Nuclear Medicine Radiation Protection

1. All nuclear medicine procedures involve the administration of a _____ to the patient.
    a. Drug
    b. Radiopharmaceutical
    c. Substance
    d. Medicine
2. For diagnostic nuclear medicine procedures, trace amounts of compounds are labeled with _____ or positron emitters.
    a. Electron
    b. Neutron
    c. Photon
    d. Alpha
3. Positron emitters allow imaging of the 3-D spatial distribution of the radiopharmaceutical using ____.
    a. PET
    b. SPECT
    c. Planar imaging
    d. SPECT-CT
4. In a typical nuclear medicine facility the source storage and preparation area are referred to as the _____.
    a. Storeroom
    b. Prep area
    c. Anti-room
    d. Hot lab
5. What power supply should be available in a nuclear medicine facility?
    a. Stable
    b. Low-current
    c. High-current
    d. Renewable
6. What should be used at the entrance of controlled and supervised areas to prevent inadvertent entry?
    a. Signs
    b. Warning lights
    c. Locks
    d. A & B
7. Radiopharmacies, where radioactive materials are handled, should have which of the following?
    a. Shielded storage for radioactive sources
    b. Emergency eyewash
    c. Emergency shower
    d. All the above
8. Radiopharmacies should have _____ for minimizing the spread of contamination in case of spillage.
    a. Sinks
    b. Drip trays
    c. Containers
    d. Tubs

9. Walls of a radiopharmacy should be finished in an impermeable material that is _____ and resistant to chemical change.
    a. Colorful
    b. Bright
    c. Washable
    d. Clean
10. Radiopharmacies handling radioactive gasses should have a _____ for proper ventilation.
    a. Fume hood
    b. System
    c. Area
    d. Fan
11. Rooms designated for patients undergoing radiopharmaceutical therapy should have _____.
    a. Separate toilets
    b. Washing facilities
    c. Separate vending machine
    d. A & B
12. Specifications of room shielding, including calculations should be performed by a _____.
    a. Radiation safety officer
    b. Medical physicist
    c. Radiologist
    d. Nuclear scientist
13. Radiopharmaceuticals should be manufactured according to good manufacturing practice following relevant international standards for _____.
    a. Radionuclide purity
    b. Specific activity
    c. Radiochemical purity
    d. All the above
14. What equipment **does not** detect ionizing radiation?
    a. Probes
    b. Gamma camera
    c. CT scanner
    d. PET scanner

For questions 15 and 18 determine the design feature category for the feature listed.

15. Uniformity
    a. Detector feature
    b. Data acquisition feature
    c. Data processing system
    d. Collimators
16. Whole body imaging
    a. Detector feature
    b. Data acquisition feature
    c. Data processing system
    d. Collimators

17. Curve generation
    a. Data processing system
    b. Detector feature
    c. Collimators
    d. Data acquisition feature
18. Tomography
    a. Data processing system
    b. Detector feature
    c. Collimators
    d. Data acquisition feature
19. What design feature **should not** be considered for PET scanners?
    a. Detector features
    b. Processing of SPECT data
    c. Time of flight capability
    d. Emergency stop
20. True or false. Security of radioactive sources should include unsealed radiopharmaceuticals, radionuclide generators, dispensing equipment, and sealed sources used for calibration and quality control tests.
    a. True
    b. False
21. What should be maintained to check and confirm that sources are in their assigned location and secure?
    a. Storage room
    b. Lead container
    c. Inventory list
    d. Labeled shelves
22. Various areas and rooms in a nuclear medicine facility should be classified as _____.
    a. Controlled areas
    b. Supervised areas
    c. Public areas
    d. A & B

For questions 23 through 26 choose the appropriate security level for the area listed.

23. NM Imaging rooms housing radiopharmaceuticals
    a. Public area
    b. Controlled area
    c. Supervised area
    d. Accessible area
24. Examination rooms
    a. Public area
    b. Controlled area
    c. Supervised area
    d. Accessible area

25. The area around the control panel of hybrid imaging equipment
    a. Public area
    b. Controlled area
    c. Supervised area
    d. Accessible area
26. Rooms for preparation of radiopharmaceuticals
    a. Public area
    b. Controlled area
    c. Supervised area
    d. Accessible area
27. True or false. The development and review of rules and procedures should involve representatives of all health professionals involved in nuclear medicine.
    a. True
    b. False
28. Which of the following is an exception and may be brought into an area where radioactive materials are used?
    a. Cosmetics
    b. Smoking materials
    c. Cutlery
    d. Food radiolabeled for patient study
29. What should never be operated by mouth?
    a. Pipettes
    b. Opening a syringe
    c. Opening a needle
    d. Instruments
30. What information should be clearly labeled on containers used for radioactive material?
    a. Name of radionuclide
    b. Chemical form
    c. Activity
    d. All the above
31. What material should not be used as shielding material?
    a. Lead
    b. Copper
    c. Tungsten
    d. Lead glass
32. Shielding incorporating _____ is usually more suitable for beta-emitting materials.
    a. Lead
    b. Tungsten
    c. Acrylic
    d. Lead glass

33. What is not a normal route to administer a radiopharmaceutical?
    a. Transdermal
    b. Oral
    c. Intravenous injection
    d. Intra-arterial injections
34. What should staff do when leaving their work area?
    a. Remove protective clothing
    b. Wash their hands
    c. Eat a snack
    d. A & B
35. The increased occupational dose for staff performing PET procedures comes from _____.
    a. Injecting the radiopharmaceutical
    b. Cleaning the exam room
    c. Patient handling
    d. Replacing the radiopharmaceutical
36. What is one of the materials that should be used to transport radiopharmaceuticals used for PET scans?
    a. Lead container
    b. Silver container
    c. Copper container
    d. Aluminum container
37. Solutions containing pure low-energy beta emitters, such as ^{14}C, require a _____ shield to attenuate the beta particles.
    a. Lead
    b. Plastic
    c. Tungsten
    d. Glass
38. Labs and other work areas which work with unsealed radiopharmaceuticals should be monitored both for external radiation and for _____ contamination.
    a. Floor
    b. Wall
    c. Ceiling
    d. Surface
39. Survey meters for external monitoring should be calibrated using the ____ as the unit of measure.
    a. Rem
    b. Millirem
    c. Sievert
    d. Rad
40. Occupational exposure monitoring involves which of the following except _____.
    a. Distribution
    b. Interpretation
    c. Assessment
    d. Investigation

41. The dosimetry monitoring period is typically a range of _____.
    a. < 1 month
    b. 1 to 2 months
    c. 1 to 3 months
    d. 1 to 4 months
42. Which of the following is a dose limit applicable to nuclear medicine workers?
    a. Limit for effective dose
    b. Limits for the equivalent dose to the lens of the eye
    c. Limits for the equivalent dose to the skin and extremities
    d. All the above
43. Monitoring the _____ with an external detector assesses the iodine update for individuals handling radioiodine.
    a. Hands
    b. Thyroid
    c. Skin
    d. Lens of the eye
44. True or false. When dosimeters are not in use, staff should take them home each night.
    a. True
    b. False
45. A staff exposure exceeding an effective dose of _____ per month should prompt an investigation.
    a. 0.5 mSv
    b. 0.6 mSv
    c. 0.7 mSv
    d. 0.8 mSv
46. The primary purpose of _____ is to assess the initial and continuing fitness of employees.
    a. Human resources
    b. Infection control
    c. Health surveillance
    d. Employee health
47. For pregnant workers, what is the dose limit for the embryo or fetus?
    a. 1 mSv
    b. 2 mSv
    c. 3 mSv
    d. 4 mSv
48. Most diagnostic procedures with ____ do not cause high fetal doses.
    a. Iodine-131
    b. ^{99m}Tc
    c. Gallium
    d. Indium-111
49. As a rule, a pregnant patient should not have radioiodine therapy unless it is _____.
    a. Ordered by a physician
    b. Reviewed by the radiologist
    c. Lifesaving
    d. Reviewed by the medical physicist

50. Which of the following is not a correct method to verify patient identification?
    a. Name
    b. Birthdate
    c. Address
    d. Patient sex
51. The radiation dose to the bladder can be minimized by _____.
    a. Drinking plenty of fluid
    b. Frequently emptying the bladder
    c. Resting
    d. A & B
52. What should be established for each type of radiopharmaceutical therapy performed?
    a. Protocols
    b. Safety measures
    c. Patient instructions
    d. Order forms