



Nuclear Cardiology Examination Content Outline Summary

	Domain	Percentage
1	Selection of Nuclear Cardiology Imaging Tests	20%
2	Performance of Nuclear Cardiology Imaging Tests (including Instrumentation, Protocols, and Processing)	32%
3	Interpretation of Nuclear Cardiology Imaging Tests	35%
4	Radiation Safety and Management of Radiopharmaceuticals	13%
Total		100%

Certification Board of Nuclear Cardiology Content Outline

(Detailed Outline)

1	Selection of Nuclear Cardiology Imaging Tests 20%	Knowledge, skill and/or ability related to selection of nuclear cardiology imaging tests
1.A	Synthesize clinical data (history, physical exam, other test results, etc.)	<ul style="list-style-type: none"> Ability to take relevant history for risk assessment Ability to perform a target-oriented physical examination to ascertain safety for stress testing Ability to utilize other test results to complement nuclear imaging Knowledge of pretest risk (Bayes theorem, etc.) Knowledge of statistics as it applies to evaluating clinical tests
1.B	Determine appropriateness of test ordered	<ul style="list-style-type: none"> Ability to apply appropriate use criteria Ability to assess patient's ability to perform sufficient exercise Knowledge of indications and contraindications of various stressor modalities (pharmacologic stress, exercise stress, etc.) Knowledge of indications for transition from submaximal exercise to pharmacologic stress
1.C	Select appropriate stressor	<ul style="list-style-type: none"> Knowledge of impact of current medications (caffeine, dipyridamole, theophylline, etc.) on pharmacologic vasodilator stress test Knowledge of mechanism of action of stressors (pharmacologic, exercise, etc.) Ability to synthesize patient characteristics in selecting radiopharmaceutical and dose (weight-based dosing, circumference/distribution of weight, etc.) Knowledge of SPECT radiopharmaceuticals and their characteristics (production, energy, half-life, etc.)
1.D	Select appropriate radiopharmaceutical and dose (including knowledge of radiation biology, radiation physics, and instrumentation)	<ul style="list-style-type: none"> Knowledge of importance of understanding hazards of radiation and need for ALARA Knowledge of principles of radiation physics (scatter, types of electromagnetic emissions, shielding, etc.) Knowledge of radiation biology (absolute dose, equivalent dose, effective dose, units, etc.)
1.E	Select appropriate imaging protocol (stress/rest, rest/stress, stress only, viability, etc.)	<ul style="list-style-type: none"> Knowledge of first-pass myocardial extraction, redistribution, and retention of different perfusion tracers Knowledge of biological effects on the body Knowledge of how SPECT and PET systems acquire images Knowledge of impact of SPECT and PET radiopharmaceuticals and their characteristics on test selection Knowledge of advantages and limitations of SPECT and PET imaging
1.F	Select appropriate imaging modality (SPECT, PET, radionuclide ventriculography)	<ul style="list-style-type: none"> Ability to synthesize patient characteristics with other considerations in selecting protocols Knowledge of imaging protocols and their advantages/disadvantages Knowledge of different viability protocols (PET FDG, thallium, SPECT, nitrate-enhanced technetium, etc.) Knowledge of benefits and applications of stress-only imaging

2	Performance of Nuclear Cardiology Imaging Tests (including Instrumentation, Protocols, and Processing) 32%	Knowledge, skill and/or ability related to performance of nuclear cardiology imaging tests (including instrumentation, protocols, and processing)
2.A	Instruct and prepare patient (using printed/recorded material, securing patient consent, etc.)	<ul style="list-style-type: none"> Knowledge of impact of medications on stress myocardial perfusion results Knowledge of impact of patient positioning on results Knowledge of potential complications of agents used in stress testing Knowledge of stress protocols
2.B	Perform stress tests (including complications and side effects of stress testing)	<ul style="list-style-type: none"> Knowledge of pertinent physiology/pathophysiology as it applies to stress testing Knowledge of how to manage complications Knowledge of when to terminate test Knowledge of pharmacokinetics of radiopharmaceuticals
2.C	Administer radiopharmaceuticals	<ul style="list-style-type: none"> Knowledge of SPECT and PET tracers and their effects Knowledge of adequacy of counts Knowledge of standard acquisition parameters and variables Knowledge of time vs radiotracer dose concepts
2.D	Define acquisition parameters (positioning of patient, etc.)	<ul style="list-style-type: none"> Knowledge of types of attenuation correction Knowledge of benefits and limitations of attenuation correction Knowledge of optimal timing of acquisition after radiotracer administration, based on radiotracer kinetics and distribution
2.E	Acquire images [with or without attenuation correction]	<ul style="list-style-type: none"> Knowledge of equipment and quantum mechanisms in play in image acquisition (collimators, crystals, photomultiplier tubes, etc.) Knowledge of multigated acquisitions (MUGAs) Knowledge of the physics of imaging
2.F	Utilize solid-state cameras	<ul style="list-style-type: none"> Knowledge and application of specific protocols for perfusion and viability assessment Knowledge and application of dynamic myocardial blood flow imaging protocols, and calculation of coronary flow reserve
2.G	Perform SPECT, PET, SPECT/PET imaging (including viability, perfusion, novel methods, myocardial flow reserve, and inflammation imaging)	<ul style="list-style-type: none"> Knowledge and application of novel SPECT, PET, and SPECT/PET protocols (sarcoid, amyloid, I-123-MIBG, etc.) Knowledge of pertinent physiology/pathophysiology Knowledge of physiology/pathophysiology Ability to assess absolute coronary blood flow Ability to assess coronary flow reserve
2.H	Interpret coronary blood flow	<ul style="list-style-type: none"> Knowledge of benefits and limitations of different methods of image processing (ramp filter, iterative reconstruction, etc.) Knowledge of the physics and mechanisms of image processing (including filtered back projections)
2.I	Select optimal imaging protocols [PET vs SPECT]	<ul style="list-style-type: none"> Knowledge of frequency cutoffs Knowledge of different filters and reconstruction methods Knowledge of data reorientation and display
2.J	Process images (filtered back projection, iterative reconstruction, motion correction, etc.)	<ul style="list-style-type: none"> Knowledge and application of motion-correction algorithms Knowledge of strengths and limitations of motion correction (vertical, horizontal, etc.) Knowledge of gated SPECT processing and artifacts
2.K	Perform routine camera quality control processes (daily flood tests, center-of-rotation checks, etc.)	<ul style="list-style-type: none"> Knowledge of processing of MUGA images, including quantifying EF and volumes (septal view, background noise, etc.) Knowledge of mechanics of quality control processes (intrinsic/extrinsic floods, differing radiation detectors, differing dose calibrators, etc.)
2.L	Perform routine non-camera instrumentation quality control processes (survey meter calibration, dose calibrators, etc.)	<ul style="list-style-type: none"> Knowledge of regulatory requirements for quality control Ability to identify common abnormalities during quality control processes (photomultiplier tube out, center-of-rotation error, etc.)

3	Interpretation of Nuclear Cardiology Imaging Tests 35%	Knowledge, skill and/or ability related to interpretation of nuclear cardiology imaging tests
3.A	Review raw data and interpret extracardiac findings (including oddities out of normal perfusion interpretation, RV hypertrophy, and papillary muscle)	<p>Knowledge of methods of raw data display (sinograms, etc.)</p> <p>Ability to interpret raw data for artifacts (motion, soft tissue, subdiaphragmatic count activity, shifting breast, etc.)</p> <p>Ability to identify abnormal extracardiac findings (pericardial effusions, soft-tissue masses, hiatal hernias, etc.)</p> <p>Knowledge of comparison of stress and rest images (comparable breast positioning, motion, arm positioning, etc.)</p>
3.B	Assess and manage image quality (repeat scan; perform prone imaging; wait for gastrointestinal clearance; have patient drink water; perform upright imaging; perform usual supine imaging; etc.)	<p>Knowledge of and ability to detect image processing artifacts (motion, soft tissue, subdiaphragmatic count activity, shifting breast, etc.)</p> <p>Knowledge of manifestations of rest/stress changes in orientation and alignment</p> <p>Ability to assess proper gating</p> <p>Ability to identify regional wall motion abnormalities and probable vessel territories</p> <p>Ability to use regional wall motion to aid in study interpretation [normal vs abnormal]</p>
3.C	Assess functional information and its reliability (including gated images and viability)	<p>Knowledge of limitations of EF estimation (in the presence of large count reductions, LV hypertrophy, ventricular cavity size, etc.)</p> <p>Knowledge of post-stress stunning and its implications</p> <p>Ability to assess MUGA images for LV/RV function</p> <p>Knowledge of PET sarcoid imaging protocol (including patient preparation and high fat diet)</p> <p>Knowledge of SPECT/PET amyloid imaging protocol (including the use of Tc-pyrophosphate, Tc-MDP, and FDG)</p>
3.D	Assess disease-specific processes (sarcoid, amyloid, infection, heart failure, sympathetic innervation, coronary calcium score, etc.)	<p>Knowledge and application of specific heart failure imaging (including the use of I-123-MIBG)</p> <p>Knowledge of CT calcium score protocol using dedicated CT, SPECT/CT, or PET/CT</p> <p>Knowledge of functionality of right ventricle</p> <p>Ability to assess normal vs abnormal findings</p> <p>Ability to assess defect size</p> <p>Ability to assess viability (PET FDG, thallium, SPECT, nitrate-enhanced technetium, etc.)</p>
3.E	Assess processed perfusion images (including attenuation-corrected images and viability)	<p>Ability to assess defect reversibility/nonreversibility</p> <p>Ability to assess defect location</p> <p>Ability to assess transient ischemic dilation (TID)</p> <p>Ability to assess defect severity</p> <p>Ability to identify infarct vs ischemia</p> <p>Ability to identify probable vessel territories</p>
3.F	Assess prognosis (including risk stratification)	<p>Ability to understand limitations of predicting vessel territories</p> <p>Ability to identify left bundle-branch block/pacing artifact patterns</p> <p>Ability to understand limitations of relative perfusion assessment (balanced ischemia)</p> <p>Ability to understand limitations of perfusion assessment for obstructive CAD in specific patient populations (congestive heart failure, myocarditis, hypertrophic cardiomyopathy, issues of partial volume effects, patients with congenital heart disease, etc.)</p>
3.G	Perform quantitative analysis (SSS, SRS, SDS, numerical quantitation, TID, LHR, EF, EDV, ESV, etc.)	<p>Ability to identify imaging variables that predict prognosis (perfusion defect size; ischemic defect size; LVEF and volumes; etc.)</p> <p>Ability to identify stress test variables (Duke treadmill score, exercise time, symptoms, heart rate recovery, degree of ST depression, etc.)</p> <p>Knowledge of diagnostic and prognostic accuracy of ST changes with pharmacologic stress</p> <p>Knowledge of extent of ischemia and benefit of revascularization</p>
3.H	Integrate data from different modalities (ECG, clinical; CT/calcium scoring and hybrid studies; etc.)	<p>Ability to understand implications of low risk with normal stress study (<1%)</p> <p>Knowledge of high risk parameters (depressed LV function, TID, post-stress stunning, large perfusion defects, etc.)</p> <p>Knowledge of special populations (women, diabetics, obese patients, renal, congestive heart failure, hypertrophic cardiomyopathy, elderly patients)</p> <p>Ability to identify differences from prior studies and their implications</p> <p>Ability to identify implications of changes in EF post-chemotherapy</p>

3.I	Generate report using standardized nomenclature	<p>Knowledge of implications of viability presence or absence for benefits of revascularization and long-term prognosis</p> <p>Knowledge of implications of test results prior to noncardiac surgery</p> <p>Knowledge of implications in evaluating stable angina, unstable angina, acute chest pain, and acute myocardial infarction</p> <p>Ability to calculate SSS/SRS/SDS</p>
3.J	Identify and communicate critical results (appropriate report content, vascular territories, etc.)	<p>Ability to calculate percentage of ischemic burden</p> <p>Knowledge of limitations and benefits of quantitative analysis</p> <p>Knowledge of clinical implications of quantitative analysis (prognosis)</p> <p>Ability to integrate exercise treadmill testing and perfusion imaging data</p> <p>Ability to integrate calcium score and perfusion imaging data ["warranty period"]</p> <p>Ability to compare with previous NC studies</p> <p>Knowledge of nomenclature of 17-segment model</p> <p>Knowledge of what constitutes a complete report (including ASNC imaging guidelines)</p> <p>Ability to communicate significance of findings and test results</p>
4	Radiation Safety and Management of Radiopharmaceuticals 13%	Knowledge, skill and/or ability related to performing post-scan tasks and reporting findings
4.A	Perform daily surveys and wipes	<p>Knowledge of regulatory requirements for radiation safety</p> <p>Ability to provide specific advice to patients after nuclear imaging (avoiding young people less than 1 year of age; pregnant women; advice slip for border-control purposes; etc.)</p>
4.B	Ensure radiation safety (including knowledge of radiation biology and dosimetry)	<p>Knowledge of types of radiation emergencies (spillage, dose misadministration, generator malfunction, fire in nuclear lab, terrorism, etc.) and appropriate response</p>
4.C	Respond to radiation emergencies	<p>Ability to monitor patient vital signs, advise on diuresis, blood investigations, quarantine, etc.</p>
4.D	Respond to radiopharmaceutical misadministration	<p>Knowledge of how to identify and report to relevant authorities, how to counsel patients, and how to communicate with test administrators when a radiopharmaceutical misadministration occurs</p>
4.E	Follow patient and occupational radiation safety protocols	<p>Knowledge of upper limits of annual radiation exposure for patient and occupational workers</p> <p>Knowledge of upper limits of radiation exposure for women per pregnancy</p> <p>Knowledge of tasks usually performed by radiation technologists under the supervision of physician-in-charge</p>
4.F	Manage the ordering, receiving, unpacking, and handling of radioactive materials safely and perform related radiation surveys	<p>Knowledge of proper documentation according to protocol (e.g., frequency of orders; dosage required; delivery of generator/unit doses via approved vehicles/sources; safe delivery of dose/generator to laboratory via specified routes; unpacking the dose/generator; quality control measures; calibrating the dose in a safe environment)</p>
4.G	Calculate, calibrate, and safely prepare radiation dosages (including generator elution; radiochemistry; mathematics pertaining to the use and measurement of radioactivity; quality control of radionuclide purity; etc.)	<p>Knowledge of how to elute, calculate, and check the radiochemical purity of the radiopharmaceutical</p> <p>Knowledge of mechanisms and procedures of red blood cell radiolabeling for MUGA (in vitro, in vivo, etc.)</p>
4.H	Perform red blood cell radiolabeling for radionuclide ventriculography (in vitro, in vivo, etc.)	<p>Knowledge of properties and characteristics of radiation physics</p> <p>Knowledge of instrumentation</p>
4.I	Understand radiation physics and instrumentation	