JOURNAL of the AMERICAN COLLEGE of CARDIOLOGY

Task Force 5: Training in Nuclear Cardiology: Endorsed by the American Society of Nuclear Cardiology

Manuel D. Cerqueira, Daniel S. Berman, Marcelo F. Di Carli, Heinrich R. Schelbert, Frans J. Th. Wackers, and Kim Allan Williams

J. Am. Coll. Cardiol. 2008;51;368-374
doi:10.1016/j.jacc.2007.11.013

JACC Vol. 51, No. 3, 2008
January 22, 2008:368–74

Task Force 5: Training in Nuclear Cardiology

Endorsed by the American Society of Nuclear Cardiology

Manuel D. Cerqueira, MD, FACC, *Chair*
Daniel S. Berman, MD, FACC, Marcelo F. Di Carli, MD, FACC,
Heinrich R. Schelbert, MD, PHD, FACC, Frans J. Th. Wackers, MD, PHD, FACC,
Kim Allan Williams, MD, FACC (*American Society of Nuclear Cardiology Representative*)

Training in Nuclear Cardiology

Nuclear cardiology (Table 1) 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. Training of fellows in nuclear cardiology is divided into 3 levels:*

- General (Level 1, 2 months): Makes trainee conversant with the field of nuclear cardiology for application in general clinical management of cardiovascular patients.
- Specialized (Level 2, 4, to 6 months): Provides trainee with special expertise to practice clinical nuclear cardiology.†
- Advanced (Level 3, 1 year): Provides advanced training sufficient to pursue an academic career or direct a nuclear cardiology laboratory.†

General Cardiology Training Background

To have an adequate understanding of the clinical applications of nuclear cardiology and to perform tests safely, the cardiology trainee must acquire knowledge and proficiency 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 physiology of commonly used stress agents, such as dipyridamole, adenosine, and dobutamine
8. Clinical outcomes assessment

Overview of Nuclear Cardiology Training

Training in nuclear cardiology at all levels should provide an understanding of the indications and appropriate use of specific nuclear cardiology tests, the safe use of radionuclides, basics of instrumentation and image processing, methods of quality control, image interpretation, integration of risk factors, clinical symptoms and stress testing, and the appropriate application of the resultant diagnostic information for clinical management. The depth of understanding will vary with each of the 3 levels of training. Training in nuclear cardiology is best acquired in Accreditation Council for Graduate Medical Education (ACGME)-approved training programs in cardiology, nuclear medicine, or radiology. An exception to this ACGME requirement is the didactic and laboratory training in radiation safety and radioisotope handling that may be provided by qualified physicians/scientists in a non-ACGME program when such

The recommendations of this Joint Task Force, made up of representatives of the American College of Cardiology Foundation (ACCF) and the American Society of Nuclear Cardiology (ASNC), have been approved by the governing bodies of the ACCF and ASNC in October 2007.

*The issues of ongoing clinical competence and training or retraining of practicing cardiologists are beyond the scope of this document. The Certification Board of Nuclear Cardiology (CBNC) was established jointly by the American College of Cardiology and ASNC and assesses knowledge and mastery in the areas of radiation safety and the technical and clinical performance of nuclear cardiology procedures. For additional information, contact CBNC at 19562 Club House Road, Montgomery Village, MD 20886; http://www.cbnc.org.

†Level 2 and Level 3 training meet eligibility criteria for taking the Certification Board of Nuclear Cardiology examination and Nuclear Regulatory Commission (NRC) training and experience requirements to become an authorized user. The NRC establishes federal policy with regard to the medical use of nuclear reactor byproduct materials. Currently, there are 33 states that have applied and been approved by the NRC to self-regulate the use of radioactive materials, so called "Agreement States." The other 17 states and the District of Columbia are regulated by the federal policy. There is variation within the Agreement States in the training and experience requirements for physicians applying to become authorized users of radioactive materials for diagnostic testing. The NRC requires only that the Agreement State requirements be as stringent as the federal NRC policy, but states have the authority to make the requirements more stringent. Some states require a greater number of total hours for the didactic, classroom, and laboratory experience in radiation safety. Other states have restricted the acceptable programs or institutions where such training hours may be acquired. Given this variability in training and experience requirements within the U.S., trainees are advised to contact the NRC and the Agreement States where they may seek to become authorized users of radioactive materials for the current rules and requirements. For details contact the Agreement States Homepage at http://www.hsrd.ornl.gov/nrc/home.html. Click on Directory and then click on Directory of Agreement States and Non-Agreement State Directors and State Liaison Officers. This will provide information on contacting the individual states and getting the specific licensure requirements.

Table 1 Classification of Nuclear Cardiology Procedures

1. Standard nuclear cardiology procedures
   a. Myocardial perfusion imaging
      i. SPECT with technetium-99m agents and/or thallium-201, with or without attenuation correction
      ii. PET with rubidium-82 and/or nitrogen-13 ammonia
      iii. Planar with technetium-99m agents and/or thallium-201
      iv. ECG gating of perfusion images for assessment of global and regional ventricular function
      v. Imaging protocols
      vi. Stress protocols
         1. Exercise stress
         2. Pharmacologic stress
      vii. Viability assessment including reinjection and delayed imaging of thallium-201 and/or metabolic imaging where available
   b. Equilibrium radionuclide angiocardiography and/or "first-pass" radionuclide angiography at rest
   c. Qualitative and quantitative methods of image display and analysis
2. Less commonly used nuclear cardiology procedures
   a. Combined myocardial perfusion imaging with cardiac CT for attenuation correction or anatomic localization
   b. Equilibrium radionuclide angiocardiography and/or "first-pass" radionuclide angiography during exercise or pharmacologic stress
   c. Metabolic imaging using single-photon and/or positron-emitting radionuclides
   d. Myocardial infarct imaging
   e. Cardiac shunt studies

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

a program is not available as part of the clinical ACGME training program. For laboratories that provide training to cardiology fellows, accreditation by the Intersocietal Commission for Accreditation of Nuclear Laboratories (ICANL) is also recommended.

Nuclear cardiology training consists of the components shown in Table 2. Didactic, clinical case experience, and hands-on training hours require documentation in a logbook, having the trainee's name appear on the clinical report or having some other specific record. The hours need to be monitored and verified by the nuclear cardiology training preceptor. For the advanced trainee, specialized training and research can be derived as part of an established program in either cardiology or a division of nuclear medicine. The person(s) responsible for the didactic, clinical, and hands-on training and experience are responsible for evaluating the competence of the trainee in nuclear cardiology upon completion of the program. This can be accomplished by observing the daily performance of the fellow, a formal testing procedure, or both. The preceptor for Level 2 or Level 3 should be an authorized user recognized by the Nuclear Regulatory Commission (NRC) or an Agreement State, have Level 3 (or the equivalent) training in nuclear cardiology, and preferably be certified by the Certification Board of Nuclear Cardiology (CBNC).

Didactic Program

Lectures 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 cases on video or CD-ROM. The lectures and reading should provide the fellow with an understanding of the clinical applications of nuclear cardiology, including imaging with positron-emitting radionuclides and computed tomography (CT) hybrid systems including single-photon emission computed tomography (SPECT)/CT and positron emission tomography (PET)/CT. The material covered should include radiopharmaceuticals, radiation physics instrumentation, nuclear cardiology diagnostic tests and procedures/protocols, general cardiology as it relates to image interpretation, risk stratification, myocardial perfusion imaging, ventricular function imaging, and assessment of myocardial viability. Specificity, sensitivity, diagnostic accuracy, utility in assessing prognoses and interventions, costs, indications, and pitfalls in interpretation and clinical application must be emphasized for each patient subset.

Table 2 Nuclear Cardiology Training Components

1. Didactic program
   a. Lectures and self-study
   b. Radiation safety
2. Interpretation of clinical cases
3. Hands-on experience
   a. Clinical cases
   b. Radiation safety

This program may be scheduled over a 12- to 24-month period, concurrent with other fellowship assignments. Some of the information can be effectively transmitted as part of a weekly noninvasive or invasive cardiology conference with presentation and discussion of nuclear cardiology image data.

Radiation safety. The second component of the didactic program should provide the fellow with an understanding of radiation safety as it relates to patient selection and administration of radiopharmaceuticals and utilization of CT systems. Fellows seeking Level 2 or Level 3 training will require greater in-depth knowledge as well as hands-on practical experience. These requirements are detailed for each level of training.

Interpretation of Clinical Cases

During training, fellows should actively participate in daily nuclear cardiology study interpretation under the direction of a qualified preceptor in nuclear cardiology. For all studies in which angiographic or hemodynamic data are available, such information should be correlated with the nuclear cardiology studies. Although experience in all aspects of nuclear cardiology is recommended, some procedures may not be available—or may be performed in low volume—in some training programs. Under such circumstances, an adequate background for general fellowship training can be satisfied with appropriate reading or review of case files. Training in nuclear cardiology needs to include extensive experience with the standard nuclear cardiology procedures and as much exposure as possible with the less commonly performed procedures. The training program needs to provide a teaching file consisting of perfusion and ventricular function studies with angiographic documentation of disease.

Hands-On Experience

Clinical cases. Fellows should have hands-on supervised experience in an appropriate number of the standard procedures (e.g., myocardial perfusion imaging and radionuclide angiography) and as many of the less commonly performed procedures as possible. Such experience should include pre-test patient evaluation; radiopharmaceutical preparation—measuring the dose, administration, and experience with relevant radionuclide generators; operation and quality control of planar and SPECT gamma camera and PET and CT systems; setup of the imaging computer; utilization of ECG gating; performing treadmill, bicycle, and pharmacologic stress testing techniques; processing the data for display; interpreting the study; and generating a clinical report. Complete nuclear cardiology studies should be performed under the supervision of qualified personnel.
Radiation safety. 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.

General Training—Level 1 (*Minimum of 2 Months*)

The trainee is exposed to the fundamentals of nuclear cardiology for a minimum period of 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 includes lectures, self-study, radiation safety and regulations, interpretation of nuclear cardiology studies, and hands-on experience.

Didactic Program

Lectures 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 a weekly noninvasive or invasive cardiology conference, with presentation and discussion of nuclear cardiology image data as part of diagnostic and therapeutic management.
Knowledge and appreciation of radiation safety. The didactic program should include reading and practical experience with the effects of radiation and provide the fellow with an understanding of radiation safety as it relates to patient selection and administration of radiopharmaceuticals and utilization of CT systems.

Interpretation of Nuclear Cardiology Studies

During the 2-month rotation, fellows should actively participate in daily nuclear cardiology study interpretation (minimum of 100 cases). Experience in all the areas listed in Table 1 is recommended. If some procedures are not available or are performed in low volume, an adequate background for general 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.

Hands-On Experience

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.

Specialized Training—Level 2 (*Minimum of 4 Months*)

Fellows who wish to practice the specialty of nuclear cardiology are required to have at least 4 months of training. Level 2 training includes a minimum of 700 h of radiation safety experience in nuclear cardiology. There needs to be didactic, clinical study interpretation, and hands-on involvement in clinical cases. In training programs with a high volume of procedures, clinical experience may be acquired in as short a period as 4 months. In programs with a lower volume of procedures, a total of 6 months of clinical experience will be necessary to achieve Level 2 competency. The additional training required of Level 2 trainees is to enhance their clinical skills, knowledge, and hands-on experience in radiation safety and qualify them to become authorized users of radioactive materials in accordance with the regulations of the NRC and/or the Agreement States.†

Didactic

Lectures and self-study. The didactic training 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.

Radiation safety. 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, the effects of ionizing radiation, and radiopharmaceuticals. There should be a thorough review of regulations dealing with radiation safety for the use of radiopharmaceuticals and ionizing radiation. This experience should total a minimum of 80 h and be separately documented.

Interpretation of Clinical Cases

Fellows should participate in the interpretation of all nuclear cardiology imaging data for the 4- to 6-month training period. 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 total of 300 cases should be interpreted under preceptor supervision, from direct patient studies (Table 3).

Hands-On Experience

Clinical cases. Fellows acquiring Level 2 training should have hands-on supervised experience with a minimum of 35 patients: 25 patients with myocardial perfusion imaging and 10 patients with radionuclide angiography. Such experience should include pre-test 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.

Radiation safety work experience. This experience should total 620 h and be acquired during training in the clinical environment where radioactive materials are being used and 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:

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 and 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 involving 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; and
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.

Table 3 Summary of Training Requirements for Nuclear Cardiology

Level	Minimum Duration of Training (Months)	Total No. of Examinations
1	2	100*
2	4–6	300*
3	12	600*

*A minimum of 35 cases with hands-on experience must be performed and interpreted under supervision.

Additional Experience

The training program for Level 2 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.

Advanced Training—Level 3 (*Minimum of 1 Year*)

For fellows planning an academic career in nuclear cardiology or a career directing a clinical nuclear cardiology laboratory, an extended program is required. This may be part of the standard 3-year cardiology fellowship. In addition to the recommended program for Level 2, the Level 3 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 for the total training period of 12 months, to include supervised interpretative experience in a minimum of 600 cases. Hands-on experience should be similar to, or greater than, that required for Level 2 training. The fellow should be trained in most of the following areas:

- Qualitative interpretation of standard nuclear cardiology studies, including SPECT and/or PET myocardial perfusion imaging, ECG-gated perfusion studies, attenuation-corrected studies, gated-equilibrium studies, "first-pass,"

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January 22, 2008:368–74

and any of the less commonly performed procedures available at the institution

- Quantitative analysis of SPECT and/or PET myocardial perfusion and/or metabolic studies
- Quantitative radionuclide angiographic and gated-myocardial perfusion analyses, including measurement of global and regional ventricular function
- SPECT and/or PET perfusion acquisition, reconstruction, and display
- ECG-gated SPECT and/or perfusion acquisition, analysis, and display of functional data
- Imaging of positron-emitting tracers using dedicated PET systems or hybrid PET/CT systems

The requirements for Level 1 to 3 training in nuclear cardiology are summarized in Table 3.

Specific Training in Cardiac Imaging of Positron-Emitting Radionuclides

Cardiac PET and PET/CT imaging of positron-emitting radionuclides are part of nuclear cardiology. An increasing number of nuclear laboratories have access to both conventional SPECT and PET imaging. For institutions that have positron-imaging devices, training guidelines are appropriate. Training in this particular imaging technology should go hand-in-hand and may be concurrent with training in conventional nuclear cardiology. Such training should include those aspects that are unique or specific to the imaging of positron-emitting radionuclides. Depending on the desired level of expertise, training in cardiac PET and imaging with positron-emitting radionuclides should include knowledge of substrate metabolism in the normal and diseased heart; knowledge of positron-emitting tracers for blood flow, metabolism and neuronal activity, medical cyclotrons, radioisotope production, and radiotracer synthesis; and principles of tracer kinetics and their in vivo application for the noninvasive measurements of regional, metabolic, and functional processes. The training should also include the physics of positron decay, aspects of imaging instrumentation specific to the imaging of positron emitters and the use of CT, production of radiopharmaceutical agents, quality control, handling of ultra-short life radioisotopes, appropriate radiation protection and safety, and regulatory aspects.

Consistent with the training guidelines for general nuclear cardiology, training should be divided into 3 classes.

General Training (*2 Months*)

This level is for cardiology fellows who are associated with an institution where PET and/or PET/CT devices are available and who wish to become conversant with cardiac positron imaging. Training should therefore be the same as for Level 1 training in nuclear cardiology but should include aspects specific to cardiac positron imaging. The additional proficiency to be acquired by physician trainees includes background in substrate metabolism, patient standardization and problems related to diabetes mellitus and lipid disorders, positron-emitting tracers of flow and metabolism, and technical aspects of positron and CT imaging. A didactic program should include the interpretation of cardiac PET studies of myocardial blood flow and substrate metabolism, the interpretation of studies combining SPECT for evaluation of blood flow with PET for evaluation of metabolism, the evaluation of diagnostic accuracy and cost-effectiveness of viability assessment of coronary artery disease detection, and the understanding of radiation safety as specifically related to positron emitters. Hands-on experience should include supervised observation and interpretation of cardiac studies performed with positron-emitting radionuclides and PET and PET/CT imaging devices.

Specialized Training (*Minimum of 4 Months*)

This level of training is for fellows who wish to perform and interpret cardiac PET or positron imaging studies in addition to nuclear cardiology. This training should include all Level 1 and Level 2 training in nuclear cardiology (4 to 6 months) as well as general training for cardiac PET and PET/CT. Specific aspects of training for PET and for using positron-emitting radionuclides should include radiation dosimetry, radiation protection and safety, dose calibration, physical decay rates of radioisotopes, handling of large doses of high-energy radioactive materials of short physical half-lives, quality assurance procedures, and NRC safety and record-keeping requirements. This level of training requires direct patient experience with a minimum of 40 patient studies of myocardial perfusion, metabolism, or both.

Advanced Training (*Minimum 1 Year*)

This level of training is intended for fellows planning an academic career in cardiac PET or who wish to direct a clinical cardiac PET laboratory. Similar to Level 3 training in nuclear cardiology, this training should include active participation in laboratory and clinical research in parallel with clinical activities.

In addition to the requirements for general and specialized cardiac PET training (including standard nuclear cardiology training, as previously described), advanced training should include the following:

1. Basic principles of cyclotrons, isotope production, radiosynthesis, tracer kinetic principles and models, cardiac innervation and receptors, and methods for quantifying regional myocardial blood flow and substrate metabolism.
2. Imaging instrumentation including dedicated PET systems, hybrid PET/CT systems and SPECT-like positron imaging devices with high-energy photon collimators or coincidence detection. Image acquisition and processing to include review of sinograms, errors in image recon-

struction, correction routines for photon attenuation, and patient misalignment.

3. Tissue kinetics of positron-emitting tracers; in vivo application of tracer kinetic principles; tracer kinetic models, generation of tissue time–activity curves, and computer-assisted calculation of region of functional processes of the myocardium.
4. Computer-assisted data manipulation, quantitative image analysis, and image display.

Hybrid Computed Tomography Imaging

Hybrid imaging devices combining PET or SPECT with CT are playing an increasing role in the field of cardiac imaging. Currently, nearly all PET scanners are sold as PET/CT devices, and SPECT/CT machines are now available from most manufacturers. As these devices become more widely disseminated, it will be important that training guidelines for their use be developed both for fellows in training and cardiologists already in practice. The applications of hybrid imaging in cardiology include the use of CT scanning to provide robust attenuation correction of SPECT or PET and to assess coronary calcium as a marker of coronary atherosclerosis. Even these noncontrast applications of hybrid imaging will require additional training beyond that required for CT alone. With CT coronary calcium and SPECT or PET perfusion assessments, additional training will be needed regarding discordant results. With contrast injection, high resolution CT coronary angiography can be combined with rest/stress assessments of myocardial perfusion provided by PET and SPECT, allowing functional assessment of the anatomic findings. The specifics of the training required in hybrid imaging are beyond the scope of this document; nonetheless, those nuclear cardiology training programs that are equipped to perform hybrid imaging should incorporate training in this field in their programs. Training should include the physics of hybrid systems, CT attenuation correction, principles and application of CT coronary calcium assessment, and principles and application of CT coronary angiography.

This is an update of the 2006 document that was written by Manuel D. Cerqueira, MD, FACC—Chair; Daniel S. Berman, MD, FACC; Marcelo F. Di Carli, MD, FACC; Heinrich R. Schelbert, MD, PhD, FACC; Frans J. Th. Wackers, MD, PhD, FACC; and Kim Allan Williams, MD, FACC (American Society of Nuclear Cardiology Representative).

doi:10.1016/j.jacc.2007.11.013

Key Words: ACCF Training Statement ▪ COCATS 3 ▪ nuclear cardiology ▪ electrocardiograph ▪ computed tomography ▪ positron emission tomography ▪ single-photon emission computed tomography.

APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY—ACCF 2008 RECOMMENDATIONS FOR TRAINING IN ADULT CARDIOVASCULAR MEDICINE CORE CARDIOLOGY TRAINING (COCATS 3)—TASK FORCE 5: TRAINING IN NUCLEAR CARDIOLOGY

Name	Consultant	Research Grant	Scientific Advisory Board	Speakers' Bureau	Steering Committee	Stock Holder	Other
Dr. Daniel S. Berman	• Tyco-Mallinckrodt	• Astellas • Bristol-Myers Squibb • GE Healthcare	• Spectrum Dynamics	None	None	• Spectrum Dynamics	• Cedars-Sinai Medical Center (Software royalties)
Dr. Manuel D. Cerqueira	None	• GE Healthcare	• Bristol-Myers Squibb • CV Therapeutics	• Astellas • Bristol-Myers Squibb • CV Therapeutics • GE Healthcare • Mallinckrodt	None	None	None
Dr. Marcelo F. Di Carli	• Bracco • Bristol-Myers Squibb Imaging • GE Healthcare	• Astellas • Bracco • Bristol-Myers Squibb Imaging • GE Healthcare	• Bracco • Bristol-Myers Squibb Imaging • GE Healthcare	• Astellas • Bracco • GE Healthcare	None	None	None
Dr. Heinrich R. Schelbert	None	None	None	None	None	None	None
Dr. Frans J. Th. Wackers	• Acusphere • GE Healthcare	• Acusphere • Astellas • Bristol-Myers Squibb • GE Healthcare	• King Pharmaceuticals	None	None	None	None
Dr. Kim Allan Williams	• King Pharmaceuticals	• Bristol-Myers Squibb • CV Therapeutics • GE Healthcare	• Bristol-Myers Squibb • GE Healthcare	• Astellas • GE Healthcare	None	None	None

This table represents the relationships of committee members with industry that were reported by the authors as relevant to this topic. It does not necessarily reflect relationships with industry at the time of publication.

APPENDIX 2. PEER REVIEWER RELATIONSHIPS WITH INDUSTRY—ACCF 2008 RECOMMENDATIONS FOR TRAINING IN ADULT CARDIOVASCULAR MEDICINE CORE CARDIOLOGY TRAINING (COCATS 3)—TASK FORCE 5: TRAINING IN NUCLEAR CARDIOLOGY

Name*	Affiliation	Consultant	Research Grant	Scientific Advisory Board	Speakers' Bureau	Steering Committee	Stock Holder	Other
Dr. David J. Clardy	• Official–Board of Trustees	None	None	None	None	None	None	None
Dr. Rick A. Nishimura	• Official–Board of Governors	None	None	None	None	None	None	None
Dr. James A. Arrighi	• Organizational–American Society of Nuclear Cardiology	None	None	None	None	None	None	None
Dr. Myron Craig Gerson	• Organizational–American Society of Nuclear Cardiology	None	None	None	None	None	None	None

This table represents the relationships of peer reviewers with industry that were reported by the authors as relevant to this topic. It does not necessarily reflect relationships with industry at the time of publication. *Names are listed in alphabetical order with each category of review.

Task Force 6: Training in Specialized Electrophysiology, Cardiac Pacing, and Arrhythmia Management

Endorsed by the Heart Rhythm Society

Gerald V. Naccarelli, MD, FACC, FHRS, *Chair*
Jamie B. Conti, MD, FACC, FHRS, John P. DiMarco, MD, PhD, FACC, FHRS,
Cynthia M. Tracy, MD, FACC, FHRS (*Heart Rhythm Society Representative*)

Clinical cardiac electrophysiology and cardiac pacing have merged into a common cardiac subspecialty discipline. Complex cardiac arrhythmias are managed by physicians with special expertise in cardiac electrophysiology, the use of cardiac implantable electrical devices (CIEDs), and the application of other interventional ablative techniques and pharmacologic treatments. Cardiac implantable electronic devices is a term used to encompass implantable cardioverter-defibrillators (ICDs), pacemakers, cardiac resynchronization therapy (CRT) devices, implantable hemodynamic monitors (IHMs), and implantable loop recorders (ILRs). For purposes of this document, IHMs and ILRs, while legitimately considered CIEDs, are excluded, and implantation numbers for these should not be considered as satisfying minimum training requirements.

The current Task Force is charged with updating previously published adult clinical cardiac electrophysiology training guidelines (1–4) based on changes in the cardiac electrophysiology field since the last revision (4). The number of procedures recommended for each level is a consensus based on published guidelines and competency statements and assumes training by an appropriately trained mentor and documentation of satisfactory completion of such training by the program director. The number of procedures and duration of training are summarized in Tables 1 and 2.

General Standards and Environment

Facilities and Faculty

Three organizations—the American College of Cardiology (ACC), the American Heart Association (AHA), and the Heart Rhythm Society (HRS)—have addressed training requirements and guidelines for permanent pacemaker selection, implantation, and follow-up (5,6); guidelines for the implantation and follow-up of ICDs in cardiovascular practice (7,8); guidelines for training in catheter ablation procedures (9,10); and teaching objectives for fellowship programs in clinical electrophysiology (11,12). The training recommendations for these 3 organizations are congruent and address new technologies, faculty, and facility requirements, as well as practice. It is strongly recommended that

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J. Am. Coll. Cardiol. 2008;51;368-374
doi:10.1016/j.jacc.2007.11.013

Journal of the American College of Cardiology
Vol. 51, No. 12, 2008
ISSN 0735-1097/08/$34.00

Published by Elsevier Inc.

CORRECTION

In the article by Cerqueira MD, Berman DS, Schelber HR, Williams KM, "Task Force 5: Training in Nuclear Cardiology," which appeared in the January 22, 2008, issue of the journal (J Am Coll Cardiol 2008;51:368–74), the following correction is necessary:

On page 371, last line under the heading "Radiation safety.": change "100 cases" to "80 hours" so that the sentence reads "This experience should total a minimum of 80 hours and be separately documented."

This error has been corrected in the current online version of the article.

doi:10.1016/j.jacc.2008.02.002