

## TRAINING STATEMENT

# COCATS 4 Task Force 11: Training in Arrhythmia Diagnosis and Management, Cardiac Pacing, and Electrophysiology



*Endorsed by the Heart Rhythm Society*

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## 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 Heart Rhythm Society (HRS) and included a cardiovascular training program director, an electrophysiology (EP) program training director, early-career experts, highly experienced specialists representing both the 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 the 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 HRS, and addressed the reviewers' comments. The document was revised and posted for public comment from December 20, 2014, to January 6, 2015. Authors addressed the additional comments 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 Heart Rhythm Society. This document is considered current until the ACC Competency Management Committee revises or withdraws it.

### 1.2. Background and Scope

The diagnosis and management of cardiac arrhythmias and conduction disorders are common and important components of the practice of clinical cardiology and are thus part of the core competency training of a clinical cardiologist. Clinical cardiac electrophysiologists are responsible for the comprehensive care of patients with more complex arrhythmias, along with advanced testing and invasive therapies. Clinical cardiac electrophysiologists are trained to implant cardiac electrical devices, perform diagnostic EP procedures and therapeutic catheter ablation procedures, and employ pharmacological agents to treat patients with complex arrhythmias and conduction disturbances. Cardiac implantable electrical devices (CIEDs) include pacemakers, implantable cardioverter-defibrillators (ICDs), cardiac resynchronization therapy (CRT) devices, implantable

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hemodynamic monitors, and implantable loop recorders (ILRs). For this document, implantable hemodynamic monitors and ILRs are excluded from the minimum training requirements. All cardiovascular trainees are expected to understand their indications for clinical use and to learn how to interpret the generated results in providing clinical care as part of their basic training.

The Task Force was charged with updating previously published standards for training fellows in cardiology enrolled in cardiac fellowship programs (1-4) on the basis of changes in the field since 2008 (2) 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 advanced cardiac electrophysiology training. Recommendations for advanced training in clinical cardiac electrophysiology (CCEP) are provided in the 2006 Clinical Competence Statement (5). The 2006 Clinical Competence Statement is currently being revised and retitled as the Electrophysiology Advanced Training Statement. In its revised form, it will provide detailed recommendations for the electrophysiology training required to obtain ABIM certification. 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 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 subspecialty like electrophysiology. The Steering Committee and Task Force recognize that implementation of these changes in training requirements will occur incrementally.

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.
- **Level II training** refers to 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. It is anticipated that during a standard 3-year cardiovascular fellowship training program, sufficient time will be available to receive Level II training in a

specific subspecialty. In the case of EP, Level II training is required for individuals to provide specialized arrhythmia and CIED management, including implantation, interrogation, and programming of pacemakers and ILRs, and interrogation and programming of implanted defibrillators. Those cardiovascular fellows seeking to implant ICDs and CRT devices without subspecialty board certification in CCEP are required to take an additional year of dedicated training beyond the 3 years required for cardiovascular training.

- **Level III training** requires additional training and experience beyond the cardiovascular fellowship for the trainee to acquire specialized knowledge and experience in performing, interpreting, and training others to perform specific procedures or render advanced specialized care for specific procedures at a high level of skill. In the case of EP, Level III training is required of individuals seeking subspecialty board certification (CCEP). As noted previously, those cardiovascular fellows seeking to implant ICDs and CRT devices without subspecialty board certification in CCEP are required to take an additional year of dedicated training beyond the 3 years required for cardiovascular training.

The recommended number of cases, procedures, and experiences is based on published guidelines, competency statements, and the experience and opinions of the members of the writing group. It is assumed that training 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 the duration of training required for fellows are summarized in Section 4. 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. The additional exposure and requirements for Level III training will be addressed in a subsequent, separately published, Advanced Training Statement, previously described in the 2006 Clinical Competency Statement (5).

## 2. GENERAL STANDARDS

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Three organizations—the ACC, American Heart Association, and HRS—have addressed training requirements and guidelines for the following topic areas: permanent pacemaker selection, implantation, and follow-up (6,7); implantation and follow-up of ICDs (8,9); training in catheter ablation procedures (10,11); and educational objectives for fellowship training in CCEP (2,12,13). The recommendations are congruent and address faculty, facility requirements, emerging technologies, and practice. We strongly recommend that candidates for the ABIM examination for certification in cardiovascular diseases, as well as those

seeking certification of added qualifications in CCEP, review the specific requirements of the ABIM (14,15).

The intensity of training and required resources vary according to the level of training provided. Cardiovascular fellowship programs do not have to satisfy the requirements regarding facilities and faculty for training in EP (10,11) unless they also have an ABIM-accredited EP training program designed to provide Level III training. Eligibility for the ABIM CCEP examination requires that training take place in a program accredited by the ACGME (14).

### 2.1. Faculty

Faculty involved in training in arrhythmia diagnosis and management, cardiac pacing, and electrophysiology should include specialists who are skilled in the pharmacological, catheter-based, and surgical aspects of pacing and EP and are knowledgeable about the risks to the patient and medical personnel associated with radiation exposure. This faculty should include at least 1 board-certified electrophysiologist (CCEP) or 1 who possesses equivalent qualifications. A physician is considered to have equivalent qualifications if he or she trained in a similar environment for a similar period of time and performed the required number of procedures.

### 2.2. Facilities

Facilities should include a cardiac EP laboratory that provides a safe, sterile, and effective environment for invasive diagnostic EP studies, catheter ablation procedures, and CIED implantation. In addition, outpatient clinical facilities should be available for implantation of CIEDs, training in the consultative aspects of arrhythmia management, and device therapy.

### 2.3. Equipment

EP laboratories require fluoroscopy and specialized equipment for the safe performance of diagnostic procedures, catheter ablation procedures, and CIED implantation. This equipment includes EP pacing and recording systems, radiofrequency generators, and defibrillators. Additional equipment is needed in programs performing lead extraction (16).

### 2.4. Ancillary Support

Ancillary support should be available to perform EP and ablation procedures and to implant CIEDs, including general anesthesia and surgical backup in the event of complications requiring surgical intervention.

## 3. TRAINING COMPONENTS

### 3.1. Didactic Program

Didactic instruction may take place in a variety of formats, including but not limited to lectures, conferences,

journal clubs, grand rounds, clinical case presentations, and patient safety or quality improvement conferences. The electrocardiographic (ECG) manifestations of arrhythmias should be taught on a regular basis during formal ECG conferences.

### 3.2. Clinical Experience

Rotation on an arrhythmia service is an essential component of all levels of EP training. A Level I trainee should gain first-hand experience as a consultant in arrhythmia management. It is important that the arrhythmia consultation service have a robust patient mix and acuity level. During the required 2 months on the consultation arrhythmia service, Level I trainees should evaluate 1 or more inpatient arrhythmia consultations daily in addition to providing follow-up care after initial consultation. In addition to participating in arrhythmia consultations, it is also important for Level I trainees to observe EP procedures including diagnostic EP studies, placement of ILRs, catheter ablation procedures including atrial fibrillation ablation procedures, and device implantation procedures (permanent pacemakers, ICDs, and CRTs). Level I trainees should also observe a number of interrogations of implanted devices (permanent pacemakers, ICDs, and CRTs) and gain a basic understanding of concepts involved in programming and interrogating implantable devices.

Level II and III training require robust clinical experiences in the outpatient setting, inpatient and inpatient consultation setting, and EP laboratory. In each of these clinical settings, trainees assist in patient care in a supervised setting that provides for patient-centered education in all aspects of arrhythmia management.

### 3.3. Hands-On Experience

Hands-on experience is important for training in arrhythmia and CIED management. Trainees in cardiology should spend a minimum of 2 months on an arrhythmia service to acquire the core competencies (Level I). During this period or during rotations in the coronary care unit and cardiac catheterization laboratory, trainees should perform cardioversion procedures; implant, evaluate, and adjust temporary pacemakers; and interpret the results of tilt-table testing.

Level II knowledge and skills can typically be obtained within 6 months dedicated training by the arrhythmia service. During this additional training, trainees should perform cardioversion procedures; implant, evaluate, and adjust temporary pacemakers; learn how to interrogate and troubleshoot implantable devices (permanent pacemakers, ICDs, and CRTs); perform and interpret the results of tilt-table testing; implant ILRs; and spend time in the device and arrhythmia clinic. Level II trainees may use part of this dedicated training period to learn to

implant permanent pacemakers safely and appropriately. The minimum number of such procedures is provided later in this document.

Level III training in cardiac EP requires additional training beyond the standard 3-year cardiovascular fellowship and typically requires 24 months of exposure to advanced cardiac electrophysiology, including a considerable amount of time in the EP laboratory performing specific procedures. Level III training is required of individuals seeking subspecialty board certification in CCEP.

#### 4. SUMMARY OF TRAINING REQUIREMENTS

##### 4.1. Development and Evaluation of Core Competencies

Training and requirements in cardiac arrhythmia diagnosis, pacing, and electrophysiology address the 6 general competency domains promulgated by the ACGME/American Board of Medical Specialties 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 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, life-long learning, and educational programs. Additionally, it has developed tools to assist physicians in assessing, enhancing, and documenting these competencies.

**Table 1** delineates each of the 6 competency domains as well as their associated curricular milestones for training in cardiac arrhythmias and electrophysiology. 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, and acquisition of Level III skills requires training in a dedicated CCEP program. The table also describes examples of evaluation tools suitable for assessment of competence in each domain.

##### 4.2. Number of Procedures and Duration of Training

The specific competencies for Levels I, II, and III are delineated in **Table 1**. Level I competencies must be

obtained by all fellows during the 3-year cardiovascular disease fellowship training program. Level II competencies may be obtained during the cardiovascular disease fellowship by selected fellows depending on their career focus and elective experiences. Level III competencies are noted so that fellows are aware of the competencies for which additional, advanced training beyond the standard 3-year fellowship is required. Details for advanced training will be included in an updated version of the 2006 Clinical Competence Statement on Invasive Electrophysiology Studies, Catheter Ablation, and Cardioversion (5), which is currently under revision. The minimum duration of training and volume of procedures required for Level I and II training in CCEP are summarized in **Tables 2** and **3**. Although these minimum training durations and numbers of procedures are typically required to obtain the competency levels, trainees must also demonstrate achievement of the competencies as assessed by the outcomes evaluation measures. A brief discussion of the competencies and training requirements follows.

##### 4.2.1. Level I Training Requirements

Level I training should occupy at least 2 months on a CCEP rotation designed to acquire knowledge, skills, and experience in the diagnosis and management of arrhythmias (**Table 1**). Level I training should focus on the value of the clinical history in the diagnosis of cardiac arrhythmias and the ECG interpretation of arrhythmias, including differentiation of supraventricular from ventricular tachycardia. Also important for Level I training is exposure to the noninvasive diagnosis of cardiac arrhythmias, including ambulatory ECG monitoring (see COCATS 4 Task Force 2 report), event recorders, ILRs, exercise testing for arrhythmia assessment, and tilt-table testing. Exposure to invasive EP studies (including measurements of AH and HV intervals, and basic activation sequences) should be provided in Level I training to allow understanding of the role of invasive EP testing in diagnosis of cardiac arrhythmias. The Level I trainee should understand the basic concepts of catheter ablation, including indications, contraindications, techniques, and potential complications. Similarly, the Level I trainee should understand the basic concepts of CIEDs, including the indications, techniques, and potential complications of ICDs and biventricular pacemakers. Knowledge of the fundamentals of cardiac pacing should encompass recognition of normal and abnormal pacemaker function (2); pacing modes; and techniques of interrogation, programming, and surveillance of pacemakers and ICDs. Instruction in cardiac pacing should emphasize the indications, cost-effective use, and limitations of these devices. Level I trainees should understand the proper use of anticoagulant and antiarrhythmic agents,

**TABLE 1 Core Competency Components and Curricular Milestones for Training in Cardiac Arrhythmias and Electrophysiology**

Competency Component		Milestones (Months)			
MEDICAL KNOWLEDGE		12	24	36	Add
1	Know the mechanism and characteristics of normal sinus rhythm and of sinus node dysfunction.	I			
2	Know the pathophysiology, differential diagnosis, clinical significance, and approach to management of re-entrant tachycardia (atrioventricular nodal re-entrant tachycardia; atrioventricular reciprocating tachycardia), ectopic atrial tachycardias, and accelerated atrioventricular junctional rhythm.		I		
3	Know the pathophysiology, differential diagnosis, clinical significance, and approach to management of atrial fibrillation and flutter, including the assessment of stroke and bleeding risk, indications of anticoagulation, and selection of anticoagulant medications.	I			
4	Know the risk factors for stroke and for bleeding in patients with atrial fibrillation or atrial flutter, as well as the indications for, and use of, anticoagulant medications.	I			
5	Know the pathophysiology, differential diagnosis, clinical significance, and approach to management of sustained and nonsustained ventricular tachyarrhythmias.		I		
6	Know the pathophysiology, differential diagnosis, and approaches to risk stratification and management of sudden cardiac death and cardiac arrest, including sudden cardiac death in athletes.		I		
7	Know the types, mechanisms, differential diagnosis, clinical significance, and approach to management of atrioventricular dissociation and atrioventricular heart blocks (first, second, and third degree).	I			
8	Know the physical examination characteristics of arrhythmias (e.g., findings of atrioventricular dissociation).		I		
9	Know the significance of underlying structural or congenital heart disease in the likelihood and significance of cardiac arrhythmias, including sudden death risk, and their impact in clinical management decisions.		I		
10	Know the indications, contraindications, and clinical pharmacology of antiarrhythmic medications, including drug-drug and drug-device interactions and proarrhythmia potential (including acquired long QT syndrome).		I		
11	Know the indications and limitations of noninvasive testing in the diagnosis and management of patients with arrhythmias: electrocardiogram, ambulatory, event, implantable loop recorder, and tilt-table testing.		I		
12	Know the indications for, and limitations and complications of, invasive electrophysiological testing, as well as catheter ablation for cardiac arrhythmias.		I		
13	Know the indications and contraindications for permanent pacemaker placement, cardiac resynchronization therapy, and implantable cardioverter-defibrillator placement.		I		
14	Know the pathophysiology, differential diagnosis, natural history, and approach to management of syncope, including neurocardiogenic causes and syncope in athletes.	I			
15	Know the mechanisms, findings, clinical significance, and approach to management of ventricular pre-excitation.		I		
16	Know the pathology, clinical significance, and approach to evaluation (including the role of genetic testing) and management of inherited diseases that may cause cardiac arrhythmias due to ion channel abnormalities or structural changes in the heart (including the long QT syndrome, Brugada syndrome, arrhythmogenic right ventricular dysplasia, hypertrophic dilated cardiomyopathy, and myotonic dystrophy).		I		
17	Know the principles and practice of radiation safety as applied to the evaluation and management of cardiac electrical disorders.	I			
18	Know the basic principles of programming and interrogating implanted devices (permanent pacemakers, implantable cardioverter-defibrillators, cardiac resynchronization therapies, and implantable monitors)		I		

**EVALUATION TOOLS:** chart-stimulated recall, global evaluation, and in-training examination.

PATIENT CARE AND PROCEDURAL SKILLS		12	24	36	Add
1	Skill to evaluate and manage patients with palpitations.		I		
2	Skill to evaluate and manage patients with syncope.		I		
3	Skill to evaluate and manage patients with supraventricular tachyarrhythmias.		I		
4	Skill to evaluate and manage patients with atrial fibrillation and flutter (including rate and rhythm control and anticoagulation strategies).		I		
5	Skill to evaluate and manage patients with wide-QRS tachycardia.		I		

**TABLE 1 Core Competency Components, continued**

Competency Component		Milestones (Months)			
PATIENT CARE AND PROCEDURAL SKILLS		12	24	36	Add
6	Skill to manage patients with nonsustained and sustained ventricular arrhythmias.		I		
7	Skill to evaluate and manage patients with bradycardia and/or heart block.		I		
8	Skill to perform electrical cardioversion.	I			
9	Skill to perform defibrillation.	I			
10	Skill to perform tilt-table testing.		II		
11	Skill to perform temporary pacemaker placement.		I		
12	Skill to select and manage patients requiring a permanent pacemaker, implantable cardioverter-defibrillator, or biventricular pacing.			I	
13	Skill to integrate the information provided in cardiac electrophysiology consultation, and reports of procedures and device interrogation, into the overall clinical assessment of the patient and plan of management.		I		
14	Skill to perform pacemaker and implantable cardioverter-defibrillator interrogation, programming, and surveillance.			II	
15	Skill to perform single- and dual-chamber permanent pacemaker implantation and manage complications, including device infections and chronic lead failure.			II	
16	Skill to perform implantation of implantable loop recorders, interpret results to guide patient management, and manage complications.			II	
17	Skill to perform implantable cardioverter-defibrillator and biventricular device implantation and manage complications.				III
18	Skill to perform and interpret invasive electrophysiological testing and carry out ablation therapy.				III
19	Skill to utilize magnetic resonance imaging, computed tomography, and intracardiac echocardiography in facilitating invasive electrophysiology and ablation therapies.				III
20	Skill to follow-up, interrogate, and troubleshoot patients with implanted devices (permanent pacemakers, implantable cardioverter-defibrillators, cardiac resynchronization therapies), including remote interrogation.			II	
21	Skill to evaluate and manage patients with cardiac arrest.		I		
22	Skill to prescribe and interpret the results of electrocardiographic recording devices.		I		
<p><b>EVALUATION TOOLS:</b> chart-stimulated recall, patient safety or quality improvement conference presentation, direct observation, global evaluation, logbook, and simulation.</p>					
SYSTEMS-BASED PRACTICE		12	24	36	Add
1	Utilize an interdisciplinary coordinated approach for patient management, including transfer of care and employment-related issues.		I		
2	Use technology and available registries to assess appropriateness, performance, and safety of implanted devices.		I		
3	Incorporate risk/benefit analysis and cost considerations in diagnostic and treatment decisions.		I		
<p><b>EVALUATION TOOLS:</b> chart-stimulated recall, direct observation, and multisource evaluation.</p>					
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		
2	Utilize decision support tools for accessing guidelines and pharmacologic information at the point of care.		I		
<p><b>EVALUATION TOOLS:</b> chart-stimulated recall, conference presentation, direct observation, and logbook.</p>					
PROFESSIONALISM		12	24	36	Add
1	Demonstrate sensitivity to patient preferences and end-of-life issues.		I		
2	Practice within the scope of expertise and technical skills.		I		

Competency Component		Milestones (Months)			
<b>PROFESSIONALISM</b>		12	24	36	Add
3	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.					
<b>INTERPERSONAL AND COMMUNICATION SKILLS</b>		12	24	36	Add
1	Communicate with and educate patients and families across a broad range of cultural, ethnic, and socioeconomic backgrounds.		I		
2	Engage in shared decision-making with patients, including decisions regarding options for diagnosis and treatment.		I		
EVALUATION TOOLS: direct observation and multisource evaluation.					

Add = additional months beyond the 3-year cardiovascular fellowship.

including their toxicity and drug-drug and drug-device interactions.

The cardiovascular trainee should be instructed in and gain experience with the indications for insertion, management, and follow-up of temporary pacemakers (2), including measurement of pacing and sensing thresholds, recording of intracardiac electrograms, and recognition of procedure-related complications. The cardiovascular trainee should also be instructed in and gain experience with cardioversion and cardiac defibrillation (17). Temporary pacemaker and cardioversion procedures may be performed in the cardiac catheterization laboratory, electrophysiology laboratory, cardiac care unit, or other critical care settings. Instruction leading to acquisition of the core competencies required of Level I trainees should meet the minimum procedural volume

criteria detailed in Table 3. These experiences and skills should be obtained throughout the cardiovascular clinical training period and be integrated with formal didactic ECG conferences, core curriculum sessions, and rotation on the arrhythmia consultation service.

#### 4.2.2. Level II Training Requirements

Trainees who wish to have more training in cardiac EP should be enrolled in programs that include specific inpatient services and outpatient clinics designed for patients requiring therapy for cardiac arrhythmias and conduction disorders, as described for Level I; however, in addition to ensuring a curriculum that satisfies the specifics of Level I training, such programs must offer greater intensity and exposure to a broader spectrum of therapeutic modalities. Level II training can be accomplished within the scope of the 3 years of initial cardiovascular training. Trainees in a Level II curriculum should actively participate in didactic activities relating more specifically to EP, including research conferences, seminars, and journal clubs with cardiac electrophysiological disorders as a primary focus.

Level II training involves more advanced knowledge and skills than Level I training but less than the comprehensive training in cardiac EP required for Level III training. Level II training typically involves 6 months of training in mechanisms of arrhythmia; pharmacology of antiarrhythmic and anticoagulant drugs; and noninvasive and invasive techniques of diagnosis, treatment, and longitudinal care of patients with complex arrhythmias.

The Level II trainee should acquire the skills and experience to manage patients with CIEDs, including permanent pacemakers, ICDs, biventricular pacemakers, and ILRs. Level II trainees who wish to implant

**TABLE 2** Cardiac Arrhythmia and Electrophysiology Curriculum Training Summary for 3-Year Cardiovascular Fellowship Training Program

Level	Curriculum/Skills	Time Requirement	Optional Training in Device Implantation
I	Cardiac arrhythmia and electrophysiology core	2 months (in addition to COCATS 4 Task Force 2 training requirements)	No
II	Advanced noninvasive arrhythmia management	6 months	Level II trainees who wish to implant permanent pacemakers and ILRs may receive this training during this 6-month period of time.

ILR = implantable loop recorder.

**TABLE 3** Core Cardiac Arrhythmia and Electrophysiology Curriculum Training for 3-Year Cardiovascular Fellowship Training Program

Level	Minimum Number of Procedures	Cumulative Duration of Training
I	5 temporary pacemakers 20 cardioversions	2 months
II	For Level II training alone (without training in pacemaker implantation) <ul style="list-style-type: none"> <li>■ 100 CIED interrogations/programming</li> <li>■ 25 remote device interrogations</li> </ul> For Level II training, including pacemaker implantation <ul style="list-style-type: none"> <li>■ 40 permanent pacemaker implantations with at least 20 single-chamber and 20 dual-chamber pacemakers</li> </ul>	6 months

CIED = cardiac implantable electrical device.

permanent pacemakers may spend time during their 6 months of dedicated Level II training in implanting permanent pacemakers. Level II training obtained during a standard 3-year clinical cardiovascular fellowship does not qualify the trainee to implant defibrillators or biventricular devices. Rather, defibrillator and biventricular device implantation requires Level III training in invasive CCEP or an additional 12 months of dedicated training in ICD and biventricular device implantation and management. During this additional 12-month period, the volume requirements for device programming and ICD and biventricular device implants must be met. The core competencies appropriate for Level II training, including minimum procedural volume criteria, are outlined in [Table 3](#).

**4.2.2.1. Optional Training in Pacemaker Implantation (Level II)**

Those who have obtained Level II training and wish to implant permanent single- and dual-chamber pacemakers should spend time implanting permanent pacemakers during the 3-year cardiovascular fellowship program if 6 months is dedicated to acquiring the knowledge and skills pertaining to permanent pacemaker implantation and related patient management and follow-up. Competence in the indications for, implantation techniques, and follow-up of ILRs is desirable. This training does not satisfy the ABIM requirements for admission to the CCEP examination and is not considered adequate training to implant implantable defibrillators.

**4.2.2.2. Training in Defibrillator Implantation**

Individuals who spend an additional 12 months (beyond a standard 3-year cardiovascular fellowship) obtaining additional training in ICD, biventricular device, and pacemaker implantation without satisfying the full requirements for Level III training in advanced cardiac electrophysiology (Level III training) can be granted

privileges to implant CIEDs, including ICDs and biventricular devices. It is recommended that this type of training for CIED implantation follow the aforementioned COCATS requirements. Although these individuals are not eligible for the ABIM EP Board Examination, they may be candidates for the International Board of Heart Rhythm Examiners physician examination (18).

**4.2.3. Level III Training Requirements**

The ACGME has defined the essential components of a specialized program for training in CCEP; the ABIM offers an examination for this additional certification. Information concerning the eligibility requirements for the examination can be obtained from the ABIM. Privileges to perform invasive procedures should be based mainly on satisfactory completion of the training outlined in this document, including demonstration of competence and technical expertise.

Level III training prepares the physician to specialize in invasive CCEP (5,19,20). Level III trainees should meet all Level II training requirements and obtain additional, advanced training in performing diagnostic EP procedures, catheter-based ablation procedures, and implantation of ICDs and biventricular pacemakers. The minimal procedure volume requirements are provided in the Clinical Competency Statement (5,19,20). The Clinical Competency Statement for training in electrophysiology will be replaced by an ACC/American Heart Association/HRS Electrophysiology Advanced Training Statement currently under development. The appropriate use, safe performance, and judicious interpretation of these complex procedures require highly specialized training for competence to be achieved. Advanced understanding of CCEP and cardiac pharmacology is required along with the technical and cognitive skills to manage patients with complex arrhythmias.

Level III training should include performing diagnostic EP procedures for a variety of indications, including evaluation of syncope, determination of the precise mechanism of supraventricular arrhythmias, and risk-stratification in patients with malignant arrhythmias. In many patients, these diagnostic EP procedures may be performed in conjunction with planned catheter ablation procedures for treatment of supraventricular arrhythmias. Level III training in EP requires experience in left ventricular lead implantation procedures, ICD implantation, and performance of pacing and defibrillation threshold testing at the time of implantation and during follow-up.

Level III training in preparation for the CCEP board examination includes training in implantable defibrillator implantation, during which the physician should develop expertise in the placement of permanent atrial, right and left ventricular, and ICD leads. Trainees should also

develop expertise in the implantation and testing of subcutaneous ICDs. This entails adhering to principles of surgical asepsis, mastering surgical implantation techniques, and managing implant-related complications. Trainees in implantable defibrillator implantation should acquire extensive knowledge of the indications for and contraindications to ICDs; thorough understanding of advanced ICD electrocardiography; knowledge of drug-device interactions; competency in interrogation and programming of complex pacemaker and ICD systems; expertise in threshold testing, ventricular fibrillation induction, and defibrillator testing; experience in managing device-related complications; and competence in managing high pacing, defibrillation thresholds, and device malfunction. Level III trainees gain extensive knowledge of the indications for placement of left ventricular leads, contraindications, and management of biventricular device malfunctions and interactions. Because competency in these procedures is related to caseload, minimal procedural volumes must be satisfied during Level III training.

## 5. EVALUATION OF COMPETENCY

Evaluation tools in cardiac arrhythmia diagnosis, pacing, and electrophysiology include direct observation by instructors, in-training examinations, case logbooks, conference and case presentations, multisource evaluations, trainee portfolios, and simulation. Case management, judgment, interpretive, and bedside skills must be

evaluated in every trainee. Quality of care and follow-up; reliability; judgment, decisions, or actions that result in complications; interaction with other physicians, patients, and laboratory support staff; initiative; and the ability to make appropriate decisions independently should be considered. 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, diagnoses, disease severity, outcomes, and disposition).

The ACC, American Heart Association, and HRS have formulated a clinical competence statement on invasive EP studies, catheter ablation, and cardioversion (5). Self-assessment programs and competence examinations in ECG are available through the ACC and other organizations. Training directors and trainees are encouraged to incorporate these resources in the course of training.

Under the aegis of the program director, 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 ensuring achievement of selected training milestones and identifying areas in which additional focused training may be required.

## REFERENCES

- Flowers NC, Abildskov JA, Armstrong WF, et al. ACC policy statement: recommended guidelines for training in adult clinical cardiac electrophysiology. Electrophysiology/ Electrocardiography Subcommittee, American College of Cardiology. *J Am Coll Cardiol* 1991;18:637-40.
- Naccarelli GV, Conti JB, DiMarco JP, Tracy CM. Task force 6: training in specialized electrophysiology, cardiac pacing, and arrhythmia management. *J Am Coll Cardiol* 2006;47:904-10.
- Josephson ME, Maloney JD, Barold SS, et al. Guidelines for training in adult cardiovascular medicine: Core Cardiology Training Symposium (COCATS). Task force 6: training in specialized electrophysiology, cardiac pacing and arrhythmia management. *J Am Coll Cardiol* 1995;25:23-6.
- Zipes DP, DiMarco JP, Gillette PC, et al. Guidelines for clinical intracardiac electrophysiological and catheter ablation procedures: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee on Clinical Intracardiac Electrophysiology and Catheter Ablation Procedures). *J Am Coll Cardiol* 1995;26:555-73.
- Tracy CM, Akhtar M, DiMarco JP, et al. American College of Cardiology/American Heart Association 2006 update of the clinical competence statement on invasive electrophysiology studies, catheter ablation, and cardioversion: a report of the American College of Cardiology/American Heart Association/American College of Physicians Task Force on Clinical Competence and Training. *J Am Coll Cardiol* 2006;48:1503-17.
- Gregoratos G, Abrams J, Epstein AE, et al. ACC/AHA/NASPE 2002 guideline update for implantation of cardiac pacemakers and antiarrhythmia devices—summary article: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/NASPE Committee to Update the 1998 Pacemaker Guidelines). *J Am Coll Cardiol* 2002;40:1703-19.
- Hayes DL, Naccarelli GV, Furman S, et al. NASPE training requirements for cardiac implantable electronic devices: selection, implantation, and follow-up. *Pacing Clin Electrophysiol* 2003;26:1556-62.
- Curtis AB, Langberg JJ, Tracy CM. Clinical competency statement: implantation and follow-up of cardioverter defibrillators. *J Cardiovasc Electrophysiol* 2001;12:280-4.
- Winters SL, Packer DL, Marchlinski FE, et al. Consensus statement on indications, guidelines for use, and recommendations for follow-up of implantable cardioverter-defibrillators. North American Society of Electrophysiology and Pacing. *Pacing Clin Electrophysiol* 2001;24:262-9.
- Scheinman MM, North American Society of Pacing and Electrophysiology Ad Hoc Committee on Catheter Ablation. Catheter ablation for cardiac arrhythmias, personnel, and facilities. *Pacing Clin Electrophysiol* 1992;15:715-21.
- American College of Cardiology Cardiovascular Technology Assessment Committee. Catheter ablation for cardiac arrhythmias: clinical applications, personnel and facilities. *J Am Coll Cardiol* 1994;24:828-33.
- Mitchell LB, Dorian P, Gillis A, Kerr C, Klein G, Talajic M, Canadian Cardiovascular Society Committee. Standards for training in adult clinical cardiac electrophysiology. *Can J Cardiol* 1996;12:476-80.
- Scheinman M, Akhtar M, Brugada P, et al. Teaching objectives for fellowship programs in clinical electrophysiology. *Pacing Clin Electrophysiol* 1988;11:989-96.
- Accreditation Council for Graduate Medical Education. Program requirements for residency programs in clinical cardiac electrophysiology. Available at: [http://www.acgme.org/acgme/PDFAssets/2013-PR-FAQ-PIF/154\\_clinical\\_card\\_electrophys\\_](http://www.acgme.org/acgme/PDFAssets/2013-PR-FAQ-PIF/154_clinical_card_electrophys_)

int\_med\_07132013\_1-YR.pdf. Accessed September 25, 2014.

15. Zipes DP, Downing SM, Kungilaski R, Norcini JJ Jr. The first cardiac electrophysiology examination for added qualifications: American Board of Internal Medicine. *J Cardiovasc Electrophysiol* 1994;5:641-4.

16. Wilkoff BL, Byrd CL, Love C. NASPE guidelines for lead extraction. *Pacing Clin Electrophysiol* 2000;23:544-51.

17. Yurchak PM, Williams SV, Achord JL, et al. Clinical competence in elective direct current (DC) cardioversion: a statement for physicians from the ACP/ACC/

AHA Task Force on Clinical Privileges in Cardiology. *J Am Coll Cardiol* 1993;22:336-9.

18. International Board of Heart Rhythm Examiners was formerly named NAPSEXAM. This physician exam is given at least twice a year. Available at: <http://www.ibhre.org/Exam-Information/Physician-Exams#axzz3VRdQ76Hi>. Accessed September 25, 2014.

19. Akhtar M, Achord JL, Reynolds WA. Clinical competence in invasive cardiac electrophysiological studies. ACP/ACC/AHA Task Force on Clinical Privileges in Cardiology. *J Am Coll Cardiol* 1994;23:1258-61.

20. Tracy CM, Akhtar M, DiMarco JP, Packer DL, Weitz HH. American College of Cardiology/American

Heart Association clinical competence statement on invasive electrophysiology studies, catheter ablation, and cardioversion: a report of the American College of Cardiology/American Heart Association/American College of Physicians—American Society of Internal Medicine Task Force on Clinical Competence. *J Am Coll Cardiol* 2000;36:1725-36.

**KEY WORDS** ACC Training Statement, cardiac arrhythmias, clinical competence, COCATS, electrophysiology, fellowship training, implantable defibrillators, pacemakers

**APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—COCATS 4 TASK FORCE 11: TRAINING IN SPECIALIZED ELECTROPHYSIOLOGY, CARDIAC PACING, AND ARRHYTHMIA MANAGEMENT**

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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](http://www.acc.org/guidelines/about-guidelines-and-clinical-documents/relationships-with-industry-policy). 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 11: TRAINING IN SPECIALIZED ELECTROPHYSIOLOGY, CARDIAC PACING, AND ARRHYTHMIA MANAGEMENT

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

### APPENDIX 3. ABBREVIATION LIST

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ABIM = American Board of Internal Medicine

ABMS = American Board of Medical Specialties

ACC = American College of Cardiology

ACGME = Accreditation Council for Graduate Medical Education

CCEP = clinical cardiac electrophysiology

CIED = cardiac implantable electrical device

COCATS = Core Cardiovascular Training Statement

CRT = cardiac resynchronization therapy

ECG = electrocardiographic

EP = electrophysiology

HIPAA = Health Insurance Portability and Accountability Act

HRS = Heart Rhythm Society

ICD = implantable cardioverter-defibrillator

ILR = implantable loop recorder