I. Diagnostic Procedures (~35%) [70 items]

A. Administration of Radiopharmaceuticals
   1. Dosage determination
      a. Calculation of pediatric dose
      b. Calculation of radiopharmaceutical/pharmaceutical dose
      c. Volume determination
      d. Units – calculations and conversion
      e. Dose determination according to scan mode and equipment type

   2. Dose preparation and administration
      a. Verify correct radiopharmaceutical for exam
      b. Preparation for administration
      c. Assay in dose calibrator
      d. Radiopharmaceutical labeling
      e. Administration technique
      f. Residual dose measurement

   3. Routes of administration
   4. Intravenous injection techniques
   5. Factors affecting biodistribution
      a. Cardiology
         i. Serum glucose level
         ii. Serum insulin level
      b. Neurology
         i. Stimulation
         ii. Surgical variants
         iii. Radiation treatment
         iv. Serum insulin/glucose levels
         v. Psychotropic drugs
         vi. Ictal vs. inter-ictal state
      c. Oncology
         i. Serum insulin/glucose levels
ii. Exercise
iii. Chemotherapy
iv. Radiation therapy
v. Surgery/biopsy
vi. Hemopoietins
vii. Muscle tension
viii. Hydration
ix. Inflammatory disease
tax. Infectious processes
xi. SSRI medication

B. Administration of interventional pharmaceuticals, pharmaceuticals and contrast media

1. Basic concepts
   a. Indications
   b. Contraindications
   c. Adverse reactions
   d. Medication interactions
   e. Dosing and route of administration
   f. Pediatric considerations

2. Emergency care
   a. CPR
   b. Emergency medications
   c. Diabetic complications
   d. Contrast reactions
   e. hypoglycemia

3. Pharmaceuticals
   a. Cardiology
      i. Dobutamine
      ii. Adenosine
      iii. Dipyridamole
      iv. Regadenoson
      v. Glucose
      vi. Insulin
   b. Neurology
      i. Sedatives/Anxiolytics
      ii. Antiseizure
   c. Oncology
      i. Diuretics
      ii. IV/oral hydration
      iii. Sedatives/ Anxiolytics
      iv. Insulin

4. Contrast media
   a. Oral
   b. Non-ionic
   c. Ionic

C. Gated Procedures

1. Equipment
2. Lead placement
3. Sources of error
   a. Patient
b. Equipment

D. Imaging Techniques:

1. Cardiology:
   a. History and assessment
   b. Indications and contraindications
   c. Patient preparation/instructions
      i. pre-arrival
      ii. pre-injection
      iii. post-injection
      iv. post-procedure– discharge instructions
   d. ECG’s
      i. Patient preparation, electrode placement
      ii. Rate calculation
      iii. Normal and abnormal rhythms
   e. Exercise
   f. Uptake period
   g. Patient positioning
      i. Low dose scout
      ii. Transmission
      iii. Anatomical markers
   h. Imaging techniques
      i. Anatomy/physiology/clinical indications
      ii. Rest/Stress Perfusion
      iii. Myocardial Viability

2. Neurology:
   a. History and assessment
   b. Indications and contraindications
   c. Patient preparation/instructions
      i. pre-arrival
      ii. pre-injection
      iii. post-injection
      iv. post-procedure– discharge instructions
   d. Uptake time
   e. EEG monitoring
      i. Patient preparation
      ii. Seizure activity patterns
   f. Patient positioning
   g. Imaging techniques
   h. Anatomy/physiology/clinical indications
      i. Epileptic seizures
      ii. Dementia
      iii. Tumor
      iv. Movement disorders

3. Oncology:
   a. History and assessment
   b. Indications and contraindications
   c. Patient preparation/instructions
      i. pre-arrival
      ii. pre-injection
      iii. post-injection
iv. post-procedure – discharge instructions

4. Acquisition modes
   a. 2D
   b. 3D
   c. Time of Flight
   d. Emission
   e. Transmission
      i. Measured
      ii. CT
   f. Single bed position
      i. Post-injection start time
      ii. Scan duration
   g. Dynamic imaging
      i. Framing rates
      ii. Injection sites/techniques
   h. Whole body imaging
      i. Post-injection start time
      ii. Number of bed positions
      iii. Scan duration/bed
      iv. Slice overlap

II. Instrumentation/Quality Control (~30%) [60 items]

A. Survey Meter
   1. Operating principles
   2. Quality control
   3. Source selection
   4. Interpretation of QC results

B. Dose calibrator
   1. Operating principles
   2. Quality control (accuracy, linearity, geometry, constancy)
   3. Frequency of quality checks
   4. Source selection
5. Interpretation of results

C. Well Counter
1. Operating principles
2. Quality control (constancy, energy FWHM, chi-square)
3. Frequency of quality checks
4. Source selection
5. Interpretation of results

D. Scintillation Detector Systems
1. Principles of scintillation detection
2. Detector materials
   a. BGO
   b. LSO
   c. GSO
   d. NaI
3. System types
   a. Dedicated PET
      i. Full ring
      ii. Partial ring
      iii. Detector panels
   b. Integrated PET/CT
4. Quality control
   a. Normalization
   b. Blank scan
   c. Gains (Singles)
   d. Calibration factors for quantification
   e. Scanner failure/recognition of instrumentation artifacts
      i. Detector failure
      ii. High voltage drift
      iii. Energy drift
      iv. Gain drift
      v. Power supply drift/failure
      vi. Temperature drift (cooling system failure)
      vii. Coincidence timing malfunction
      viii. Transmission source malfunction
      ix. Septa mis-positioning/alignment
   x. Imaging table failure
5. System performance
   a. Scatter fraction
   b. Randoms fraction
   c. Noise equivalent count rate (NEC)
   d. NEMA standards and testing

E. Theory of Operation
1. Principles of Coincidence Detection
   a. Trues
   b. Randoms
   c. Scatter
   d. Lines of response (LORs)
   e. Delayed event
   f. Coincidence timing window
2. Image Formation and Reconstruction
   a. Sinograms
      i. 2D
      ii. 3D
      iii. Fourier rebinning
      iv. Filtered back projection (FBP)
   v. Iterative reconstruction
      a. Ordered subset expectation maximization (OSEM)
      b. Maximum likelihood expectation maximization (MLEM)
   b. Image filters/cutoff frequencies

3. Data processing/corrections
   a. Normalization
   b. Decay correction
   c. Attenuation correction
      i. Calculated
      ii. Measured
      iii. Segmented
      iv. No attenuation correction
   d. Random correction
   e. Scatter correction

F. Data Analysis
   1. Quantitative analysis
      a. Region of interest
      b. Time activity curves
      c. Standardized Uptake Value (SUV)
         i. Methods of calculation
         ii. Sources of error
      d. Metabolic flow rate measurement and analysis
      e. R to L count profiles and histogram
      f. Cardiac polar mapping
      g. Other
   2. Image reconstruction variants

G. Basic Principles of Image Fusion/Image Registration
   1. Manual
   2. Mechanical
   3. Automated
      a. Rigid
      b. Deformable

H. Image Artifacts
   1. Pre-procedure
      a. Medications
      b. Prosthetics
      c. Therapeutic effects
      d. Exercise
   2. Injection/uptake
      a. Muscle tension
      b. Injection sites/tubing
      c. Radioactive contamination
      d. Environment (temperature, noise)
3. Scanning Procedure
   a. Patient motion
   b. Transmission/emission (misalignment)
   c. Bed position overlap
   d. Urinary catheter lines
   e. IV lines
   f. High Z material
   g. Filter/cutoff selection
   h. Partial volume effect
   i. Attenuation correction
   j. CT
      i. Contrast
      ii. Attenuation correction

III. RADIATION PROTECTION (~10%) [20 items]

A. Personal protection/monitoring
   1. Basic concepts (ALARA)
   2. Personnel protection
      a. Time
      b. Distance
      c. Shielding
         i. Patient dose
         ii. Dose calibrator
         iii. Scanning room
         iv. Waiting room
         v. Control room
         vi. Patient holding room
         vii. Waste
   3. Personnel monitoring devices (body/extremity)
   4. Regulatory requirements including appropriate signage

B. Area/facilities monitoring
   1. Basic concepts
   2. Survey equipment
   3. Radiation surveys
   4. Regulatory requirements

C. Packaging and storage of radioactive materials
   1. Inspection of incoming/outgoing materials
   2. Storage of radiopharmaceuticals

D. Records
   1. Shipping of radioactive materials
   2. Receipt of radioactive materials
   3. Administration of radioactive materials
   4. Storage of radioactive materials
   5. Disposal of radioactive materials
   6. Radiation surveys

E. Radioactive decontamination
1. Area
2. Personnel

**F. Disposal of Radioactive Waste**
1. Release to environment
2. Decay to storage
3. Incineration
4. Transfer to authorized recipient

**G. Medical Events**
1. Definitions
2. Reporting and notification

**IV. RADIOPHARMACEUTICALS (~25%) [50 items]**

**A. Radiopharmaceutical Characteristics**
1. Method of localization
2. Radiopharmaceutical kinetics
3. Radiopharmaceutical dosimetry
4. Radiopharmaceutical biodistribution and normal variants

**B. Physical properties of radioactive materials**
1. Types of emissions
2. Energies
3. Decay rate and half-life

**C. Positron radionuclide principles**
1. Positron decay
2. Positron energy
3. Annihilation reaction
4. Bremsstrahlung radiation
5. Decay factors
6. Exposure rates
7. Half value layer

**D. Radionuclide production**
1. Cyclotron
   a. Principles of operation
   b. Targetry
2. Generators – Ge-68/Ga-68, Sr-82/Rb-82
   a. Principles of operation
   b. Elution
   c. Quality control

**E. Synthesis of radiopharmaceuticals**
1. Basic chemistry
2. Synthesis modules

**F. Quality control of radiopharmaceuticals/radiochemicals/chemicals**
1. Purity
2. Identity
3. Sterility
4. Apyrogenicity
5. pH
6. Stability

PROCEDURES LIST
Cardiology
  CMS approved indications, including but not limited to:
  1. Rest/stress perfusion
  2. Viability
Neurology
  CMS approved indications, including but not limited to:
  1. Alzheimer
  2. Epileptic seizures
     Other indications
  3. Dementia
  4. Brain tumor
  5. Movement disorder
Oncology
  CMS approved indications, including but not limited to:
  1. Colon cancer
  2. Cervical cancer
  3. Head/Neck cancer
  4. Non-small cell lung cancer
  5. Solitary pulmonary nodule (SPN) evaluation
  6. Breast cancer
  7. Melanoma
  8. Lymphoma
  9. Thyroid cancer
     Other indications:
  10. Ovarian cancer
  11. Pancreatic cancer
  12. Sarcomas
  13. Prostate
  14. Neuroendocrine tumor
Other
  1. F-18 sodium fluoride - skeletal imaging
  2. F-18 FDG inflammation/infection imaging

DIAGNOSTIC RADIOPHARMACEUTICALS
1. C-11 acetate
2. C-11 Choline
3. C-11 Palmitate
4. F-18 fluorodeoxyglucose (FDG)
5. F-18 fluorodopa (F-Dopa)
6. F-18 sodium fluoride
7. F-18 fluorothymidine (FLT)
8. F-18 fluoromisonidazole (FMISO)
9. N-13 ammonia
10. O-15 O2
11. O-15 water
12. Rb-82 chloride
13. F-18 sodium fluoride
14. F-18 florbetapir
15. F-18 flurpiridaz
16. F-18 choline
17. Ge-68
18. Ga-68 dotatoc
19. Ga-68 dotanoc
20. Ga-68 dotatate
21. I-124
22. Cu-64
23. C-11 choline
24. F-18 flutemetamol
25. F-18 florbetaben
26. F-18 fluciclovine

**MISCELLANEOUS PHARMACEUTICALS**
1. Acetylsalicylic acid
2. Anticoagulants
3. Antiarrhythmics
4. Calcium channel blockers
5. ACE inhibitors
6. Cholesterol-lowering drugs
7. Digoxin
8. Nitrates
9. Beta blockers
10. Caffeine
11. Growth stimulation hormone factor
12. Hematopoietins
13. Diabetic medications
14. Steroids
15. Glucose

**INTERVENTIONAL PHARMACEUTICALS**
1. Adenosine
2. Dipyridamole
3. Diuretics
4. Aminophylline
5. Dobutamine
6. Theophylline
7. Furosemide
8. Insulin
9. Glucose
10. Sedatives/Anxiolytics

**CONTRAST MEDIA**
1. Oral
2. Non-ionic
3. Ionic
EQUIPMENT LIST

1. Dedicated PET scanner and integrated PET/CT scanner
2. Dose calibrator
3. Well counter
4. Survey meter
5. Glucose meter
6. ECG monitor
7. Gate box/trigger
8. Defibrillator, emergency cart access
9. O2 saturation monitor
10. Intravenous infusion pump
11. EEG monitor
12. Radiopharmaceutical generator
13. Dose delivery system

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