 8.1 Conduct and record a chi-square evaluation and analyze the results for acceptable instrument performance.
- 8.2 Perform and record an energy linearity check and volumetric calibration.
- 8.3 Demonstrate knowledge of proper use and maintenance of the scintillation counter or probe.
- 8.4 Demonstrate statistical significance of counting and decay by comparing the mean and standard deviation of a sample counted for IK to the same sample counted ten times as long, or for a minimum of 10K count.
- 8.5 Demonstrate the importance of using a technique that will maintain the exact geometry from one count to another.
- 8.6 Demonstrate the effects of dead time on the capacity of the system.



Common Course Number: NMT 2854

Unit 9 Gas-Filled Detectors

General Outcome:

9.0 The student shall be able to demonstrate an understanding of gas filled detectors.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 9.1 Perform the following with a G-M survey meter:
 - a. calibrate according to NRC specifications
 - b. perform a reference check source test and evaluate the results
 - c. compare results with those previously obtained
 - d. maintain records of calibration and testing
 - e. change batteries as appropriate

- 9.2 Perform the following with a dose calibrator:
 - a. determine linearity of response over entire range of radionuclide activity to be measured
 - b. determine significant geometrical variation in activity measured as a function of volume or configuration
 - c. test for accuracy with commonly used radionuclides that have adequate reference standards available
 - d. check for constancy (precision) by using a long-lived radionuclide standard
 - e. evaluate test results and determine when service is needed
 - f. maintain records for each of the above procedures



Common Course Number: NMT 2854

Unit 10 Dose Calculation and Administration

General Outcome:

10.0 The student shall be able to be able to demonstrate an understanding of dose calculation.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 10.1 Calculate the dose of a specific radiopharmaceutical for a certain study using a calculator and decay chart:
 - a. verify and record patient name and age and the study requested
 - b. identify from the label on the radiopharmaceutical vial: concentration, total activity, total volume, assay time, date of assay
 - c. determine lapsed time and calculate activity remaining
 - d. ascertain the activity needed for the procedure
 - e. calculate the volume of the radiopharmaceutical required to provide the appropriate patient dosage
 - f. log appropriate data into radiopharmaceutical dispensing records for the procedure
- 10.2 Verify radiopharmaceutical dose calculation.
- 10.3 Demonstrate the correct method for dispensing a liquid radiopharmaceutical for intravenous administration
 - a. use aseptic techniques
 - b. use gloves and shields to minimize self-contamination problems
 - c. draw up the radiopharmaceutical behind a lead shield to within +/- 5% of the calculated dose
 - d. verify the radioactivity with the dose calibrator
 - e. record patient data and radiopharmaceutical data according to approval policy
 - f. label the syringe and/or syringe shield
- 10.4 Demonstrate the correct method for dispensing a gaseous radiopharmaceutical using a gaseous dispensing/collecting apparatus and with patient who is able to cooperate with appropriate breathing technique.
- 10.5 Demonstrate the correct method for calculating doses and administering capsules.
- 10.6 Demonstrate the correct method for dispensing and administering liquid radiopharmaceuticals for oral administration.



Common Course Number: NMT 2854

Unit 10 Dose Calculation and Administration continued

- 10.7 Demonstrate the correct method of administering a radiopharmaceutical intravenously (as allowed by law/hospital policy) to include the following:
- a. assemble injection tray with all necessary materials for venipuncture, including shielded syringe of radioactive material and gloves
 - b. position patient for the study to be done and/or for radiopharmaceutical administration
 - c. select a suitable vein and attach tourniquet
 - d. select a suitable needle or Angiocath
 - e. communicate with and reassure the patient, as appropriate
 - f. perform the venipuncture and administer the dose
 - g. observe the patient for reactions/extravasation
 - f. dispose of waste in appropriate radioactive waste or nonradioactive waste, a appropriate



BROWARD COMMUNITY COLLEGE

COURSE OUTLINE

Common Course Number: NMT 2854

Unit 11 Radiopharmacy

General Outcome:

11.0 The student shall be able to be able to demonstrate an understanding of radiopharmacy.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 11.1 Demonstrate the correct procedure for elution of a $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ generator
 - a. assemble shield, vials, and all materials necessary for aseptic elution of the generator
 - b. perform complete procedure behind a lead shield using gloves
 - c. attach vials to correct input and output needles
 - d. use a shield on the vial that will contain eluate
 - e. assay elute in dose calibrator and record eluate activity in appropriate radiopharmaceutical accountability log
 - f. check to determine whether volume and activity eluted are appropriate to volume used and activity expected for that day
 - g. label the vial/shield with the appropriate information to include activity, volume, concentration, date and time of assay and radiopharmaceutical

- 11.2 Perform a ^{99}Mo breakthrough Verify test on a $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ eluate:
 - a. determine $^{99\text{m}}\text{Tc}$ activity per volume using the appropriate dose calibrator setting
 - b. determine ^{99}Mo activity per volume using the appropriate dose calibrator setting (and correction factors if appropriate)
 - c. calculate ^{99}Mo activity per mCi of $^{99\text{m}}\text{Tc}$ activity
 - d. determine whether this concentration is acceptable for use
 - e. determine why an unacceptable level of ^{99}Mo occurred and take appropriate measures
 - f. record results in the log book

- 11.3 Perform an alumina ion colorimetric assay on a $^{99}\text{Mo}/^{99\text{m}}\text{Tc}$ eluate (following the procedure protocol), analyze the results, and record in the book.

- 11.4 Demonstrate proper preparation of a radiopharmaceutical kit for MAA, colloid, phosphates/phosphonate, DTPA, gluceptate, DMSA, IDA agents, MAG3 $^{99\text{m}}\text{Tc}$ -labeled cardiac and/or brain imaging agents, correctly labeling the material with [$^{99\text{m}}\text{Tc}$] pertechnetate or other appropriate agent to form a radiopharmaceutical:
 - a. to determine the amount and volume of radioactivity to be added to the kit, paying special attention to any imitation for level of activity or volume
 - b. to record radioactive dose and volume used in the daily log
 - c. to prepare the radiopharmaceutical with strict adherence to manufacturer's direction on heating, sequence of additions, and mixing



Common Course Number: NMT 2854

Unit 11 Radiopharmacy continued

- d. to check total activity in radiopharmaceutical vial with dose calibrator
 - e. to calculate and record the concentration of radioactivity of the compound, time and date of preparation, total activity and volume
 - f. to label the vial with time and date of preparation, lot number, radiopharmaceutical form, concentration and total volume
- 11.5 Check radiopharmaceutical for proper pH, color, clarity and particle size, as appropriate, and record results in radiopharmaceutical log.
- 11.6 Perform chromatography for the determination of radiochemical purity by:
- a. assembling all materials for the procedure
 - b. expediently performing the procedure according to department protocol
 - c. demonstrating appropriate use of counting instrumentation in the determination of percent free, percent hydrolyzed and percent bound
 - d. recording data for each radiopharmaceutical on appropriate data log
- 11.7 Evaluate quality control results and determine whether the material can be used.
- 11.8 Evaluate an imaging procedure which demonstrates a radiopharmaceutical biological distribution different than expected and determine the probable cause for such distribution.



Common Course Number: NMT 2854

Unit 12 Radiation Safety and Protection

General Outcome:

12.0 The student shall be able to be able to demonstrate an understanding of radiation safety.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 12.1 Where whole-body and ring badges at all times in the clinical area.
- 12.2 Review the monthly and cumulative personnel exposure records with regard to maximum permissible dose limits.
- 12.3 Recognize and take appropriate measures to reduce exposure.
- 12.4 Use appropriate protection techniques to keep exposure as low as reasonable achievable.
- 12.5 Perform area surveys of the hot lab and department
 - a. check survey instruments for proper function and calibration
 - b. use department protocol to determine areas for survey
 - c. use correct survey instrument for each type and level of radiation
 - d. interpret results and notify personnel, as appropriate
 - e. perform wipe tests and decontamination procedures as appropriate
- 12.6 Receive and process radioactive shipments, including the generator, in the laboratory
 - a. log in the receipt of radioactive shipments
 - b. visually determine damaged packaging, and take appropriate precautions
 - c. monitor packaging material
 - d. contact the radiation safety officer in the event of receipt of contaminated material
 - e. perform wipe tests, as appropriate, on exterior packaging and radioactive material containers
 - f. deface radiation sign on all discarded packaging
 - g. store radioactivity in the appropriate area according to the storage needs and activity level of the material
 - h. notify the manufacturer in the event of receipt of damaged goods
 - i. wear gloves when processing incoming shipment
 - j. ensure that packages are opened within a timely manner after arrival in the department



Common Course Number: NMT 2854

Unit 12 Radiation Safety and Protection continued

- 12.7 Perform periodic leak tests on sealed sources as appropriate.
- 12.8 Record all data from various surveys, wipe tests and leak tests in the appropriate record book and, when applicable, notify the radiation safety officer of abnormal results.
- 12.9 Demonstrate correct decontamination procedures for a contaminated surface:
 - a. restrict access to area and confine spill as indicated
 - b. determine the nature of the spill (major or minor) and decide whether the radiation safety officer needs to be notified prior to clean-up
 - c. use protective clothing as appropriate
 - d. store contaminated articles as appropriate
 - e. remove and/or decontaminate nondisposable articles
 - f. decontaminate the area to acceptable level of activity
 - g. record cleanup and final survey results after decontamination
- 12.10 Demonstrate correct decontamination procedures with personnel contamination.
- 12.11 Demonstrate the correct waste disposal methods for syringes, vials, needles contaminated articles, and radioactive waste, as defined by the radioactive materials license, universal precautions, and departmental protocol.
- 12.12 Routinely monitor the stored radioactive materials (including generators and/or liquid waste) to determine when the level of activity is acceptable for discarding.
- 12.13 Identify the location and parameters of the department's radioactive materials license.
- 12.14 Discuss conditions and/or limitations of the license and federal requirements or parameters that may apply to:
 - a. disposal of radioactive waste
 - b. records of radioactive materials use and disposal
 - c. accepted maximum dose levels of radiopharmaceuticals
 - d. levels of radiation to be identified by the radiation signs in all areas
 - e. decontamination and/or storage requirements



Common Course Number: NMT 2854

Unit 13 In Vivo Non-imaging Procedures

General Outcome:

13.0 The student shall be able to be able to demonstrate an understanding of in vivo non-imaging procedures

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

13.1 Perform a routine thyroid uptake (1231I)

- a. question the patient regarding medications, x-ray studies using contrast media, possibility of pregnancy, and previous nuclear medicine studies
- b. measure thyroid background activity if indicated
- c. administer radioactive iodine and instruct patient to return at the appropriate time
- d. prepare a standard which is equivalent to the patient dose
- e. collect appropriate patient data according to department protocol
- f. calculate the thyroid uptake

13.2 Perform [99mTc} pertechnetate uptake according to department protocol if the procedure is routine performed in the department.

13.3 Perform a blood volume examination (RISA 125I, 51Cr-RBC):

- a. explain the procedure to the patient, including the time frame for all injections and withdrawals
- b. determine patient weight and height
- c. perform the procedure according to department protocol
- d. using the appropriate formula, calculate the blood volume and report the results in comparison with the predicted normal value for that patient

13.4 After performing a blood volume procedure having abnormally high or low values, evaluate the procedure to determine whether the results might be attributed to technical error.

13.5 perform a standard 51Cr-RBC labeled blood volume procedure.

13.6 Withdraw blood samples according to department protocol, prepare samples and hematocrits and quantitative data.

13.7 Plot data to determine half-time blood activity.

13.8 Perform the sequestration study by obtaining external counts according to department protocol.



Common Course Number: NMT 2854

Unit 13 In Vivo Non-imaging Procedures continued

- 13.9 Quantitate and graph data to determine the spleen-to-liver ratio.
- 13.10 Perform a Schilling Test procedure according to the department protocol
- a. collect background specimen when indicated
 - b. determine whether patient preparation has been done
 - c. explain procedure and importance of appropriate and complete sample collection to patient
 - d. administer radioactive and nonradioactive pharmaceuticals according to protocol
 - e. prepare and quantitate samples and standards
 - f. calculate excretion fraction
 - g. report results in comparison with normal values
- 13.11 Determine whether the results of a Schilling test may be abnormally increased or decreased due to technical problems



Common Course Number: NMT 2854

Unit 14 In Vitro Testing

General Outcome:

14.0 The student shall be able to be able to demonstrate an understanding of in vitro testing.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 14.1 Identify and use correctly: glassware, pipettes, centrifuges, waterbaths, pH meters, laboratory scales and balances, vortex mixers, shakers, and counting equipment (single sample at automated).
- 14.2 Balance centrifuges when used.
- 14.3 Check and record the temperature of water baths and refrigerators on a routine schedule.
- 14.4 Calibrate scales, balances and pH meters.
- 14.5 Correctly select, change, use, calibrate and dispose of pipet tips.
- 14.6 Review requisitions to determine volume of sample needed type of sample needed, and anticoagulant that should be used (where applicable).
- 14.7 Identify procedures where special collecting techniques and/time factors must be observed.
- 14.8 Properly label blood sample with patient name, number and other identifying data according to department protocol.
- 14.9 Correctly dispose of waste materials using universal precautions.
- 14.10 Separate and prepare samples for assays.
- 14.11 Store samples according to protocol if assays are not to be done properly May Be Substituted When the Facility no Longer Uses RIA).
- 14.12 Identify the purpose of each routine test performed in the laboratory and the patient preparation for each.
- 14.13 Classify tests according to the priority for completion.
- 14.14 Obtain blood samples from patients and prepare, label, and number the samples in an appropriate order to run the assay.



Common Course Number: NMT 2854

Unit 14 In Vitro Testing

- 14.15 Demonstrate proficiency in the performance of assay procedures:
- a. allow components and specimens to equilibrate to room temperature
 - b. assemble appropriate sizes of pipettes and tips and other equipment needed for the procedure
 - c. prepare and number samples in an appropriate sequence
 - d. prepare and number samples in an appropriate sequence
 - e. add assay components with strict adherence to the protocol
 - f. incubate in the correct environment for the accurate time period
 - g. separate bound from free activity according to protocol
 - h. load samples in the counter and set all counting parameters for the isotope being quantitated
 - i. plot data according to the protocol
 - j. determine patient results and quality control results
 - k. determine whether quality control measures are within normal limits
 - l. report patient results along with normal values troubleshoot the assay to determine whether technical errors might have attributed to unacceptable values for quality control measures outside the acceptable range
- 14.16 Demonstrate proficiency in assessing the accuracy, precision, sensitivity and specificity of each assay done in the department.
- 14.17 For a frequently performed assay, collect sufficient data to determine the normal range for that test in that laboratory.
- 14.18 Set up a quality control chart that could be used to assess usability of assay results and record data for a period of several days.



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Unit 15 Radionuclide Therapy Procedures

General Outcome:

15.0 The student shall be able to be able to demonstrate an understanding of Radionuclide Procedures.

Specific Measurable Learning Outcomes:

Upon successful completion of this unit, the student shall be able to:

- 15.1 Determine the purpose for the therapeutic procedure from the requisition and/or the patient's chart.
- 15.2 Consult with the nuclear medicine physician regarding the procedure and the appropriate dosage.
- 15.3 Determine whether patient is to be hospitalized, and if so, consult with the hospital staff and radiation safety officer about room preparation and staff training.
- 15.4 Calculate the amount of radiopharmaceutical to be administered and assemble all materials for administration.
- 15.5 Discuss with the patient and/or the patient's family or hospital staff the radiation safety aspects of the procedure and be sure all questions have been answered.
- 15.6 Observe as the supervisor administers the dose to the patient.
- 15.7 Dispose of and store all radioactive waste according to departmental protocol.
- 15.8 Monitor administration area to ensure there is no contamination.
- 15.9 When a patient is hospitalized, monitor the patient and the room according to department protocol to determine when the patient can be released and when the room can be occupied by another patient.
- 15.10 Perform thyroid bioassays on personnel who have assisted with administration of therapeutic ^{131}I according to department protocol.