JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY
© 2015 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION
PUBLISHED BY ELSEVIER INC.

VOL. 65, NO. 17, 2015
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2015.03.019

TRAINING STATEMENT

COCATS 4 Task Force 6: Training in Nuclear Cardiology

Endorsed by the American Society of Nuclear Cardiology

Vasken Dilsizian, MD, FACC, *Chair*
James A. Arrighi, MD, FACC*
Rose S. Cohen, MD, FACC
Todd D. Miller, MD, FACC
Allen J. Solomon, MD, FACC
James E. Udelson, MD, FACC, FASNC

1. INTRODUCTION

1.1. Document Development Process

1.1.1. Writing Committee Organization

The Writing Committee was selected to represent the American College of Cardiology (ACC) and the American Society of Nuclear Cardiology (ASNC) and included a cardiovascular training program director; a nuclear cardiology training program director; early-career experts; highly experienced specialists in both academic and community-based practice settings; and physicians experienced in defining and applying training standards according to the 6 general competency domains promulgated by the Accreditation Council for Graduate Medical Education (ACGME) and American Board of Medical Specialties (ABMS), and endorsed by the American Board of Internal Medicine (ABIM). The ACC determined that relationships with industry or other entities were not relevant to the creation of this general cardiovascular training statement. Employment and affiliation details for authors and peer reviewers are provided in Appendixes 1 and 2, respectively, along with disclosure reporting categories. Comprehensive disclosure information for all authors, including relationships with industry and other entities, is available as an online supplement to this document.

1.1.2. Document Development and Approval

The Writing Committee developed the document, approved it for review by individuals selected by the ACC and ASNC, and addressed their comments. The document was revised and posted for public comment from December 20, 2014, to January 6, 2015. Authors addressed additional comments from the public to complete the document. The final document was approved by the Task Force, COCATS Steering Committee, and ACC Competency Management Committee; ratified by the ACC Board of Trustees in March, 2015; and endorsed by the ASNC. This document is considered current until the ACC Competency Management Committee revises or withdraws it.

1.2. Background and Scope

Nuclear cardiology provides important diagnostic and prognostic information that is an essential part of the knowledge base required of the well-trained cardiologist for optimal management of the cardiovascular patient (Table 1).

The Task Force was charged with updating previously published standards for training fellows in adult nuclear cardiology on the basis of changes in the field since 2008 and as part of a broader effort to establish consistent training criteria across all aspects of cardiology. This document does not provide specific guidelines for training in advanced cardiovascular subspecialty areas but identifies opportunities to obtain advanced training where appropriate. The Task Force also updated previously published standards to address the evolving framework of competency-based medical education described by the ACGME Outcomes Project and the 6 general competencies endorsed by the ACGME and ABMS. The background and overarching principles governing fellowship training are provided in the COCATS 4 Introduction, and readers should become familiar with this foundation before considering the details of training in a subdiscipline like nuclear cardiology. The Steering Committee and

*American Society of Nuclear Cardiology Representative.

The American College of Cardiology requests that this document be cited as follows: Dilsizian V, Arrighi JA, Cohen RS, Miller TD, Solomon AJ, Udelson JE. COCATS 4 task force 6: training in nuclear cardiology. J Am Coll Cardiol 2015;65:1800-9.

TABLE 1 Classification of Nuclear Cardiology Procedures and Skills

A. Procedures in which competency should be achieved during Level II training
1. Myocardial perfusion imaging
   a. SPECT, with or without attenuation correction
   b. ECG-gated perfusion images
   c. Stress protocols (exercise and pharmacologic)
   d. Viability assessment using SPECT and/or PET
2. Radionuclide angiography
3. Use of methods for acquisition, reconstruction, and quantitative analysis of images
4. Appropriate radiation safety and quality improvement programs
5. Use of radiation monitoring instruments

B. Procedures in which medical knowledge should be demonstrated and achievement of competency may be accomplished during or after fellowship
1. PET myocardial perfusion imaging
2. Myocardial blood flow quantification
3. Cardiac planar imaging
4. Hybrid PET/CT and SPECT/CT
5. Myocardial innervation
6. Myocardial metabolism

CT = computed tomography; ECG = electrocardiogram; PET = positron emission tomography; SPECT = single-photon computed tomography.

Task Force recognize that implementation of these changes in training requirements will occur incrementally over time.

For most areas of adult cardiovascular medicine, 3 levels of training are delineated:

- **Level I training**, the basic training required of trainees to become competent consultant cardiologists, is required of all fellows in cardiology and can be accomplished as part of a standard 3-year training program in cardiology. For nuclear cardiology, Level I training enables trainees to become conversant with the field of nuclear cardiology for application in general clinical management of cardiovascular patients.
- **Level II training** refers to the additional training in 1 or more areas that enables some cardiologists to perform or interpret specific procedures or render more specialized care for patients and conditions. This level of training is recognized for those areas in which an accepted instrument or benchmark, such as a qualifying examination, is available to measure specific knowledge, skills, or competence. Level II training in selected areas may be achieved by some trainees during the standard 3-year cardiovascular fellowship, depending on the trainees' career goals and use of elective rotations. In the case of nuclear cardiology, Level II training provides trainees with expertise to practice clinical nuclear cardiology as a subspecialty by providing supervision and interpretation of the following: myocardial perfusion single-photon emission computed tomography (SPECT) and/or positron emission tomography (PET); cardiac function assessment with gated SPECT and/or PET; and gated equilibrium radionuclide angiography. Additionally, Level II training will provide the requisite training for clinicians to learn emerging nuclear cardiology procedures with appropriate additional clinical training and experience.
- **Level III training** requires additional experience beyond the 3-year cardiovascular fellowship dedicated to acquiring specialized knowledge and competencies in performing, interpreting, and training others to perform specific procedures or to render advanced, specialized care at a high level of skill. Level III training is described here only in broad terms to provide context for trainees and clarify that these advanced competencies are not covered during the cardiovascular fellowship and require additional training and designation by an independent certification board, often coupled with a certifying examination. Level III training cannot be obtained during the standard 3-year cardiovascular fellowship and requires additional exposure in a program that meets requirements that will be addressed in a subsequent, separately published Advanced Training Statement (formerly in Clinical Competence Statement).

It is assumed that training at all levels is directed by appropriately trained mentors in an ACGME-accredited program and that satisfactory completion of training is documented by the program director. The number and types of encounters and duration of training required for trainees are summarized in Section 4.

2. GENERAL STANDARDS

Three organizations—the ACC, American Heart Association, and ASNC—have addressed training requirements and guidelines for patient selection, imaging protocols, interpretation, correlation with coronary anatomy, follow-up, and prognosis. The recommendations are congruent and address faculty, facility requirements, emerging technologies, and clinical practice. We recommend strongly that candidates for the ABIM examination for certification in cardiovascular diseases who seek competency in nuclear cardiology, as well as those seeking certification and Authorized User status for nuclear cardiology procedures, review the specific requirements of the Certification Board of Nuclear Cardiology (CBNC) and Nuclear Regulatory Commission (NRC) (1,2).

Cardiovascular fellowship programs should satisfy the requirements regarding facilities and faculty for training in nuclear cardiology as defined in the following text. Eligibility for the CBNC examination requires that training take place in a cardiology, radiology, or nuclear medicine training program that is accredited by the ACGME. The intensity of training and required resources vary according to the level of training.

To have an adequate understanding of the clinical applications of nuclear cardiology and to perform tests safely, the cardiovascular trainee must acquire

JACC VOL. 65, NO. 17, 2015
MAY 5, 2015:1800–9

knowledge and competency in the following areas of general cardiology:

1. Coronary angiography and physiology
2. Cardiac physiology and pathophysiology
3. Rest and exercise electrocardiography
4. Exercise physiology
5. Pharmacology of standard cardiovascular drugs
6. Cardiopulmonary resuscitation and treatment of other cardiac emergencies
7. Pharmacology and actions of commonly used stress agents, such as dipyridamole, adenosine, regadenoson, and dobutamine
8. Clinical outcomes assessment

2.1. Faculty

Faculty should include specialists skilled in administering and interpreting stress testing (exercise and pharmacological), performing and interpreting radionuclide cardiac imaging, and assessing the potential risks of radiation exposure to patients and medical personnel. There must be a minimum of 1 faculty member who is the Authorized User at the training institution. Clinical faculty should be certified by CBNC or possess equivalent board qualifications from the American Board of Nuclear Medicine or American Board of Radiology. A physician is considered to have equivalent qualifications if he or she trained in a similar environment for a similar duration of time and performed the required number of procedures.

2.2. Facilities

Facilities should be adequate to ensure a safe, secure, and effective environment for noninvasive radionuclide SPECT and/or PET studies. The facilities should maintain all Radiation Safety, NRC, and Joint Commission requirements. Accreditation of the facility through the Intersocietal Commission for the Accreditation of Nuclear Medicine Laboratories or American College of Radiology is strongly encouraged.

2.3. Equipment

Nuclear laboratories should be equipped with at least 1 SPECT camera. Additional attenuation correction capability, hybrid SPECT/computed tomography (CT), PET, and hybrid PET/CT cameras are optional.

2.4. Ancillary Support

Ancillary support should be available to perform nuclear cardiology procedures, including nuclear technologists, nurses to perform stress testing, a physicist, and a radiation safety officer.

3. TRAINING COMPONENTS

3.1. Didactic Program

3.1.1. Lectures, Radiation Safety, Radiopharmacy, and Self-Study

This component consists of lectures on the basic aspects of nuclear cardiology and parallel self-study material consisting of reading and viewing case files. The material presented should integrate the role of nuclear cardiology into total patient management. Such information can be included within the didactic curriculum of the training program and should include presentation and discussion of nuclear cardiology image data as it relates to diagnostic and therapeutic management. In addition, there should be a didactic program on radiation safety and radiopharmacy, which should provide the fellow with an understanding of radiation safety as it relates to patient selection and risk/benefit assessment of diagnostic tests that utilize ionizing radiation.

3.2. Clinical Experience

At least 2 months of the cardiovascular fellowship training should be dedicated to nuclear cardiology. Fellows should actively participate in daily nuclear cardiology study interpretation (at least 100 cases). Experience in as many areas as possible from those listed in Table 1 is recommended. If some procedures are not available or are performed in low volume, an adequate background for fellowship training can be satisfied by appropriate reading or review of case files. The teaching file should consist of perfusion and ventricular function studies with angiographic/cardiac catheterization documentation of disease.

3.3. Hands-On Experience

3.3.1. Clinical Cases

All fellows should perform complete nuclear cardiology studies alongside a qualified technologist or other qualified laboratory personnel. They should, under supervision, observe and participate in a large number of the standard procedures and as many of the less commonly-performed procedures as possible. Fellows should have experience in the practical aspects of radiation safety associated with performing clinical patient studies.

3.3.2. Radiation Safety

All Level I fellows need to be familiar with radiation biology and the regulations governing the use of radioactive materials and ionizing radiation for performing diagnostic nuclear cardiology and hybrid CT studies. This knowledge includes details for protecting patients, the public, and the user from the effects of radiation.

3.3.3. Additional Training

The requirements for Level II training in nuclear cardiology are delineated in Section 4.

4. SUMMARY OF TRAINING REQUIREMENTS

4.1. Development and Evaluation of Core Competencies

Training and requirements in nuclear cardiology address the 6 general competencies promulgated by the ACGME/ABMS and endorsed by the ABIM. These competency domains are: medical knowledge, patient care and procedural skills, practice-based learning and improvement, systems-based practice, interpersonal and communication skills, and professionalism. The ACC has used this structure to define and depict the components of the core clinical competencies for cardiology. The curricular milestones for each competency and domain also provide a developmental roadmap for fellows as they progress through various levels of training and serve as an underpinning for the ACGME/ABIM reporting milestones. The ACC has adopted this format for its competency and training statements, career milestones, lifelong learning, and educational programs. Additionally, it has developed tools to assist physicians in assessing, enhancing, and documenting these competencies.

Table 2 delineates each of the 6 competency domains, as well as their associated curricular milestones for training in nuclear cardiology. The milestones are categorized into Level I, II, and III training (as previously defined in this document) and indicate the stage of fellowship training (12, 24, or 36 months, and additional time points) by which the typical cardiovascular trainee should achieve the designated level. Given that programs may vary with respect to the sequence of clinical experiences provided to trainees, the milestones at which various competencies are reached may also vary. Level I competencies may be achieved at earlier or later time points. Acquisition of Level II skills requires additional training. The table also describes examples of evaluation tools suitable for assessing competence in each domain.

4.2. Number of Procedures and Duration of Training

The specific competencies for Levels I and II are delineated in Table 2. The minimum duration of training and volume of procedures required for each level of training in nuclear cardiology are summarized in Table 3. A brief discussion of the competencies and training requirements follows.

4.2.1. Level I Training Requirements

The trainee is exposed to the fundamentals of nuclear cardiology for at least 2 months during training. This 2-month experience provides familiarity with nuclear cardiology technology and its clinical applications in the general clinical practice of adult cardiology, but it is not sufficient for the specific practice of nuclear cardiology. The 3 components of training include a didactic program that involves lectures, self-study, instruction in radiation safety and regulations, interpretation of nuclear cardiology studies, and hands-on experience.

4.2.2. Level II Training Requirements

Fellows who wish to practice the specialty of nuclear cardiology are required to have at least 4 months of training. Level II training includes a minimum of 700 hours of work experience in nuclear cardiology, inclusive of radiation safety. This requirement is based in part on NRC regulations. Didactic instruction, clinical study interpretation, and hands-on involvement in clinical cases are all required. In training programs with a high volume of procedures, clinical experience may be acquired in as little as 4 months during fellowship. In programs with a lower volume of procedures, at least 6 months of clinical experience will be necessary to achieve Level II competency. The additional training required of Level II trainees is intended to enhance their clinical skills, knowledge, and hands-on experience in radiation safety and to qualify them to become authorized users of radioactive materials in accordance with the regulations of the NRC and/or the Agreement States.

The various nuclear cardiology procedures are listed in Table 1. It is recommended that all fellows receive training aligned with achieving competency in the procedures listed in Section A of this table. For procedures listed in Section B, which may not be widely available, fellows should receive at minimum didactic instruction and, when available, clinical experience to achieve competency. For Level II training in cardiac PET, direct patient experience with at least 40 patient studies of myocardial perfusion, metabolism, or both, is required. Level II training must also provide experience in computer methods for analysis. This should include perfusion and functional data derived from thallium or technetium agents and ejection fraction and regional wall motion measurements from radionuclide angiographic studies.

The didactic training required to develop Level II competence should include in-depth details of all aspects of the procedures listed in Table 1. This program may be scheduled over a 12- to 24-month period concurrent and integrated with other fellowship assignments. Alternatively, a fellow may choose to fulfill the advanced procedures of Table 1 by pursuing an additional year of fellowship dedicated to nuclear cardiology.

Classroom and laboratory training needs to include extensive review of radiation physics and instrumentation, radiation protection, mathematics pertaining to the use and measurement of radioactivity, chemistry of byproduct material for medical use, radiation biology, effects of ionizing radiation, and radiopharmaceuticals in order to meet the NRC requirements and qualifications for becoming an authorized user. There should be a thorough review of regulations dealing with radiation safety for

TABLE 2 Core Competency Components and Curricular Milestones for Training in Nuclear Cardiology

Competency Component		Milestones (Months)			
MEDICAL KNOWLEDGE		**12**	**24**	**36**	**Add**
1	Know the principles of SPECT and radionuclide ventriculography image acquisition and display, including the standard tomographic planes and views.		I		
2	Know the properties and use of standard perfusion tracers.			I	
3	Know the principles of radiation safety and how to minimize radiation exposure.			II	
4	Know the indications for myocardial perfusion imaging and the appropriate selection of exercise versus pharmacologic stress testing.	I			
5	Know the principles and use of pretest probability and sequential probability analysis to assess post-test probability.	I			
6	Know the mechanism of pharmacologic stress agents, methods of their administration, and safety issues in using the agents.		I		
7	Know the protocols for administration of standard perfusion agents and the influence of the clinical situation on choice of imaging protocol.		I		
8	Know the quality control issues, how to review raw data, and recognize artifacts.			II	
9	Know the use of nuclear cardiology in the assessment of ventricular function.		I		
10	Know the protocols for the use of perfusion imaging to assess myocardial viability.		I		
11	Know the indications for PET imaging and use of PET tracers.			II	
	EVALUATION TOOLS: direct observation and in-training examination.				
PATIENT CARE AND PROCEDURAL SKILLS		**12**	**24**	**36**	**Add**
1	Skill to select the appropriate imaging study.		I		
2	Skill to integrate perfusion imaging findings with clinical and other test results in the evaluation and management of patients.		I		
3	Skill to identify results that indicate a high-risk state.		I		
4	Skill to perform and interpret gated stress-rest perfusion study.			II	
5	Skill to perform and interpret a radionuclide ventriculography study.			II	
6	Skill to perform and interpret hybrid SPECT/CT and PET/CT imaging.				III
7	Skill to perform and quantify PET absolute myocardial blood flow and metabolism.				III
8	Skill to perform and interpret cardiac innervation, first pass, and planar studies.				III
	EVALUATION TOOLS: conference presentation, direct observation, and logbook.				
SYSTEMS-BASED PRACTICE		**12**	**24**	**36**	**Add**
1	Work effectively and efficiently with the nuclear laboratory staff.			II	
2	Incorporate risk/benefit and cost considerations in the use of radionuclide imaging techniques.			I	
3	Participate in laboratory quality monitoring and initiatives.			II	
	EVALUATION TOOLS: chart-stimulated recall, conference presentation, direct observation, and multisource evaluation.				
PRACTICE-BASED LEARNING AND IMPROVEMENT		**12**	**24**	**36**	**Add**
1	Identify knowledge and performance gaps and engage in opportunities to achieve focused education and performance improvement.			I	
	EVALUATION TOOLS: conference presentation and direct observation.				

TABLE 2 Core Competency Components, continued

	Competency Component	Milestones (Months) 12	24	36	Add
PROFESSIONALISM					
1	Know and promote adherence to guidelines and appropriate use criteria.		I		
2	Interact respectfully with patients, families, and all members of the healthcare team—including ancillary and support staff.	I			
	EVALUATION TOOLS: chart-stimulated recall, conference presentation, and direct observation.				
INTERPERSONAL AND COMMUNICATION SKILLS					
1	Communicate effectively and timely with patients, families, and referring physicians.		I	II	
2	Communicate test results in a comprehensive and user-friendly manner.			II	
	EVALUATION TOOLS: direct observation and multisource evaluation.				

Add = additional months beyond the 3-year cardiovascular fellowship; CT = computed tomography; PET = positron emission tomography; SPECT = single-photon computed tomography.

the use of radiopharmaceuticals and ionizing radiation. This experience should total at least 80 hours and be documented separately. This experience may include web-based didactics.

It is expected that the foundation of Level II nuclear cardiology training, including didactic instruction, radiation safety training, and clinical experience during fellowship, is required to achieve competency after formal fellowship training for those emerging procedures listed in Table 1. Didactic instruction in those procedures listed in Table 1 should include the topics listed in Table 4.

Fellows seeking Level II training should participate in the interpretation of nuclear cardiology imaging data for a minimum of 4 months. It is imperative that the fellows have experience in correlating catheterization or CT angiographic data with radionuclide-derived data for a minimum of 30 patients. A teaching conference in which the fellow presents the clinical material and nuclear cardiology results is an appropriate forum for such experience. A minimum of 300 cases should be interpreted under preceptor supervision from direct patient studies. Upon satisfactory completion of Level II training, which includes demonstration of competency in both clinical interpretation and technical aspects as assessed by the outcomes evaluation measures, fellows will be eligible for the CBNC examination.

The CBNC was established jointly by the ACC and ASNC and assesses knowledge and mastery in the areas of radiation safety and the technical and clinical performance of nuclear cardiology procedures. The CBNC is recognized by the NRC as a certification pathway for obtaining authorized user status for administering radiotracers that are specific to the field of cardiology. Information concerning the eligibility requirements for the examination can be obtained from the CBNC. Privileges to interpret nuclear cardiology studies should be based mainly on satisfactory completion of the training outlined in this document, including demonstration of competence and technical expertise. The issues of ongoing clinical competence and training or retraining of practicing cardiologists are beyond the scope of this document.*

Fellows acquiring Level II training should have hands-on, supervised imaging experience with a minimum of 30 patients: 25 patients with myocardial perfusion imaging and 5 patients with radionuclide angiography. Such experience should include pretest patient evaluation; radiopharmaceutical preparation (including experience with relevant radionuclide generators and CT systems); performance of studies with and without attenuation correction; administration of the dosage, calibration, and setup of the gamma camera and CT system; setup of the imaging computer; processing the data for display; interpretation of the studies; and generating clinical reports.

TABLE 3 Summary of Training Requirements for Nuclear Cardiology

Level	Minimum Duration of Training (Months)*	Minimum No. of Examinations
I	2	100†
II	4*	300†

*Refer to COCATS 4 Task Force 4 Multimodality Imaging report for guidelines regarding the number of months that may be shared with training in other imaging modalities. †These are approximate cumulative numbers of examinations. At least 30 cases with hands-on experience must be performed and interpreted under supervision, with a greater emphasis on demonstrating competency in both clinical interpretation and technical aspects as assessed by the outcomes evaluation measures.

*For additional information, contact CBNC at 101 Lakeforest Boulevard, Suite 401, Gaithersburg, Maryland 20877; http://www.cccvi.org/cbnc/.

JACC VOL. 65, NO. 17, 2015
MAY 5, 2015:1800–9

TABLE 4 Didactic Instruction in Procedures in Which Medical Knowledge Should be Demonstrated and Achievement of Level II Competency May Be Accomplished During or After Fellowship

Cardiac PET a. Production and use of positron-emitted radiotracers b. Instrumentation and physics of PET c. Radiation safety and regulatory requirements unique to PET d. Range of PET cardiac studies (e.g., myocardial perfusion, metabolism, innervation)
Hybrid SPECT/CT and PET/CT a. Use for attenuation correction b. Coronary calcium scoring c. Combined anatomic/physiologic imaging
Myocardial Innervation a. I-123 MIBG imaging

Abbreviations as in Table 1.

Level II trainees must acquire 620 hours of work experience inclusive of radiation safety (in addition to the 80 hours of classroom and laboratory experience) during training in the clinical environment where radioactive materials are being used. This training should take place under the supervision of an authorized user who meets the NRC requirements of Part 35.290 or Part 35.290(c)(ii)(G) and Part 35.390 or the equivalent Agreement State requirements and must include the following:

a. Ordering, receiving, and unpacking radioactive materials safely and performing the related radiation surveys.
b. Performing quality control procedures on instruments used to determine the activity of dosages as well as performing checks for proper operation of survey meters.
c. Calculating, measuring, and safely preparing patient or human research subject dosages.
d. Using administrative controls to prevent a medical event that involves the use of unsealed byproduct material.
e. Using procedures to safely contain spilled radioactive material and using proper decontamination procedures.
f. Administering dosages of radioactive material to patients or human research subjects.
g. Eluting generator systems appropriate for preparation of radioactive drugs for imaging and localization studies; measuring and testing the eluate for radionuclide purity; and processing the eluate with reagent kits to prepare labeled radioactive drugs.

4.2.3. Level III Training Requirements

For fellows planning an academic career in nuclear cardiology or a career directing a clinical nuclear cardiology laboratory, an extended program is required. More advanced competency (Level III) in nuclear cardiology is generally obtained within the context of multimodality imaging training and requires additional training beyond the standard 3-year cardiovascular fellowship. In addition to the recommended program for Level II, the Level III program should include advanced quality control of nuclear cardiology studies and active participation and responsibility in ongoing laboratory or clinical research. In parallel with participation in a research program, the trainee should participate in clinical imaging activities; some of these experiences may involve concurrent training in other imaging modalities as defined in the guidelines for the COCATS 4 Task Force 4 Multimodality Imaging report. Fellows pursuing Level III training should already be eligible for the CBNC on the basis of their prior Level II training. Level III training should include both hands-on experience and supervised interpretative experience greater than that required for Level II training. Additional training in nuclear cardiology may include quantification of absolute myocardial blood flow, assessment of coronary artery disease and myocardial perfusion using hybrid PET/CT and/or SPECT/CT protocols, patient preparation and imaging protocols for planar imaging, first-pass radionuclide angiography, myocardial metabolism, and innervation.

4.2.4. Training in Multiple Imaging Modalities

The recent emergence of other noninvasive imaging modalities, especially cardiovascular magnetic resonance and CT angiography, is having a profound impact on the practice of cardiology and the fellowship training experience. The cardiovascular medicine specialist is increasingly expected to provide expertise in 2 or more of the imaging techniques. It is understandable that trainees will desire the opportunity to gain exposure to multiple imaging modalities during their fellowship experience. To the degree possible, the training program should strive to meet these needs by offering a “multimodality” imaging experience (see COCATS 4 Task Force 4 Multimodality Imaging report). This might include an appreciation for each technique’s uses and clinical indications, strengths and limitations, safety issues, and relevant guidelines and appropriateness criteria, when available.

5. EVALUATION OF COMPETENCY

Evaluation tools in nuclear cardiology include direct observation by instructors, in-training examinations, case logbooks, conference and case presentations, multisource evaluations, trainee portfolios, and simulation. Acquisition and interpretive skills should be evaluated in every trainee. Interaction with other physicians, patients, and laboratory support staff; initiative; reliability; decisions or actions that result in clinical error; and the ability to make appropriate decisions independently and follow-up appropriately should be considered in these assessments.

Trainees should maintain records of participation and advancement in the form of a Health Insurance Portability and Accountability Act (HIPAA)-compliant electronic database or logbook that meets ACGME reporting standards and summarizes pertinent clinical information (e.g., number of cases, diversity of referral sources, testing modalities, diagnoses, and findings). The use of nuclear cardiology should be aligned with clinical need and appropriate use criteria. Trainees should be prepared to explain why a given nuclear cardiology test is better suited to the clinical question than another imaging option. Fellows should document clinical correlation with the other imaging, hemodynamic, invasive laboratory, surgical pathology, and outcomes data to enhance understanding of the diagnostic utility and value of various studies. Finally, experiences in nuclear cardiology should be assessed against measures of quality with regard to test selection, performance, interpretation, and reporting in the interest of appreciating the potential adverse consequences of suboptimal testing (3–5).

Under the aegis of the program director and director of each imaging laboratory, facility, or program, the faculty should record and verify each trainee's experiences, assess performance, and document satisfactory achievement. The program director is responsible for confirming experience and competence and reviewing the overall progress of individual trainees with the Clinical Competency Committee to ensure achievement of selected training milestones and identify areas in which additional focused training may be required.

REFERENCES

1. Certification Board of Nuclear Cardiology. Certification Board of Nuclear Cardiology certification requirements. Available at: http://www.cccvi.org/cbnc. Accessed September 26, 2014.

2. U.S. Nuclear Regulatory Commission. §35.290 Training for imaging and localization studies. Available at: http://www.nrc.gov/reading-rm/doc-collections/cfr/part035/part035-0290.html. Accessed September 26, 2014.

3. DePuey EG, Mahmarian JJ, Miller TD, et al. Patient-centered imaging. J Nucl Cardiol 2012;19:185–215.

4. Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 appropriate use criteria for cardiac radionuclide imaging: a report of the American College of Cardiology Foundation Appropriate Use Criteria Task Force, the American Society of Nuclear Cardiology, the American College of Radiology, the American Heart Association, the American Society of Echocardiography, the Society of Cardiovascular Computed Tomography, the Society for Cardiovascular Magnetic Resonance, and the Society of Nuclear Medicine. J Am Coll Cardiol 2009;53:2201–29.

5. Tilkemeier PL, Cooke CD, Ficaro EP, Glover DK, Hansen CL, McCallister BD Jr. American Society of Nuclear Cardiology information statement: standardized reporting matrix for radionuclide myocardial perfusion imaging. J Nucl Cardiol 2006;13:e157–71.

KEY WORDS ACC Training Statement, cardiovascular imaging, clinical competence, COCATS, fellowship training, nuclear cardiology

APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—COCATS 4 TASK FORCE 6: TRAINING IN NUCLEAR CARDIOLOGY

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional/ Organizational or Other Financial Benefit	Expert Witness
Vasken Dilsizian *(Chair)*	University of Maryland School of Medicine—Professor of Medicine and Radiology; Director, Division of Nuclear Medicine	None	None	None	None	None	None
James A. Arrighi	Rhode Island Hospital, Brown University—Program Director, Cardiology Fellowship and Associate Professor of Medicine	None	None	None	None	None	None
Rose S. Cohen	Contra Costa Regional Medical Center, Department of Cardiology—Physician Advisor	None	None	None	None	None	None
Todd D. Miller	Mayo Clinic—Professor of Medicine	None	None	None	None	None	None
Allen J. Solomon	The George Washington University, Division of Cardiology—Associate Professor of Medicine	None	None	None	None	None	None
James E. Udelson	Tufts Medical Center—Chief, Division of Cardiology	None	None	None	None	None	None

For the purpose of developing a general cardiology training statement, the ACC determined that no relationships with industry or other entities were relevant. This table reflects authors' employment and reporting categories. To ensure complete transparency, authors' comprehensive healthcare-related disclosure information—including relationships with industry not pertinent to this document—is available in an online data supplement. Please refer to http://www.acc.org/guidelines/about-guidelines-and-clinical-documents/relationships-with-industry-policy for definitions of disclosure categories, relevance, or additional information about the ACC Disclosure Policy for Writing Committees.

ACC = American College of Cardiology.

APPENDIX 2. PEER REVIEWER RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—COCATS 4 TASK FORCE 6: TRAINING IN NUCLEAR CARDIOLOGY

Name	Employment	Representation	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional/ Organizational or Other Financial Benefit	Expert Witness
Richard Kovacs	Indiana University, Krannert Institute of Cardiology—Q.E. and Sally Russell Professor of Cardiology	Official Reviewer, ACC Board of Trustees	None	None	None	None	None	None
Dhanunjaya Lakkireddy	Kansas University Cardiovascular Research Institute	Official Reviewer, ACC Board of Governors	None	None	None	None	None	None
Howard Weitz	Thomas Jefferson University Hospital—Director, Division of Cardiology; Sidney Kimmel Medical College at Thomas Jefferson University—Professor of Medicine	Official Reviewer, Competency Management Committee Lead Reviewer	None	None	None	None	None	None
Dennis Calnon	OhioHealth Heart and Vascular Physicians—Director, Cardiac Imaging; Riverside Methodist Hospital	Organizational Reviewer, American Society of Nuclear Cardiology	None	None	None	None	None	None
Kenneth Ellenbogen	VCU Medical Center—Director, Clinical Electrophysiology Laboratory	Content Reviewer, Cardiology Training and Workforce Committee	None	None	None	None	None	None
Brian D. Hoit	University Hospitals Case Medical Center	Content Reviewer, Cardiology Training and Workforce Committee	None	None	None	None	None	None
Larry Jacobs	Lehigh Valley Health Network, Division of Cardiology; University of South Florida—Professor, Cardiology	Content Reviewer, Cardiology Training and Workforce Committee	None	None	None	None	None	None
Andrew Kates	Washington University School of Medicine	Content Reviewer, Academic Cardiology Section Leadership Council	None	None	None	None	None	None
Nishant Shah	Brigham and Women's Hospital, Harvard Medical School—Cardiovascular Imaging Fellow	Content Reviewer, Imaging Council	None	None	None	None	None	None
Prem Soman	University of Pittsburgh Medical Center—Director, Nuclear Cardiology and Associate Professor, Medicine	Content Reviewer, Cardiovascular Imaging Summit Steering Committee	None	None	None	None	None	None
Kim Williams	Rush University Medical Center—James B. Herrick Professor and Chief, Division of Cardiology	Content Reviewer, Cardiology Training and Workforce Committee	None	None	None	None	None	None

For the purpose of developing a general cardiology training statement, the ACC determined that no relationships with industry or other entities were relevant. This table reflects peer reviewers' employment, representation in the review process, as well as reporting categories. Names are listed in alphabetical order within each category of review. Please refer to http://www.acc.org/guidelines/about-guidelines-and-clinical-documents/relationships-with-industry-policy for definitions of disclosure categories, relevance, or additional information about the ACC Disclosure Policy for Writing Committees.

ACC = American College of Cardiology; VCU = Virginia Commonwealth University.

APPENDIX 3. ABBREVIATION LIST

ABIM = American Board of Internal Medicine

ABMS = American Board of Medical Specialties

ACC = American College of Cardiology

ACGME = Accreditation Council for Graduate Medical Education

ASNC = American Society of Nuclear Cardiology

CBNC = Certification Board of Nuclear Cardiology

COCATS = Core Cardiovascular Training Statement

CT = computed tomography

HIPAA = Health Insurance Portability and Accountability Act

NRC = Nuclear Regulatory Commission

PET = positron emission tomography

SPECT = single-photon emission computed tomography