Components of Preparedness: A Study Tool for the NMTCB Examination

Ann M. Steves, Karen L. Blondeau and Martha W. Pickett

Nuclear Medicine Technology Certification Board, Atlanta, Georgia

Objective: Preparedness is vital for the successful completion of the NMTCB examination.
Methods: The NMTCB has developed a set of statements called the Components of Preparedness (COP) that are designed to provide additional information about examination content. The COP statement for each task in the 1991 validated task analysis includes a definition of the content base, the knowledge required to perform the task and one or more taxonomy levels. The validated task analysis appears in an earlier JNMT article.
Results: Three taxonomy levels are defined that are used to assess the examinee's intellectual preparedness to practice entry-level nuclear medicine technology.
Conclusion: By testing an examinee's various levels of understanding, the NMTCB hopes to ensure the quality of certified nuclear medicine technologists and maintain the highest standards possible.
Key Words: Components of Preparedness, comprehension, application, analysis, NMTCB.

J Nucl Med Technol 1994; 22:79–92

The Nuclear Medicine Technology Certification Board (NMTCB) uses a validated task analysis to ensure that the nuclear medicine technology examination's content reflects current practice (*1–5*). The validated task analysis consists of a task list of entry-level responsibilities, an equipment list and a procedures list. The tasks are identified by nuclear medicine practitioners (technologists, physicians, physicists and radiopharmacists) as being essential to success as an entry-level nuclear medicine technologist. The equipment list is an inventory of nuclear medicine instrumentation and auxiliary devices used to accomplish certain tasks identified on the task list. The procedures list identifies the clinical examinations typically performed by entry-level technologists. Thus, the task analysis defines the subject matter included on the examination and provides direction to the examination developers, item writers and examinees. At present, there are 92 tasks included in the task analysis and tested on the NMTCB examination (*5*).

To complement and expand upon the 92 tasks, the NMTCB has also developed the Components of Preparedness (COP) statements. These statements are intended to provide additional information to examinees and item writers about examination content related to each task. The COP statement for each task includes a definition of the content base, the knowledge required to carry out the task and one or more taxonomy levels, i.e., statements that describe the level of thought processes needed to complete the task successfully.

For purposes of the NMTCB certification examination, three taxonomy levels in the cognitive area are defined: comprehension, application and analysis. These three levels are based on a classification of educational objectives developed by Bloom et al. (*6*) and are used to evaluate the examinee's intellectual preparedness to practice nuclear medicine technology. Skills such as knowledge, understanding and reasoning are all evaluated. Characteristics of each taxonomy level are described in Table 1.

Certain tasks involve thought processes at the comprehension level only, or at the comprehension and application levels only. Therefore, not all tasks have COP statements for all three taxonomy levels. For example, tasks related to maintaining written records only involve the comprehension level because the information to be recorded is defined in the relevant regulation and is not determined by a staff technologist. However, thought processes are hierarchical, i.e., they range from the simplest thought process of comprehension, to the more complex processes of application and analysis. Each higher classification includes the lower level thought processes. For instance, posting appropriate signs in radiation areas to comply with NRC regulations includes both identifying the signs used to post radiation areas (comprehension) and choosing the appropriate sign based on the measured radiation level (application).

The NMTCB examination is developed according to the taxonomy levels, and attempts to test at the highest taxonomy level defined for a particular task. In the previous example, test questions are written at the application level to

For correspondence or reprints contact: Ann M. Steves, NMTCB, 2970 Clairmont Rd., Suite 610, Atlanta, GA 30329.

TABLE 1
Characteristics of Taxonomy Levels

Level	Characteristics
Comprehension	• Most basic level of understanding and remembering. • Involves recall, recognition or understanding of facts, specifics or patterns. • Refers to a basic type of understanding or comprehension, but relationships or implications of such information to other information are not involved. • May involve recognizing information presented in graph form. • Behavior terms that may fall under this category include restate, recognize, remember, express, identify, recall and translate.
Application	• Requires comprehension as well as the ability to apply knowledge in a novel situation. • Involves identifying the operation necessary for a problem or context and performing them. • May involve recognizing and applying technical principles, ideas, theories and formulas in a novel context. • May involve interpreting graphs or images. • Behavior terms that may fall under this category include interpret, employ, illustrate, practice, sketch, predict, use and apply.
Analysis	• Requires both comprehension and application as well as analysis of a concept, principle or idea. • Involves separating a concept, principle or idea into its component parts and identifying relationships among the parts. • May involve combining concepts, principles or ideas into a new pattern or structure. • Involves evaluation of an image or procedure to determine accuracy or errors. • Involves reducing complex expressions into simpler or more basic expressions. • Involves comparing and contrasting, identifying similarities and differences among concepts, principles or ideas. • Behavior terms that may fall under this category include compare, contrast, diagram, examine, analyze, construct and relate.

test the examinee's ability to choose the correct sign based on specific information given in the test question about the area to be posted. Sometimes taxonomy levels for certain tasks, particularly application and analysis, overlap because it is difficult to clearly define where one level ends and another begins. For example, all mathematical calculations are applications of formulas and are considered to be at the application taxonomy level. In certain instances, the result of a calculation must be interpreted or applied by the examinee to a given situation. Then, the taxonomy level is designated as analysis. Calculating a chi-square value, for instance, involves thought processes at the application level, but interpreting the value to determine whether an instrument is properly functioning involves analytical thinking.

The COP statements containing the content base and taxonomy levels defined for each task in the latest validated NMTCB task analysis appear on the following pages. The statements have been used extensively by item writers to develop questions for the examination and should be useful to students and faculty of educational programs in preparing for the NMTCB examination.

Samples of former test questions paired with the related task and COP statement have been distributed to all program directors for the past three years. For additional information, contact the NMTCB office at (404) 315-1739.

REFERENCES

1. Nuclear Medicine Technology Certification Board. NMTCB certification examination validation report. *J Nucl Med Technol* 1982;10:210–222.
2. Nuclear Medicine Technology Certification Board. NMTCB critical task validation study: identification of entry-level domain. *J Nucl Med Technol* 1984;12:192–200.
3. Nuclear Medicine Technology Certification Board. Reexamination of NMTCB board critical task survey: a response to changing entry-level practice. *J Nucl Med Technol* 1986;14:228–234.
4. Blosser N, Drew H, Steves A. NMTCB task analysis validation update. *J Nucl Med Technol* 1988;16:216–221.
5. Blondeau KL, Hartnett SD, Pickett MW, et al. Nuclear Medicine Technology Certification Board (NMTCB) 1991 critical task analysis validation report. *J Nucl Med Technol* 1992;20:173–176.
6. Bloom BS, et al. *Taxonomy of educational objectives: handbook I, cognitive domain.* New York, NY: David McKay Company, Inc.; 1956.

NMTCB COMPONENTS OF PREPAREDNESS

GROUP I: RADIATION SAFETY

1. Post appropriate signs in designated areas to comply with NRC regulations.

CONTENT BASE
1. NRC regulations
2. Restricted and unrestricted areas maximum permissible radiation levels (exposure limits)
3. Radiation surveys
   a. Survey meters
   b. Area monitoring

COMPREHENSION
Identify appropriate signs for posting in designated radiation areas.

APPLICATION
Choose appropriate radiation signs for areas where radioactivity is stored or used.

ANALYSIS
None

2. Package radioactive materials according to regulations.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. DOT
2. Radiation surveys of packages
   a. Survey meters
   b. Surface contamination
3. Transport index
4. Packaging types (materials)

COMPREHENSION
State the regulatory requirements for packaging radioactive materials

APPLICATION
Determine appropriate methods for packaging radioactive materials according to regulations.

ANALYSIS
None

3. Maintain accurate, written radiation safety/protection records to comply with regulations.

CONTENT BASE
Note: This applies to FDA, NRC and DOT regulations.
1. Personnel exposure documents
2. Wipe tests
3. Area radiation surveys
4. Survey instruments
5. Radiopharmaceutical receipt, transfer and disposal
6. Management of radioactive spills

COMPREHENSION
Identify regulations regarding written records for radiation safety/protection procedures and the information to be recorded to comply with regulations.

APPLICATION
None

ANALYSIS
None

4. Use radiation monitoring devices.

CONTENT BASE
1. NRC regulations
2. Types and characteristics of personnel monitoring devices
3. Properties of nuclear radiation
4. Radiation surveys
5. Exposure limits for hospitalized patients

COMPREHENSION
Identify various personnel monitoring devices and explain their proper use.

APPLICATION
Determine appropriate personnel monitoring devices for various contexts. Determine appropriate patient monitoring devices given specific circumstances.

ANALYSIS
None

5. Review monthly personnel exposure records with regard to maximum permissible radiation dose limits.

CONTENT BASE
1. NRC regulations
2. Absorbed dose units
3. Maximum permissible radiation doses (MDP)
4. Types and characteristics of personnel monitoring devices

COMPREHENSION
State maximum permissible radiation dose limits for personnel.

APPLICATION
Examine monthly personnel exposure reports to determine if MPD limits have been exceeded.

ANALYSIS
Analyze instances of increased radiation exposure and recommend measures to reduce or eliminate unnecessary exposure.

6. Take appropriate measures to reduce radiation exposure when necessary.

CONTENT BASE
1. NRC regulations
2. Properties of nuclear radiation
3. Radiation protection techniques
   a. Time
   b. Distance
   c. Shielding
4. ALARA concept
5. Types and characteristics of personnel monitoring devices
6. Radiation surveys

COMPREHENSION
Identify appropriate measures to reduce radiation levels and to keep exposure as low as reasonably achievable.

APPLICATION
Recommend appropriate techniques to reduce radiation levels and to keep exposure as low as reasonably achievable in various contexts.

ANALYSIS
Examine instances of increased radiation levels and recommend measures to reduce them.

7. Notify the appropriate authority of excessive radiation exposure.

CONTENT BASE
1. NRC regulations
2. Personnel monitoring
3. Radiation surveys
   a. Survey meters
   b. Area monitoring
   c. Patient monitoring
4. Acceptable activity ranges for diagnostic and therapeutic procedures
5. Maximum permissible radiation doses for personnel

COMPREHENSION
Identify unacceptable levels of radiation exposure and the appropriate authority to notify.

APPLICATION
Determine if excessive radiation exposure has occurred and select the appropriate authority to notify.
ANALYSIS
None

8. Notify the appropriate authority of misadministration when applicable.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. FDA
2. Approved routes of radiopharmaceutical administration
3. Acceptable activity range for diagnostic and therapeutic radiopharmaceuticals
4. Approved FDA radiopharmaceuticals

COMPREHENSION
Identify a radiopharmaceutical misadministration and the appropriate authority to notify.
APPLICATION
Determine if a radiopharmaceutical misadministration has occurred and select the appropriate authority to notify.
ANALYSIS
None

9. Use proper shielding and the inverse square law to reduce radiation exposure.

CONTENT BASE
1. NRC regulations
2. Properties of nuclear radiation
3. Radiation protection techniques
   a. Time
   b. Distance
   c. Shielding
4. ALARA concept
5. Types and characteristics of personnel monitoring devices
6. Radiation surveys

COMPREHENSION
Identify appropriate measures to reduce radiation levels and to keep exposure as low as reasonably achievable.
APPLICATION
Recommend appropriate techniques to reduce radiation levels and to keep exposure as low as reasonably achievable in various contexts.
ANALYSIS
Examine instances of increased radiation levels and recommend measures to reduce them.

10. Use proper methods for the storage of radiopharmaceuticals.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. FDA
2. Radiation protection techniques
   a. Beta emitters
   b. Gamma emitters
3. Storage requirements of radiopharmaceuticals
   a. Temperature
   b. Light
   c. Humidity
   d. Ventilation

COMPREHENSION
Identify proper storage methods for radiopharmaceuticals.
APPLICATION
Determine proper storage conditions for a given radiopharmaceutical.
ANALYSIS
Analyze consequences of improper storage and alter storage methods accordingly.

11. Identify and use proper procedures for radiopharmaceuticals that pose special hazards.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. FDA
2. Radiopharmaceutical characteristics
   a. Physical properties
   b. Radiation emissions
3. Radiation protection techniques

COMPREHENSION
Identify the radiopharmaceuticals that pose special hazards and identify proper procedures for handling those materials.
APPLICATION
Determine proper procedures for handling a given radiopharmaceutical.
ANALYSIS
Analyze circumstances contributing to special hazards associated with radiopharmaceuticals and alter procedures appropriately.

12. Instruct the patient, family and hospital staff in radiation safety precautions after the administration of diagnostic and therapeutic radiopharmaceuticals.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. FDA
2. Radiation safety practices
3. Patient communications
4. Patient and personnel monitoring

COMPREHENSION
Identify radiation safety precautions which should be conveyed to the patient, family and hospital staff following the administration of radiopharmaceuticals.
APPLICATION
Choose appropriate instructions to be conveyed to the patient, family and hospital staff following the administration of diagnostic and therapeutic radiopharmaceuticals.
ANALYSIS
None

13. Provide instruction on proper radiation emergency procedures to be followed.

CONTENT BASE
1. NRC regulations
2. Radiation safety practices
3. Decontamination procedures

COMPREHENSION
Identify a radiation emergency.
APPLICATION
Choose appropriate instructions in proper radiation emergency procedures to be followed until radiation personnel arrive.
ANALYSIS
None

14. Perform wipe tests and area radiation surveys following a standardized schedule and format.

CONTENT BASE
1. NRC regulations
2. Properties of nuclear radiation
3. Survey instruments
4. Area monitoring-surveys and wipe tests

COMPREHENSION
Identify the procedure for performing wipe tests and area radiation surveys.
APPLICATION
Perform wipe tests and area radiation surveys with appropriate survey instrument and frequency.
ANALYSIS
None

15. Follow required procedures for receipt of radioactive materials.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. DOT
2. Package survey requirements
3. Survey instruments
4. Wipe tests

COMPREHENSION
Identify procedures for receipt of radioactive materials.

APPLICATION
Determine appropriate procedure for receiving a package containing radioactive materials.

ANALYSIS
None

16. Appropriately dispose of radioactive material.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. DOT
2. Disposal methods for radioactive liquids, solids and gases
3. Half-life
4. Survey meters

COMPREHENSION
Identify disposal procedures solid, liquid and gaseous radioactive materials.

APPLICATION
Determine the appropriate procedure for disposing of a radioactive material.

ANALYSIS
None

17. Maintain a long-term storage area to allow for decay of radioactivity.

CONTENT BASE
1. NRC regulations
2. Disposal of radioactive waste
3. Posting requirements
4. Shielding
5. Other characteristics of a decay storage area

COMPREHENSION
Identify the requirements of a long-term storage area for the decay of radioactive waste.

APPLICATION
None

ANALYSIS
None

18. Use proper procedures for managing a radioactive spill.

CONTENT BASE
1. NRC regulations
2. Radioactive spill management
   a. Containment: major, minor spills
   b. Equipment
3. Decontamination procedures
   a. Patient and personnel decontamination
   b. Equipment
   c. Area decontamination
4. Waste disposal
5. Survey methods

COMPREHENSION
Identify procedures for handling a radioactive spill.

APPLICATION
Determine the appropriate procedures for containing and decontaminating a radioactive spill and for notifying the proper authority.

ANALYSIS
None

GROUP II: INSTRUMENTATION

19. Maintain appropriate instrumentation quality control records to comply with regulatory requirements.

CONTENT BASE
This task relates to regulations which require written records for the following instrumentation quality control:
1. Scintillation camera
   a. Linearity
   b. Resolution
   c. Sensitivity
   d. Uniformity
2. Scintillation spectrometer
   a. Resolution
   b. Sensitivity
   c. Constancy (Chi square)
3. Dose calibrator
   a. Accuracy
   b. Constancy
   c. Geometry
   d. Activity linearity
4. Survey instruments
   a. Accuracy
   b. Constancy
5. Laboratory equipment
   a. Balances
   b. Pipets, precision and accuracy
   c. Refrigerator/water bath temperatures
   d. Centrifuge (tachometer and timer)

COMPREHENSION
Identify regulations regarding written records for instrumentation quality control and the information to be recorded to comply with regulations.

APPLICATION
None

ANALYSIS
None

20. Calibrate a scintillation spectrometer.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Gamma ray spectra
5. Quality control of scintillation spectrometer

COMPREHENSION
Define full width at half maximum (FWHM).

APPLICATION
Determine the percent energy resolution of a scintillation spectrometer.

ANALYSIS
Evaluate results of energy resolution determination.

21. Determine the percent energy resolution of a scintillation spectrometer.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Gamma ray spectra

22. Conduct sensitivity checks on the scintillation spectrometer or scintillation camera.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Quality control of scintillation spectrometer/camera

COMPREHENSION
Define sensitivity.

APPLICATION
Determine the sensitivity of a scintillation spectrometer or scintillation camera.

ANALYSIS
Analyze changes in sensitivity and determine cause.

23. Obtain background counts on a scintillation spectrometer.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Quality control of scintillation spectrometer

COMPREHENSION
Define background.

APPLICATION
Determine background.

ANALYSIS
Assess changes in background and determine cause of increased background.

24. Perform a chi-square test on a scintillation spectrometer.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Quality control of scintillation spectrometer
5. Chi-square formula

COMPREHENSION
Define chi-square and identify the procedure for performing a chi-square test.

APPLICATION
Determine the chi-square value for a scintillation spectrometer.

ANALYSIS
Evaluate chi-square results.

25. Adjust pulse-height analyzer (PHA) on the scintillation spectrometer or camera for the appropriate photopeak.

CONTENT BASE
1. Sodium iodide detector system components.
   a. Scintillation spectrometer
   b. Scintillation cameras
2. Pulse-height analysis (PHA)
3. Gamma ray spectra
4. Basic electronic nomenclature

COMPREHENSION
Define the purpose of the pulse-height analyzer.

APPLICATION
Determine the appropriate PHA adjustment.

ANALYSIS
Analyze operational problems caused by improper PHA adjustment.

26. Perform field uniformity check on the scintillation camera on a routine basis.

CONTENT BASE
1. Scintillation camera
   a. Components
   b. Collimators
   c. Image display
2. Uniformity quality control
3. Scintillation camera performance characteristics
4. Uniformity requirements for SPECT

COMPREHENSION
Define field uniformity.

APPLICATION
Determine the field uniformity of a scintillation camera.

ANALYSIS
Analyze field uniformity images and differentiate source of nonuniformities.

27. Perform detector linearity check on a scintillation camera on a routine basis.

CONTENT BASE
1. Scintillation camera
   a. Components
   b. Collimators
   c. Image display
2. Linearity quality control
3. Scintillation camera performance characteristics

COMPREHENSION
Define linearity.

APPLICATION
Determine the linearity of a scintillation camera.

ANALYSIS
Analyze images for nonlinearity and assess cause.

28. Perform spatial resolution check on a scintillation camera on a routine basis.

CONTENT BASE
1. Scintillation camera
   a. Components
   b. Collimators
   c. Image display
2. Resolution quality control
3. Scintillation camera performance characteristics
4. Phantoms
5. SPECT center of rotation

COMPREHENSION
Define spatial resolution.

APPLICATION
Determine the spatial resolution of a scintillation camera.

ANALYSIS
Analyze images to determine any loss of spatial resolution and assess causes for loss of resolution.

29. Assess performance of image recording equipment.

CONTENT BASE
1. Scintillation camera/computer
   a. Image display multiformatter, CRT
   b. Quality control of image recording devices
2. Film processor quality control
3. Photographic film characteristics

COMPREHENSION
Identify the components of the image recording equipment and their function.

APPLICATION
Determine the performance of image recording equipment.

ANALYSIS
Analyze images for proper performance of image recording equipment and assess cause of improper performance.

30. Perform reference check on survey meter.

CONTENT BASE
1. NRC regulations
2. Survey meter quality control

COMPREHENSION
Identify test to evaluate survey meter operation.

APPLICATION
Determine the performance of a survey meter.

ANALYSIS
Assess survey meter operation based on reference source test results.

31. Ascertain the activity linearity of the dose calibrator over the entire range of radionuclide activity to be used.

CONTENT BASE
1. NRC regulations
2. Dose calibrator
   a. Operation
   b. Quality control

COMPREHENSION
Define activity linearity.

APPLICATION
Determine the activity linearity of a dose calibrator.

ANALYSIS
Analyze activity linearity test results and assess dose calibrator performance.

32. Test accuracy of dose calibrator for commonly used radionuclides.

CONTENT BASE
1. NRC regulations
2. Dose calibrator
   a. Operation
   b. Quality control

COMPREHENSION
Define accuracy
APPLICATION
Determine the accuracy of a dose calibrator.
ANALYSIS
Analyze accuracy test results and assess dose calibrator performance.

33. Check for constancy of dose calibrator using a long-lived radionuclide standard.

CONTENT BASE
1. NRC regulations
2. Dose calibrator
   a. Operation
   b. Quality control

COMPREHENSION
Define constancy.
APPLICATION
Determine the constancy of a dose calibrator.
ANALYSIS
Analyze constancy test results and assess dose calibrator performance.

34. Perform basic computer operations.

CONTENT BASE
1. Digital computer components
   a. Hardware
   b. Software
   c. Peripheral devices
2. Computer operation
   a. Acquisition
   b. Data processing and analysis
   c. Display
3. SPECT reconstruction

COMPREHENSION
Define the following: peripheral devices, software and hardware.
APPLICATION
Choose the appropriate computer routines for data acquisition, processing, display and retrieval.
ANALYSIS
Analyze information obtained from a computer for accuracy and completeness.

35. Maintain proper environmental conditions for computer and associated equipment and supplies.

CONTENT BASE
1. Computer and associated equipment operating conditions
2. Data storage conditions

COMPREHENSION
Identify proper environment for optimal computer operation and data storage.
APPLICATION
Maintain appropriate environmental conditions for proper computer operation and data storage.
ANALYSIS
None

36. Conduct temperature checks on water baths and refrigerators.

CONTENT BASE
1. Water bath operation and maintenance
2. Refrigerator operation and maintenance
3. Thermometer calibration

COMPREHENSION
Identify the proper method for conducting temperature checks on water baths and refrigerator.
APPLICATION
Determine the temperature of water baths and refrigerator using a properly calibrated thermometer.
ANALYSIS
None

37. Operate centrifuge and conduct routine tachometer checks.

CONTENT BASE
1. Centrifuge components and types of centrifuges
2. Computation of relative centrifugal force
3. Quality control using a tachometer

COMPREHENSION
Identify the appropriate type of centrifuge for the procedure being performed and the method for computing relative centrifugal force.
APPLICATION
Calculate the relative centrifugal force given the rotating radius in cm, and the rotating speed in rpm. Determine centrifuging time when the optimum speed cannot be obtained.
ANALYSIS
None

38. Calibrate and use single-sample well counter.

CONTENT BASE
1. Basic electronic nomenclature
2. Sodium iodide scintillation detector system components
3. Sodium iodide scintillation detector performance characteristics
4. Gamma ray spectra
5. Quality control of a scintillation counter
6. Characteristics of a standard well detector
7. Counting geometry and efficiency

COMPREHENSION
State the procedure for calibrating a scintillation counter. Identify considerations about sample volume, counting geometry and amount of activity to be counted.
APPLICATION
Determine the correct calibration for a scintillation counter. Use appropriate sample volume, counting geometry and activity.
ANALYSIS
None

39. Perform film processor quality control.

CONTENT BASE
1. Automatic film processor operation
2. Automatic film processor quality control

COMPREHENSION
Identify quality control procedures to monitor film processor performance.
APPLICATION
Determine film processor performance using appropriate quality control procedures.
ANALYSIS
Assess results of quality control procedures and initiate corrective measures as needed.

GROUP III: CLINICAL PROCEDURES

40. Store and maintain adequate supplies including kits to assure timely completion of patient studies.

CONTENT BASE
1. Inventory control
   a. Usage rate
   b. Expiration date
2. Storage conditions for supplies
3. Ordering procedures
4. Patient scheduling

COMPREHENSION
List type and quantity of supplies required and identify method for obtaining them.

APPLICATION
Determine supply needs to assure that patient studies are scheduled on a timely basis.

ANALYSIS
None

41. Maintain and operate auxiliary equipment identified in the equipment procedures list.

CONTENT BASE
1. Safety requirements
2. Theory of operation
3. Quality control procedures

COMPREHENSION
Identify and state the proper procedure to use auxiliary equipment required for imaging procedures.

APPLICATION
Determine appropriate procedures to maintain and operate auxiliary equipment for imaging procedures.

ANALYSIS
None

42. Schedule patient studies, ensuring appropriate sequence for multiple procedures, and interact with hospital staff regarding special orders.

CONTENT BASE
1. Imaging and nonimaging procedures
2. Sequence of procedures
3. Special orders
   a. Premedication
   b. Dietary restriction
   c. Specimen collection
   d. Other
4. Radiopharmaceuticals
   a. Effective half-life
   b. Energy ranges
5. Inventory controls
6. Communication skills

COMPREHENSION
Identify appropriate patient scheduling sequences and special orders for procedures.

APPLICATION
Determine the most appropriate and timely sequence for patient studies and any special orders required.

ANALYSIS
Analyze patient scheduling difficulties and revise schedule accordingly.

43. Maintain appropriate patient procedure records.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. FDA
2. Written patient records and reports

COMPREHENSION
Identify appropriate written records to be maintained for patient procedures.

APPLICATION
None

ANALYSIS
None

44. Receive patient and provide proper nursing care during nuclear medicine procedure.

CONTENT BASE
1. Communication skills
2. Basic nursing procedures
   a. Body mechanics
   b. Vital signs
   c. Infection control
   d. First aid
3. Patient support devices
   a. Intravenous fluids
   b. Oxygen
   c. Foley catheter and drainage bag
   d. ECG monitor
   e. Other

COMPREHENSION
Identify basic nursing procedures.

APPLICATION
Determine appropriate nursing care during procedure.

ANALYSIS
Appraise a situation that requires nursing care be provided and determine the most appropriate action.

45. Maintain good communication with patient by explaining procedure, answering questions and listening to patient's comments.

CONTENT BASE
1. Knowledge of nuclear medicine procedures
2. Communication skills
3. Medical ethics

COMPREHENSION
Identify responsibilities of technologist in maintaining effective communication with patients.

APPLICATION
Recommend appropriate communication with patients given a particular situation.

ANALYSIS
None

46. Provide functionally safe and sanitary conditions for patient.

CONTENT BASE
1. Body mechanics
2. Infection control precautions
3. Medical legal aspects

COMPREHENSION
Identify unsafe or unsanitary conditions.

APPLICATION
Determine safe and sanitary conditions for patient.

ANALYSIS
None

47. Recognize emergency conditions and determine patient's vital signs when necessary.

CONTENT BASE
1. Vital signs
   a. Pulse rate
   b. Respiratory rate
   c. Blood pressure
   d. Temperature
2. Signs/symptoms
   a. Fainting
   b. Seizure
   c. Cardiopulmonary arrest
   d. Other

COMPREHENSION
Identify normal values for vital signs and describe signs and symptoms of medical emergencies.

APPLICATION
Recognize signs and symptoms of medical emergencies.

ANALYSIS
Assess an emergency situation and initiate appropriate action.

48. Administer cardiopulmonary resuscitation and first aid when necessary.

CONTENT BASE
1. Vital signs
2. Signs/symptoms of cardiopulmonary arrest
3. First aid techniques

COMPREHENSION
Describe CPR and first aid techniques.

APPLICATION
Determine patient condition and initiate CPR and/or appropriate first aid measures as indicated.

ANALYSIS
None

49. Receive patient and verify patient identification and written orders for study.

CONTENT BASE
1. NRC regulations
2. Patient preparation
3. Medical legal aspects
4. Communication skills

COMPREHENSION
Identify procedure for receiving patient and methods of verifying patient identification and written orders for study.

APPLICATION
Determine appropriate methods to receive patients and verify patient identification and written order for study.

ANALYSIS
None

50. Check procedural contraindications for study and obtain pertinent patient history.

CONTENT BASE
1. Communication skills
2. Medical/legal aspects
3. Patient preparation
   a. Premedications
   b. Dietary restrictions
   c. Radiopharmaceutical administration
   d. Other
4. Contraindications for nuclear medicine procedures

COMPREHENSION
Identify contraindications and pertinent patient history for nuclear medicine studies.

APPLICATION
Obtain pertinent patient history and determine if a contraindication for performing study exists.

ANALYSIS
None

51. When necessary, obtain written informed consent to perform study.

CONTENT BASE
1. Regulatory requirements
   a. FDA
   b. IND
2. Informed consent
3. Communication skills

COMPREHENSION
Define informed consent.

APPLICATION
Determine when informed consent is required.

ANALYSIS
None

52. Prepare patient for procedure as required.

(NOTE: THIS APPLIES TO PREPARATIONS THAT OCCUR IN THE NUCLEAR MEDICINE DEPARTMENT AND ARE NORMALLY PERFORMED BY THE TECHNOLOGIST.)

CONTENT BASE
1. Communication skills
2. Procedural requirements

COMPREHENSION
Identify patient preparation required for nuclear medicine procedures.

APPLICATION
Determine appropriate patient preparation to be performed for a specific procedure.

ANALYSIS
Analyze consequences of inappropriate patient preparation and initiate corrective action.

53. Transfer patient from wheelchair/stretcher to the imaging table.

CONTENT BASE
1. Communication skills
2. Body mechanics

COMPREHENSION
Identify patient transfer techniques.

APPLICATION
Determine appropriate transfer technique based on patient's condition and ability to cooperate.

ANALYSIS
None

54. Administer the appropriate radiopharmaceutical by the proper route.

CONTENT BASE
1. Approved radiopharmaceuticals
2. Radiopharmaceutical administration
   a. Approved routes
   b. Aseptic technique
   c. Bolus technique
3. Radiation safety

COMPREHENSION
Identify the appropriate radiopharmaceuticals for nuclear medicine procedures and the method of administration.

APPLICATION
Determine the appropriate radiopharmaceutical and route of administration for a procedure.

ANALYSIS
None

55. Discard contaminated materials in appropriate waste container.

CONTENT BASE
1. Regulatory requirements
2. Infection control precautions
3. Radiation safety practices

COMPREHENSION
Identify the appropriate methods for discarding contaminated materials.

APPLICATION
Determine which materials require special methods of disposal and discard them appropriately.

ANALYSIS
None

56. Wait appropriate length of time after administration of the radiopharmaceutical to begin imaging.

CONTENT BASE
1. Radiopharmacology
   a. Mechanisms of localization
   b. Biological and effective half-life
   c. Temporal relationship to other medications
   d. Blood clearance rates
2. Procedural requirements

COMPREHENSION
Identify appropriate waiting period after radiopharmaceutical administration to begin imaging procedure.

APPLICATION
Determine appropriate imaging time after radiopharmaceutical administration for a given procedure.

ANALYSIS
Analyze consequences of early or delayed imaging and initiate corrective measures as appropriate.

57. Select and prepare proper instrument, computer and auxiliary equipment necessary to perform imaging procedures as indicated by protocol.

CONTENT BASE
1. Nuclear medicine procedures

2. Imaging parameters
3. Data acquisition
4. Auxiliary equipment operation

COMPREHENSION
Identify instruments and auxiliary equipment available for imaging procedures.

APPLICATION
Determine the appropriate instrument, imaging and data acquisition parameters and auxiliary equipment necessary to perform an imaging procedure according to protocol.

ANALYSIS
None

58. Place the patient in correct position, using supportive materials and immobilizers, at appropriate distance from detector for obtaining each view.

CONTENT BASE
1. Nuclear medicine procedures
2. Patient positioning
   a. Anatomy
   b. Positioning terminology
   c. Immobilization
   d. Anatomical markers

COMPREHENSION
Identify routine patient position for an imaging procedure.

APPLICATION
Determine correct patient position for an imaging procedure, including correct detector-to-patient distance, using supportive materials and immobilizers as necessary.

ANALYSIS
Evaluate images for possible positioning errors and initiate corrective measures.

59. Indicate appropriate anatomical landmarks for each view of a procedure.

CONTENT BASE
1. Nuclear medicine procedures
2. Anatomical landmarks
3. Patient positioning

COMPREHENSION
Identify commonly used anatomical landmarks.

APPLICATION
Determine the appropriate anatomical landmark to be used for each view of a procedure.

ANALYSIS
None

60. Collect specimens according to imaging protocol if applicable.

CONTENT BASE
1. Nuclear medicine procedures
2. Collection techniques for blood, urine, CSF, etc.

COMPREHENSION
Identify procedures requiring specimen collection and describe collection procedure.

APPLICATION
Determine appropriate time for specimen collection using appropriate container.

ANALYSIS
None

61. Analyze image appearance or computer information for normal structure and artifacts making adjustments if necessary, and assuring correct information is supplied.

CONTENT BASE
1. Anatomy
2. Nuclear medicine procedures
3. Quality control procedures

COMPREHENSION
Identify anatomical structures and other information to be included in a diagnostic study. Also identify common artifacts that may appear on the images.

APPLICATION
Determine appropriate imaging parameters and data acquisition to deliver technically satisfactory diagnostic images and/or computer information.

ANALYSIS
Assess diagnostic images and/or computer information for technical quality and initiate corrective measures if appropriate.

62. Perform any special views as required.

CONTENT BASE
1. Nuclear medicine procedures
2. Patient positioning
   a. Anatomy
   b. Markers

COMPREHENSION
Identify need for special views.

APPLICATION
Recommend special views for an imaging procedure.

ANALYSIS
Assess images and determine most appropriate special views to aid image interpretation.

63. Retrieve and process patient data acquired on a computer.

CONTENT BASE
1. Data retrieval
2. Data processing techniques

COMPREHENSION
Identify techniques to retrieve and process data.

APPLICATION
Determine the appropriate technique to retrieve and process computer data for a diagnostic procedure.

ANALYSIS
Analyze processed patient data and assess appropriate computer manipulation for interpretation.

64. Process film according to manufacturer's specifications and film processor optimum operation.

CONTENT BASE
1. Film processor operation
2. Film types and properties
3. Film processing quality control

COMPREHENSION
Identify manufacturer's specifications for proper film processing and recognize optimum operation of film processor.

APPLICATION
Determine methods to properly process film and operate automatic film processor.

ANALYSIS
Examine images for problems related to film processing or automatic film processor problems and initiate corrective measures if appropriate.

65. Record information relative to any special circumstances affecting the procedure as needed.

CONTENT BASE
1. Nuclear medicine procedures
2. Quality control procedures

COMPREHENSION
Identify conditions which may affect the procedure and recognize the necessity of recording that information.

APPLICATION
Recommend information to be recorded relative to special circumstances affecting the procedure.

ANALYSIS
Differentiate those circumstances that would affect the procedure.

66. Determine hematocrit.

CONTENT BASE
1. Definition of hematocrit
2. Method of obtaining hematocrit
3. Micro hematocrit centrifuge operation

COMPREHENSION
Define hematocrit and identify when utilized in nuclear medicine procedures.

APPLICATION
Determine hematocrit.

ANALYSIS
None

67. Collect and process patient samples appropriately.

CONTENT BASE
1. Nuclear medicine procedures
2. Collection techniques for blood and urine
3. Sample processing and storage

COMPREHENSION
Identify type of specimen required for given procedure; describe collection, processing and storage procedures.

APPLICATION
Determine appropriate time for specimen collection; collect, process and store specimen as required.

ANALYSIS
None

68. Prepare a standard dilution.

CONTENT BASE
1. Standard preparation
   a. Radiopharmaceutical and activity required
   b. Amount of dilution required based on counting rate limitations of instrumentation
2. Dilution technique
   a. Calculation of dilution concentration
   b. Solvents and wetting solutions
   c. Use of volumetric glassware and pipets

COMPREHENSION
Identify necessary equipment, solvents and volumes need to prepare a standard dilution.

APPLICATION
Determine the appropriate dilution of a standard for a given procedure and calculate the amount of sample and solvent required.

ANALYSIS
Analyze effects of improper dilution on patient results.

69. Prepare patient specimens for analysis.

CONTENT BASE
1. Equilibration to room temperature
2. Lab equipment e.g., pipets, etc.
3. Protocol

COMPREHENSION
Identify materials necessary to prepare patient specimens.

APPLICATION
Determine protocol to be used for patient specimen preparation.

ANALYSIS
None

70. Count patient samples for statistically significant number of counts.

CONTENT BASE
1. Counting statistics
2. Effect of background
3. Level of activity to be counted

COMPREHENSION
Identify count required for statistical significance.

APPLICATION
Determine counts or time required to reach statistical significance for a given set of samples.

ANALYSIS
None

71. Choose correct detector-patient distance for external counting and count for a statistically significant number of counts.

CONTENT BASE
1. Collimator characteristics
2. Counting statistics
3. Effect of background

COMPREHENSION
Identify the appropriate patient-detector distance and the total count required for statistical significance.

APPLICATION
Determine appropriate detector-patient distance and counting times given a specific situation.

ANALYSIS
None

72. Review nonimaging procedures for possible technical errors that may alter results.

CONTENT BASE
1. Random errors
   a. Human variables
   b. Mechanical variables (pipets, centrifuge, etc.)
   c. Environmental variables (timing, temperature)
2. Systematic errors
3. Precision
   a. Standard deviation
   b. Coefficient of variation
4. Accuracy

COMPREHENSION
Identify variables that can cause random and systematic errors.

APPLICATION
Determine standard deviation and coefficient of variation of data points.

ANALYSIS
Analyze data to differentiate acceptable from unacceptable data and determine source of error.

73. Perform calculations, as required, to determine final results for nonimaging procedures.

CONTENT BASE
1. Calculations
2. Graphing techniques
   a. Data presentation on linear/semi-log plot
   b. Derivation of half-time and slope

COMPREHENSION
Identify formula and/or graph paper required to calculate results of an nonimaging procedure.

APPLICATION
Determine final results of a given nonimaging procedure using the appropriate formulae and/or graphing technique.

ANALYSIS
None

74. Report both patient calculated values and the reference range for nonimaging procedures.

CONTENT BASE
1. Patient records and reports
   a. Contents
   b. Medicolegal considerations
2. Reference ranges

COMPREHENSION
Identify the appropriate information to be reported for a nonimaging procedure.

APPLICATION
Determine the appropriate information to be reported for a nonimaging procedure.

ANALYSIS
None

GROUP IV: RADIOPHARMACY

75. Assemble and elute a radionuclide generator using aseptic technique.

CONTENT BASE
1. Shielding considerations
2. Types of generators ("wet" vs. "dry" column)
   a. Operation
   b. Elution technique
   c. Generator yield (volume and activity)
3. Aseptic technique
4. Radiation protection practices

COMPREHENSION
Describe the assembly and operation of a radionuclide generator. Define aseptic technique.

APPLICATION
Determine the appropriate elution technique for a particular generator and elute it using aseptic technique and appropriate radiation protection.

ANALYSIS
Assess operational problems and determine most appropriate corrective action.

76. Assay the activity of the generator eluate using a dose calibrator and affix label.

CONTENT BASE
1. NRC regulations
2. Units of radioactivity
3. Dose calibrator operation
4. Vial label

COMPREHENSION
Identify methods used to assay generator eluate and information that must appear on the label.

APPLICATION
Determine the appropriate procedure for assaying generator eluate using a dose calibrator and the appropriate information for the vial label.

ANALYSIS
Analyze circumstances contributing to improper assay of generator eluate in a dose calibrator and alter procedures accordingly.

77. Check the generator eluate for radionuclide and chemical contamination.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. USP
2. Dose calibrator operation
3. Units of radioactivity
4. Molybdenum-99 breakthrough and Al^{+3} testing
5. Allowable limits of ^{99}Mo and Al^{+3}

COMPREHENSION
Define radionuclidic and chemical purity and state the allowable limits of ^{99}Mo and Al^{+3} in generator eluate.

APPLICATION
Determine the appropriate procedure to check the generator eluate for radionuclide and chemical contamination.

ANALYSIS
Analyze circumstances leading to radionuclidic and chemical contamination and recommend methods for eliminating and/or minimizing contamination.

78. Review the daily work schedule to plan radiopharmaceutical needs.

CONTENT BASE
1. Patient scheduling
   a. Match procedure with appropriate radiopharmaceutical
   b. Time interval between radiopharmaceutical administration and procedure
   c. Length of time to complete procedure
2. Activity ranges for diagnostic procedures
3. Effect of radioactive decay and shelf-life on available radiopharmaceutical inventory

COMPREHENSION
Identify the radiopharmaceutical and activity range for each procedure required.

APPLICATION
Determine radiopharmaceutical needs required to complete daily work schedule based on shelf-life and decay.

ANALYSIS
Adjust daily work schedule to use available radiopharmaceutical inventory effectively.

79. Prepare radiopharmaceutical compounds.

CONTENT BASE
1. Kit procedures and techniques
   a. Activity calculations
   b. Activity and volume limits
   c. Aseptic technique
2. Preparation of compounds
3. Operation of dose calibrator
4. Radiopharmaceutical quality control results
   a. pH
   b. Color
   c. Clarity
   d. Particle size
   e. Radiochemical purity

COMPREHENSION
Describe the preparation of a specified ^{99m}Tc-labeled radiopharmaceutical compound.

APPLICATION
Determine the appropriate preparation of a specified radiopharmaceutical compound.

ANALYSIS
Analyze quality control results to determine quality of prepared radiopharmaceutical.

80. Determine the total volume and radioactivity to be added to a radiopharmaceutical kit within activity limits.

CONTENT BASE
1. Activity and chemical limits in kit preparation
2. Activity/volume calculations

COMPREHENSION
Identify the volume and activity of generator eluate to be added to a radiopharmaceutical kit.

APPLICATION
Determine the total volume and radioactivity to be added to a radiopharmaceutical kit within activity limits.

ANALYSIS
Analyze consequences of the addition of inappropriate volume or activity to a radiopharmaceutical kit.

81. Check total activity in radiopharmaceutical reaction vials with a dose calibrator.

CONTENT BASE
1. Activity limits in kit preparation
2. Dose calibrator operation
3. Units of activity

COMPREHENSION
Identify method for determining total activity in a radiopharmaceutical reaction vial.

APPLICATION
Determine the total activity in radiopharmaceutical reaction vials using a dose calibrator.

ANALYSIS
None

82. Calculate the concentration of radioactivity of a compound and label vial as to date, time of preparation, lot number, concentration and volume.

CONTENT BASE
1. Regulatory requirements
   a. NRC

b. USP
2. Units of activity
3. Radiopharmaceutical concentration calculation

COMPREHENSION
Identify appropriate labeling information for radiopharmaceutical preparations and how to calculate concentration of radioactivity.

APPLICATION
Calculate the concentration of radioactivity of a radioactive compound and label vials with the correct date, time of preparation, lot number, concentration and volume.

ANALYSIS
None

83. Check all radiopharmaceutical preparations for proper pH, color, clarity and particle size as appropriate.

CONTENT BASE
1. Radiopharmaceutical quality control
   a. pH testing
   b. Visual inspection
   c. Microscopic inspection

COMPREHENSION
Identify the procedures for checking radiopharmaceutical preparations for pH, color, clarity and appropriate particle size.

APPLICATION
Determine the appropriate quality control procedures for a specific radiopharmaceutical preparation.

ANALYSIS
Analyze circumstances leading to improper particle size, pH color or clarity of a radiopharmaceutical preparation and assess whether patients and/or nuclear medicine procedures would be affected adversely.

84. Determine the radiochemical purity of radiopharmaceutical preparations by chromatography.

CONTENT BASE
1. USP Regulations
2. Radiochemical purity testing
   a. Chromatography
   b. Acceptable limits of radiochemical impurities

COMPREHENSION
Define radiochemical purity and state the acceptable limits of radiochemical impurities for radiopharmaceuticals.

APPLICATION
Determine the appropriate method to evaluate the radiochemical purity of a specified radiopharmaceutical.

ANALYSIS
Examine chromatography results to determine if radiochemical purity of preparation is within acceptable limits.

85. Verify label on radiopharmaceutical vial, including concentration, specific activity, total activity, lot number, assay tie and date.

CONTENT BASE
1. Regulatory requirements
   a. NRC
   b. USP
2. Definition of label contents
   a. Concentration
   b. Specific activity
   c. Total activity
   d. Assay time and date

COMPREHENSION
Identify the appropriate information to appear on the label of a radiopharmaceutical vial.

APPLICATION
Determine the concentration, specific activity, total activity, lot number, assay time and date from the radiopharmaceutical vial label.

ANALYSIS
None

86. Calculate activity to be administered for diagnostic or therapeutic procedures.

CONTENT BASE
1. NRC regulations
2. Units of activity
3. Vial label contents (total activity, total volume, etc.)
4. Determination of elapsed time
5. Activity calculation
6. Acceptable activity range for diagnostic and therapeutic procedures

COMPREHENSION
Identify the formula to calculate activity to be administered for a diagnostic or therapeutic procedure.

APPLICATION
Calculate activity to be administered for diagnostic or therapeutic procedures.

ANALYSIS
None

87. Determine the volume or number of capsules of the radiopharmaceutical required for diagnostic and therapeutic procedures.

CONTENT BASE
1. NRC regulations
2. Units of activity
3. Vial label contents (total activity, total volume, etc.)
4. Determination of elapsed time
5. Activity calculation
6. Acceptable activity range for diagnostic and therapeutic procedures
7. Volume or capsule determination

COMPREHENSION
Identify the formula to determine the volume or number of capsules to be administered for a diagnostic or therapeutic procedure.

APPLICATION
Calculate the volume or number of capsules to be administered for a diagnostic or therapeutic procedure.

ANALYSIS
None

88. Withdraw correct volume of the radiopharmaceutical into a syringe using aseptic technique and proper radiation safety precautions.

CONTENT BASE
1. Aseptic technique
2. Radiation protection techniques
3. Venipuncture materials

COMPREHENSION
Describe proper preparation of a unit dose radiopharmaceutical in a syringe including aseptic technique and radiation safety precautions.

APPLICATION
Determine the proper procedure for withdrawing an accurate volume of radiopharmaceutical into a syringe using aseptic technique and radiation safety precautions.

ANALYSIS
None

89. Using a dose calibrator, verify the activity to be administered in the dispensed preparation.

CONTENT BASE
1. NRC regulations
2. Dose calibrator operation
3. Activity units
4. Activity range for diagnostic and therapeutic procedures

COMPREHENSION
Describe how to verify the activity of a radiopharmaceutical using a dose calibrator.

APPLICATION
Determine the activity of a radiopharmaceutical to be administered using a dose calibrator.

ANALYSIS
None

90. Verify that radionuclide impurity limits are not exceeded in the dispensed preparation.

CONTENT BASE

1. Regulatory requirements
   a. NRC
   b. USP
2. Radionuclide purity testing
3. Acceptable limits of radionuclide impurities
4. Dose calibrator operation
5. Multichannel analyzer operation

COMPREHENSION

Identify radionuclide impurity limits and methods for their determination.

APPLICATION

Determine the appropriate methods to evaluate radiopharmaceutical preparations for radionuclidic impurities and confirm that limits are not exceeded.

ANALYSIS

Analyze situations in which radionuclidic impurity limits are exceeded and recommend remedial measures.

91. Maintain appropriate radiopharmaceutical preparation and administration records to comply with regulatory requirements.

CONTENT BASE

1. Regulatory requirements
   a. NRC
   b. USP
2. Generator eluate assay
   a. Dose calibrator/whole vial assay
   b. Radionuclide and chemical contamination
3. Radiopharmaceutical kit preparation
   a. Volume and activity calculations
   b. Volume of generator eluate used
   c. Total activity assay
4. Radiopharmaceutical quality control
   a. pH
   b. Color
   c. Clarity
   d. Particle size
   e. Radiochemical purity
5. Patient radiopharmaceutical administration
   a. Name
   b. Examination
   c. Activity
   d. Volume
   e. Lot number
   f. Time and date
   g. Misadministration

COMPREHENSION

Identify regulations regarding written records for radiopharmaceutical preparation and administration and the information to be recorded to comply with regulations.

APPLICATION

None

ANALYSIS

None

92. Transfer radioactive gas or liquid into administration equipment if appropriate.

CONTENT BASE

1. Operation of radioactive gas/aerosol administration equipment
2. Radiation safety precautions

COMPREHENSION

Identify the appropriate procedure for loading radioactive gas/liquid into administration equipment.

APPLICATION

Choose the appropriate method for loading radioactive gas into administration equipment given specific circumstances, using appropriate radiation safety precautions.

ANALYSIS

None

93. Label cells with a radiopharmaceutical according to protocol for procedure.

CONTENT BASE

1. Labeling procedure
   a. Lab equipment required
   b. Anticoagulants
   c. Chemical reactions to stop tagging
   d. Cell washing
   e. Radiopharmaceuticals required
2. Aseptic technique
3. Centrifuge operation

COMPREHENSION

Identify appropriate blood components and equipment necessary to label cells with a radiopharmaceutical.

APPLICATION

Determine appropriate procedure for labeling blood cells with a given radiopharmaceutical.

ANALYSIS

None