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COMPETENCE AND TRAINING STATEMENT

2016 ACC Lifelong Learning Competencies for General Cardiologists

A Report of the ACC Competency Management Committee

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PREAMBLE

Beginning with publication of the first Core Cardiovascular Training Statement (COCATS) in 1995, the American College of Cardiology (ACC) has played a central role in defining the knowledge, experiences, skills, and behaviors expected of adult clinical cardiologists upon completion of fellowship training. Subsequent updates have incorporated major advances and revisions—both in structure and content—including, most recently, a transition to training based on competency outcomes under the 6 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). Many hospital systems now use the 6-domain structure as part of medical staff privileging, professional competence assessments, and peer review. The ACC endorses a similar structure to align the competencies and lifelong learning objectives that all practicing cardiologists are expected to maintain throughout their careers.

The ACC Competency Management Committee (CMC) oversees the development and periodic revision of cardiovascular training and competency statements pertaining to general cardiology and advanced training in various areas for which there are ABIM added-qualification designations. Whereas COCATS focuses on general clinical cardiology, ACC advanced training statements define selected competencies beyond those expected of all cardiologists and that require training beyond a standard 3-year general cardiovascular fellowship. These include sub-subspecialties for which there are ABIM added-qualification designations, such as clinical cardiac electrophysiology, interventional cardiology, heart failure, and adult congenital heart disease. The advanced training statements also describe key experiences and outcomes necessary to maintain or expand competencies during practice.

A key feature of competency-based training and performance is an outcome-based evaluation system. All ACC competence and training statements, therefore, include examples of tools that can be used to assess achievement of the individual components of competency. Recommendations in these statements are based on available evidence and, where evidence is lacking, reflect expert opinion. The writing committees reflect the diversity of clinical cardiology, and typically include content experts, general cardiology and sub-subspecialty training program directors, practicing cardiologists, and early-career representatives. All documents are subject to rigorous peer review. Recommendations are intended to guide the assessment of the competence of cardiovascular care providers beginning independent practice as well as of those undergoing periodic review to help ensure that competence is maintained.

This Competency Statement complements the basic training in cardiovascular medicine required of all trainees during the standard 3-year cardiovascular fellowship by focusing on the core competencies reasonably expected of all general cardiologists throughout the span of their careers. It also identifies certain aspects of cardiovascular medicine that exceed core expectations and may be maintained or achieved by some general cardiologists, depending on their background and practice focus. This document provides examples of appropriate measures for assessing competence in the context of lifelong learning.

Writing committee members volunteered their time for this effort, which was supported exclusively by the ACC without commercial involvement. Meetings and conference calls were confidential and attended only by committee members. To avoid actual, potential, or perceived conflict of interest arising as a result of relationships with industry or other entities (RWI) on the part of writing committee members or peer reviewers of the document, each individual was required to disclose all current healthcare-related relationships, including those existing 12 months before initiation of the writing effort. The ACC Competency Management Committee determined that RWI were not relevant to the creation of a general cardiology competence statement but provided employment and affiliation information for authors and peer reviewers in Appendixes 1 and 2, respectively, along with disclosure reporting categories. In addition, to ensure transparency, comprehensive health care-related disclosure information, including relationships with industry and other entities (RWI) not pertinent to this document, has been posted online. Disclosure information for the ACC Competency Management Committee is also available online, as is the ACC disclosure policy for document development.

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1. INTRODUCTION

1.1. Document Development Process

1.1.1. Writing Committee Organization

The writing committee was selected by the American College of Cardiology (ACC) and included cardiovascular training program directors, cardiology clinic directors, early career cardiovascular disease prevention experts, experienced specialists representing both the academic and community-based practice settings, and physicians experienced in defining and applying training standards according to the core competencies structure promulgated by the ACGME and ABMS and endorsed by the ABIM. The writing committee met the College's disclosure requirements for RWI as described in the Preamble.

1.1.2. Document Development and Approval

The writing committee initially adapted the 20 competency tables in COCATS 4 (1-16) to align with the lifelong learning environment that defines the practice of general

clinical cardiology. Individual tables were then sent to the corresponding COCATS authoring groups for review and commentary. The writing committee reviewed this feedback and revised the tables to ensure applicability to general cardiologists in practice, including competencies pertinent to practice focus, and establish continuity across all tables. The writing committee then compiled the tables, aggregated a common set of professional behavior competencies (Systems-Based Practice, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, and Professionalism), and added Leadership and Administrative competencies in a separate section of the document. The writing committee approved the document for peer review by individuals selected by the ACC (see Appendix 2 for reviewer names, their affiliations in the review process, and their employment information) and simultaneously posted the document for public comment from November 2, 2015 to November 20, 2015. A total of 165 comments were received and addressed by the writing committee to finalize the document.

The final document was approved by the Writing Committee, ACC Competency Management Committee, and ACC Lifelong Learning Oversight Committee, and ratified by the ACC Board of Trustees and Executive Committee in February 2016. This document is considered current until the ACC Competency Management Committee revises, replaces, or withdraws it.

1.2. Background and Scope

In 2010, the ACC began an ambitious initiative to delineate: 1) the core clinical competencies essential for trainees to attain during a 3-year cardiovascular fellowship (COCATS 4); and 2) the aligned competencies that patients and accrediting bodies can reasonably expect clinical cardiologists in practice to acquire, maintain, or enhance through lifelong learning throughout their career. Key features of this outcomes-based curriculum include the 6-domain structure promulgated by the ACGME. The cardiovascular competencies, organized in a topical format (Table 1), provide a structure for the ACC learning pathways and underpin all ACC educational activities.

The first iterations of the core cardiovascular competencies were delineated in 2012. COCATS 4 expanded and updated these, and when published in March 2015, incorporated the new curricular competency format. This document aligns the lifelong learning competencies with the COCATS 4 training milestones. Although the COCATS 4 and lifelong learning competencies are similar, they are not identical, reflecting the impact of practice focus and patterns on expectations of competency. The aggregated lifelong learning competencies collectively underlie the Entrustable Professional Activities (EPAs) that patients and the public can reasonably expect all competent clinical cardiologists to be able to perform (Table 2).

TABLE 1 Framework of Cardiovascular Competencies for Lifelong Learning

1. Ambulatory, Consultative, and Longitudinal Cardiovascular Care
2. Cardiovascular Disease Prevention
3. ECG and Ambulatory ECG Testing
4. Exercise ECG Testing
5. Echocardiography
6. Nuclear Cardiology
7. Cardiovascular Computed Tomography
8. Cardiovascular Magnetic Resonance
9. Invasive Cardiology
10. Stable Ischemic Heart Disease
11. Acute Coronary Syndromes
12. Valvular Heart Disease
13. Heart Failure
14. Pericardial Disease
15. Vascular Medicine
16. Arrhythmias and Electrophysiology
17. Critical Care Cardiology
18. Adult Congenital Heart Disease
19. Additional Professional Behavior Relevant to All Clinical Areas
20. Leadership and Administration

ECG = electrocardiography.

1.2.1. Lifelong Learning Competencies

The lifelong learning competencies for general cardiologists are organized using the 6 domains promulgated by ACGME/ABMS and endorsed by ABIM (see Table 3). Section 2 focuses on clinical competencies, encompassing both the Medical Knowledge competencies and Patient Care and Procedural Skills competencies related to the 18 clinical areas identified in Table 1 (see Tables 4 to 22). These competencies are unique to each clinical area. In

TABLE 2 Entrustable Professional Activities for Subspecialists in Cardiovascular Disease

- **Cardiovascular Consultation—**evaluate, diagnose, and develop treatment plans for patients with known or suspected cardiovascular disease, or who are at risk of developing cardiovascular disease.
- **Acute Cardiac Care—**manage patients with acute cardiac conditions.
- **Chronic Cardiovascular Disease Management—**manage patients with chronic cardiovascular diseases.
- **Cardiovascular Testing—**appropriately utilize cardiovascular diagnostic testing.
- **Disease Prevention and Risk Factor Control**—implement disease prevention and risk factor control measures, addressing comorbidities.
- **Team-Based Care**—work effectively to promote and coordinate interdisciplinary, patient-centered care.
- **Lifelong Learning—**engage in lifelong learning to maintain and enhance knowledge and skills.

addition, Section 2 includes a common set of professional behavior competencies that pertain to all clinical areas (see **Table 23**), describing competencies for Systems-Based Practice, Practice-Based Learning and Improvement, Interpersonal and Communication Skills, and Professionalism. Section 3 of the document focuses on leadership and administrative competencies that pertain to general clinical cardiologists, highlighting leadership, operational skills, professional identity, and personal balance (see **Table 24**).

1.2.1.1. Distinction Between Competencies Expected of All Clinical Cardiologists and Those Required Based on the Focus of Practice

All tables distinguish competency components expected of *all* clinical cardiologists (left column) from those expected of *selected* clinical cardiologists based on background, specialized knowledge, skills, experience, and practice focus (right column). It is important to note that the practice-focused designation in this document *does not refer to the advanced competencies of cardiovascular sub-subspecialties*—such as interventional cardiology, cardiac electrophysiology, advanced heart failure, and adult congenital heart disease—that require training beyond the standard training common to all clinical cardiologists. Rather, the practice-focused competencies in this document parallel, and are analogous to, the Level II competencies defined in COCATS 4.

1.2.2. Assessment Tools

There are a number of ways physicians can maintain competency and expand lifelong learning in the course of practice (ensuring currency with the evolving art and science of the field), and assess their own professional needs for education and performance improvement. Objective evaluation of competence in the practice setting can be challenging, but a number of tools are available for this purpose. These include, for example, certified continuing medical education (CME) activities relevant to an individual's practice, review of practice or hospital data, performance assessment and improvement programs, and facilitated self-reflection. For procedural or diagnostic laboratory activities, assessment tools may include registry and/or hospital data, appropriate use criteria, and metrics developed by professional organizations. Patient surveys and multisource (360°) evaluations in hospital or practice environments can provide information about outcomes, communication skills, and professionalism. The ABIM is evolving a portfolio of professional development offerings, including components designed to facilitate maintenance and assessment of competency.

1.2.3. Research and Scholarly Activity

The topic areas in **Table 1** define the core clinical, leadership, and administrative competencies for practicing cardiologists. Scholarly activity and clinical research are also important in lifelong learning and professional competency. All physicians should have the skills to assess new research findings and appropriately incorporate new diagnostic and treatment modalities in patient care. In addition, a scholarly approach is required to evaluate evidence, address clinical questions, and enhance outcomes through literature review, including at the point of care. Knowledge should also be maintained and enhanced through regular reading of journals and other sources of reliable information and through attending scholarly scientific meetings and professional congresses. Referral of patients for participation in well-designed clinical trials is encouraged for both academic and nonacademic cardiologists.

2. CLINICAL COMPETENCIES

TABLE 3 ACGME Core Competencies

- **Patient Care** that is compassionate, appropriate, and effective for treating health problems and promoting health.
- **Medical Knowledge** about established and evolving biomedical, clinical, and cognate (e.g., epidemiological and social-behavioral) sciences and the application of this knowledge to patient care.
- **Practice-Based Learning and Improvement** that involve investigation and evaluation of their own patient care, self-appraisal, and assimilation of scientific evidence, and improvements in patient care.
- **Interpersonal and Communication Skills** that result in effective information exchange and teaming with patients, their families, and other health professionals.
- **Professionalism** as manifested by a commitment to carrying out professional responsibilities, adherence to ethical principles, and sensitivity to a diverse patient population.
- **Systems-Based Practice** as manifested by actions that demonstrate an awareness of and responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value.

These minimum general competencies were endorsed by the ACGME in February 1999 (www.acgme.org) and all residency review committees and institutional review committees were to include this minimum language in their respective Program and Institutional Requirements by June 2001. The definitions are available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3043418/.

ACGME = Accreditation Council for Graduate Medical Education.

TABLE 4 Ambulatory, Consultative, and Longitudinal Cardiovascular Care Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-AMB-MK1	Know the major cardiovascular risk stratification tools and principles of primary and secondary prevention of cardiovascular disease.	X	
L-AMB-MK2	Know the roles of genetics, family history, and environmental and lifestyle factors in the development and clinical course of cardiovascular disease.	X	
L-AMB-MK3	Know the effects of age on cardiovascular function, response to medications, and risks of diagnostic and therapeutic procedures.	X	
L-AMB-MK4	Know the roles of lifestyle, activity level, body mass, nutrition, and alcohol and recreational drug use in patients with and at risk of cardiovascular disease.	X	
L-AMB-MK5	Know guideline recommendations for evaluation and management of hypertension, diabetes, and dyslipidemia in diverse patient populations.	X	
L-AMB-MK6	Know the treatment options to facilitate smoking cessation and their limitations.	X	
L-AMB-MK7	Know the roles of stress, anxiety, and depression in patients with known or suspected cardiovascular disease.	X	
L-AMB-MK8	Know the differential diagnosis of chest pain and the features distinguishing its various etiologies.	X	
L-AMB-MK9	Know the differential diagnosis of palpitation, lightheadedness and syncope, and the features distinguishing the various etiologies.	X	
L-AMB-MK10	Know the differential diagnosis of dyspnea and the features distinguishing its various etiologies.	X	
L-AMB-MK11	Know the differential diagnosis of peripheral edema and the features distinguishing its various etiologies.	X	
L-AMB-MK12	Know the roles of renal, hepatic, pulmonary, hematologic, rheumatologic, and endocrine disorders in the development of cardiovascular disease and responses to treatment.	X	
L-AMB-MK13	Know the clinical pharmacology of cardiovascular medications, their interactions with other medications generally, in special populations, and in patients with relevant comorbidities.	X	
L-AMB-MK14	Know the potential cardiovascular toxicity and side effects of the major classes of drugs used for management of patients with common medical conditions, including antimicrobial agents, immune system modulators, chemotherapeutic agents, and neuropsychiatric drugs.	X	
L-AMB-MK15	Know the differential diagnosis and distinguishing characteristics of heart murmurs and vascular bruits.	X	
L-AMB-MK16	Know the characteristic clinical manifestations, differential diagnosis, and appropriate testing for cerebrovascular, aortic, and peripheral artery disease.	X	
L-AMB-MK17	Know the causes and cardinal symptoms and findings of stroke, transient cerebral ischemia, and dementia.	X	
L-AMB-MK18	Know the methods to assess and treat patients with common venous disorders, including acute thromboembolic disease and chronic venous insufficiency.	X	
L-AMB-MK19	Know the principles of and indications for palliative care in patients with heart disease.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-AMB-PC1	Skills to effectively and efficiently perform an initial outpatient cardiovascular consultation and establish a differential diagnosis.	X	
L-AMB-PC2	Skills to appropriately utilize diagnostic testing for both initial diagnosis and follow-up care of patients with cardiovascular disease.	X	
L-AMB-PC3	Skills to integrate clinical information and test results to assess risk, establish diagnosis, and formulate treatment and follow-up for patients with cardiovascular disease.	X	

TABLE 4 Ambulatory, Consultative, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-AMB-PC4	Skills to identify patients with acute cardiovascular disorders or high-risk states who require immediate treatment and/or hospitalization and to prioritize management steps in patients with complex or multicomponent illness.	X	
L-AMB-PC5	Skills to establish an effective treatment regimen and monitor for side effects, intolerance or nonadherence, and assure patient safety.	X	
L-AMB-PC6	Skills to assess the cardiovascular risks associated with recreational and/or competitive sports, physically demanding occupations, and other vigorous physical activities, and to counsel patients about levels of physical activity appropriate to their cardiovascular health status in the context of disease prevention, rehabilitation, enhancement of functional capacity and quality of life, and promotion of longevity.	X	
L-AMB-PC7	Skill to effectively manage patients with chronic ischemic heart disease, hypertension, heart failure, and peripheral artery disease.	X	
L-AMB-PC8	Skills to coordinate ambulatory and longitudinal follow-up care and facilitate transitions of care from hospital to ambulatory or intermediate-care settings for patients with cardiovascular disease.	X	
L-AMB-PC9	Skill to provide pre-operative risk assessment for patients with cardiovascular disease undergoing noncardiac surgery.	X	

TABLE 5 Cardiovascular Disease Prevention Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-PREV-MK1	Know the structure of normal arteries and the basic vascular biology of atherosclerosis.	X	
L-PREV-MK2	Know the principles of genetics and pharmacogenomics as applied to patients with or at risk of cardiovascular disease.	X	
L-PREV-MK3	Know the influence of family history on cardiovascular risk and the utility of family screening in risk assessment and disease prevention.	X	
L-PREV-MK4	Know the epidemiology of cardiovascular disease, including incidence/prevalence, sex and ethnic differences, and the influence of risk factors and demographics on natural history and clinical outcomes.	X	
L-PREV-MK5	Know the principles and methods of implementation of individual and population-based cardiovascular disease prevention.	X	
L-PREV-MK6	Know the major tools to assess lifetime and 10-year risks of a first cardiovascular event and how to employ them in primary prevention.	X	
L-PREV-MK7	Know the effects of diabetes mellitus, obesity, hypertension, lipid disorders, physical inactivity, and tobacco use on the development and progression of atherosclerosis and the corresponding treatment strategies.	X	
L-PREV-MK8	Know the incremental benefit of additional screening methods (including biomarkers, coronary calcification, carotid intima-media thickness, and ankle-brachial index) over a traditional risk-based approach to assess subclinical atherosclerosis.	X	
L-PREV-MK9	Know the principles of nutrition and obesity assessment and management, including the roles of pharmacotherapy and bariatric surgery.	X	
L-PREV-MK10	Know the behavioral and psychosocial factors that contribute to cardiovascular disease and the principles of management.	X	
L-PREV-MK11	Know the principles of exercise physiology and roles of physical activity counseling and cardiac rehabilitation.	X	
L-PREV-MK12	Know the effects of systemic diseases (including renal, hepatic, inflammatory, and autoimmune disorders) and their treatment on cardiovascular disease.	X	
L-PREV-MK13	Know the adverse effects of sleep apnea on the incidence and control of hypertension, atrial fibrillation and other arrhythmias, heart failure, and atherosclerosis.	X	
L-PREV-MK14	Know the indications for noninvasive screening for carotid artery disease, abdominal aortic aneurysm, and peripheral artery disease.	X	
L-PREV-MK15	Know the impact of pregnancy and hormonal treatment for reproductive disorders on cardiovascular risk.	X	
L-PREV-MK16	Know the pharmacology, indications, contraindications, risks, and interactions of medications commonly used for prevention and therapy of cardiovascular disease (e.g., antithrombotic, antihypertensive, lipid-lowering, diabetes management, and tobacco cessation agents).	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-PREV-PC1	Skill to perform global risk assessment and appropriately utilize diagnostic testing in patients with or at risk of cardiovascular disease.	X	
L-PREV-PC2	Skill to evaluate a patient's family history and appropriately recommend family screening.	X	
L-PREV-PC3	Skill to identify patients with common systemic disorders, such as obstructive sleep apnea and thyroid conditions, that affect cardiovascular disease diagnosis and treatment.	X	
L-PREV-PC4	Skill to implement and prescribe lifestyle approaches for prevention and treatment of patients with hypertension, dyslipidemia, tobacco use, obesity, and diabetes mellitus.	X	
L-PREV-PC5	Skill to evaluate and manage hypertensive cardiovascular disease, including treatment-resistant hypertension.	X	
L-PREV-PC6	Skills to assess physical activity patterns and exercise capacity in patients with or at risk of cardiovascular disease and provide counseling and exercise prescription, including whether and when to begin or resume participation in sports.	X	

TABLE 6 ECG/Ambulatory ECG Testing Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-TEST-ECG-MK1	Know the principles of ECG and the use of instruments to acquire, display, and store ECGs.	X	
L-TEST-ECG-MK2	Know the principles underlying the surface ECG and the effects of the autonomic nervous system on cardiac electrical activity.	X	
L-TEST-ECG-MK3	Know the normal values for electrical axis and ECG intervals and voltage.	X	
L-TEST-ECG-MK4	Know the anatomy of the specialized conducting tissue and the spread of excitation in the conduction system and myocardium.	X	
L-TEST-ECG-MK5	Know the mechanisms of re-entry, automaticity, and triggered activity in cardiac arrhythmias.	X	
L-TEST-ECG-MK6	Know the types and mechanisms of aberrant cardiac conduction.	X	
L-TEST-ECG-MK7	Know capture and fusion complexes and the ECG criteria for distinguishing supraventricular arrhythmias with aberrancy, accessory pathway conduction, pacing, and artifact from ventricular arrhythmias.	X	
L-TEST-ECG-MK8	Know the concepts and ECG manifestations of concealed conduction and exit block.	X	
L-TEST-ECG-MK9	Know the characteristic ECG patterns of key clinical diagnoses. (See Appendix 3.)	X	
L-TEST-ECG-MK10	Know the ECG patterns commonly seen in trained athletes and the challenges of distinguishing normal from abnormal findings.	X	
L-TEST-ECG-MK11	Know the indications for and limitations of continuous ambulatory (Holter) and intermittent (event) ECG recordings.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-TEST-ECG-PC1	Technical skill to record and interpret standard 12-lead ECG tracings and to incorporate the findings in patient care.	X	
L-TEST-ECG-PC2	Skill to identify normal ECG patterns, variants, and artifacts (including lead misplacement).	X	
L-TEST-ECG-PC3	Skills to identify and interpret ECG signs of atrial abnormalities and right and left ventricular hypertrophy or enlargement.	X	
L-TEST-ECG-PC4	Skills to identify and interpret intraventricular conduction delay or block including aberrant conduction abnormalities.	X	
L-TEST-ECG-PC5	Skills to identify and interpret atrioventricular dissociation.	X	
L-TEST-ECG-PC6	Skill to identify first-degree, second-degree (types I, II, and 2:1), and third-degree atrioventricular block.	X	
L-TEST-ECG-PC7	Skills to identify the ECG patterns and localization of myocardial ischemia and infarction.	X	
L-TEST-ECG-PC8	Skill to identify the ECG patterns associated with electrolyte imbalance, metabolic abnormalities, and drug effects.	X	
L-TEST-ECG-PC9	Skill to identify nonspecific QRS and ST-T-wave abnormalities.	X	
L-TEST-ECG-PC10	Skill to identify atrial, atrioventricular, nodal, and ventricular arrhythmias.	X	
L-TEST-ECG-PC11	Skill to integrate ECG findings into the clinical assessment and management of patients with known or suspected heart disease.	X	
L-TEST-ECG-PC12	Skill to select and interpret ambulatory ECG recordings and integrate the findings in the evaluation and management of patients with known or suspected heart disease.	X	
L-TEST-ECG-PC13	Skills to identify ECG patterns associated with normal and abnormal pacemaker function and consult an electrophysiologist when advanced interpretation is necessary.	X	

ECG = electrocardiography.

TABLE 7 Exercise ECG Testing Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-TEST-STRESS-MK1	Know the indications for, risks and limitations of, and contraindications to exercise stress testing for diagnosis and risk stratification in patients with known or suspected ischemic heart disease.	X	
L-TEST-STRESS-MK2	Know the principles of exercise stress testing and the common exercise test protocols and targets.	X	
L-TEST-STRESS-MK3	Know the concept of metabolic equivalent (MET) and estimation of intensity for various modes of exercise.	X	
L-TEST-STRESS-MK4	Know the ECG criteria indicative of an ischemic stress test response.	X	
L-TEST-STRESS-MK5	Know the normal and abnormal heart rate, rhythm, and blood pressure responses to graded exercise and recovery.	X	
L-TEST-STRESS-MK6	Know the influence of baseline ECG abnormalities and medications on the ECG response to exercise.	X	
L-TEST-STRESS-MK7	Know the exercise capacity, ECG and hemodynamic findings indicating a strongly positive test or adverse prognosis.	X	
L-TEST-STRESS-MK8	Know the indications and criteria for stopping a test before the target heart rate is reached.	X	
L-TEST-STRESS-MK9	Know the role of exercise testing in the evaluation of patients with cardiac arrhythmias and the significance of exercise-induced arrhythmias.	X	
L-TEST-STRESS-MK10	Know the use of exercise testing in special groups (e.g., women, asymptomatic patients, and patients who have sustained myocardial infarction or a recent acute coronary syndrome).	X	
L-TEST-STRESS-MK11	Know the use of, precautions for, and contraindications to exercise testing in patients with valvular and myocardial diseases.	X	
L-TEST-STRESS-MK12	Know the role of exercise ECG testing in the evaluation of genetic cardiovascular conditions (e.g., long QT syndrome and hypertrophic cardiomyopathy).	X	
L-TEST-STRESS-MK13	Know the indications for incorporating echocardiographic, radionuclide perfusion, and magnetic resonance imaging in stress testing.	X	
L-TEST-STRESS-MK14	Know the indications for selection of exercise versus pharmacological testing.	X	
L-TEST-STRESS-MK15	Know the indications for cardiopulmonary exercise testing.	X	
L-TEST-STRESS-MK16	Know the roles of exercise testing in physical activity counseling and exercise prescription in patients with cardiovascular disease.	X	
L-TEST-STRESS-MK17	Know the role of exercise testing with measurement of ankle-brachial indices in the evaluation of patients with known or suspected peripheral artery disease.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-TEST-STRESS-PC1	Skills to select appropriate exercise test modalities and protocols for diverse patient types and clinical settings and integrate the findings in patient evaluation and management.	X	
L-TEST-STRESS-PC2	Skill to safely perform appropriate heart-rate-limited and maximal or near-maximal treadmill exercise tests.	X	
L-TEST-STRESS-PC3	Skill to integrate exertional symptoms and capacity, ECG findings, and hemodynamic response in cardiovascular risk assessment and management.	X	
L-TEST-STRESS-PC4	Skill to utilize data from exercise testing in developing an exercise prescription for patients with cardiovascular disease.	X	
L-TEST-STRESS-PC5	Skill to identify and effectively treat complications arising during and after stress testing.	X	
L-TEST-STRESS-PC6	Skill to integrate exercise test findings with segmental limb blood pressure measurements and pulse volume recordings in patients with known or suspected peripheral artery disease.		X

ECG = electrocardiography.

TABLE 8 Echocardiography Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-IMAG-ECHO-MK1	Know the physical principles of ultrasound and the instrumentation used to obtain echocardiographic images.		X
L-IMAG-ECHO-MK2	Know the indications for and limitations of M-mode, 2-dimensional, and 3-dimensional transthoracic echocardiography, Doppler echocardiography, color flow imaging, transesophageal echocardiography, tissue Doppler, and contrast echocardiography.	X	
L-IMAG-ECHO-MK3	Know the potential artifacts that may confound the echocardiographic examination.		X
L-IMAG-ECHO-MK4	Know the standard views included in a comprehensive transthoracic echocardiographic examination.	X	
L-IMAG-ECHO-MK5	Know the methods to evaluate cardiac chamber sizes, left and right ventricular systolic and diastolic function, and hemodynamics by echocardiography.	X	
L-IMAG-ECHO-MK6	Know the characteristic echocardiographic findings associated with cardiomyopathies and heart failure.	X	
L-IMAG-ECHO-MK7	Know the indications for and characteristic findings of echocardiography in patients with native valvular heart diseases and prosthetic heart valves, including endocarditis and its complications.	X	
L-IMAG-ECHO-MK8	Know the characteristic echocardiographic findings associated with myocardial ischemia and infarction and the structural complications of myocardial infarction.	X	
L-IMAG-ECHO-MK9	Know the characteristic echocardiographic findings associated with pericardial effusion and tamponade.	X	
L-IMAG-ECHO-MK10	Know the characteristic echocardiographic findings associated with pericardial constriction.		X
L-IMAG-ECHO-MK11	Know the characteristic echocardiographic findings characteristic of simple adult congenital heart disease.	X	
L-IMAG-ECHO-MK12	Know the characteristic echocardiographic findings of cardiac masses.		X
L-IMAG-ECHO-MK13	Know the characteristic echocardiographic findings of thoracic aortic aneurysm and dissection.	X	
L-IMAG-ECHO-MK14	Know the characteristic echocardiographic findings associated with pulmonary hypertension and right ventricular dysfunction and enlargement.	X	
L-IMAG-ECHO-MK15	Know the characteristic echocardiographic findings associated with systemic diseases involving the heart, including amyloidosis.		X
L-IMAG-ECHO-MK16	Know the indications for echocardiography in patients with known or suspected cardiogenic embolism.	X	
L-IMAG-ECHO-MK17	Know the standard views included in a comprehensive transesophageal echocardiographic examination.		X
L-IMAG-ECHO-MK18	Know the principles of, indications for, and interpretation of contrast echocardiography, including techniques of contrast, administration, and safety considerations.		X
L-IMAG-ECHO-MK19	Know the characteristic echocardiographic findings associated with complex and post-operative adult congenital heart disease.		X
L-IMAG-ECHO-MK20	Know the principles and general applications of 3-dimensional echocardiography.		X
L-IMAG-ECHO-MK21	Know the indications for 3-dimensional echocardiography and strain imaging.		X
L-IMAG-ECHO-MK22	Know the indications for stress echocardiography and the appropriate selection of exercise versus pharmacological modalities.	X	

TABLE 8 Echocardiography Lifelong, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-IMAG-ECHO-PC1	Skill to review echocardiographic images and integrate the findings in patient evaluation and management.*	X	
L-IMAG-ECHO-PC2	Skill to perform and interpret a transthoracic echocardiographic examination.		X
L-IMAG-ECHO-PC3	Skill to perform and interpret a transesophageal echocardiographic examination.		X
L-IMAG-ECHO-PC4	Skill to perform and interpret stress echocardiography.		X
L-IMAG-ECHO-PC5	Skill to perform and interpret basic 3-dimensional echocardiography.		X
L-IMAG-ECHO-PC6	Skill to perform and interpret contrast echocardiography.		X
L-IMAG-ECHO-PC7	Skill to identify and manage complications of stress, contrast, and transesophageal echocardiography.		X
L-IMAG-ECHO-PC8	Skill to incorporate resting and stress hemodynamic information in the evaluation and management of patients with complex valvular heart disease or hypertrophic cardiomyopathy.	X	

*In this document, "skill to review" refers to the ability to evaluate echocardiographic images during the course of patient care and integrate echocardiographic information with other clinical data in patient management. It does not imply the formal interpretation and reporting of echocardiographic studies.

TABLE 9 Nuclear Cardiology Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-IMAG-NC-MK1	Know the indications for and limitations of radionuclide imaging in the assessment of patients with myocardial ischemia or viability and ventricular dysfunction.	X	
L-IMAG-NC-MK2	Know the indications for myocardial perfusion imaging and the appropriate selection of exercise versus pharmacological stress modalities.	X	
L-IMAG-NC-MK3	Know the principles of radiation safety and methods to minimize radiation exposure to patients, operators, and staff.	X	
L-IMAG-NC-MK4	Know the indications, contraindications, and limitations of radionuclide imaging in the context of the pre-test likelihood of disease and the predictive value of positive and negative tests.	X	
L-IMAG-NC-MK5	Know the principles of single-photon emission computed tomography and planar radionuclide ventriculography, including image acquisition and display and the standard tomographic planes and views.		X
L-IMAG-NC-MK6	Know the properties and use of standard perfusion, metabolism, and cardiac innervation tracers.		X
L-IMAG-NC-MK7	Know the principles underlying selection of pharmacological stress agents, methods of administration, and safety considerations involved in their use.		X
L-IMAG-NC-MK8	Know the protocols for administration of standard perfusion agents and the influence of the clinical situation on choice of imaging protocol.		X
L-IMAG-NC-MK9	Know the principles of image interpretation, quality control, and recognition of artifacts.		X
L-IMAG-NC-MK10	Know the indications for and limitations of positron emission tomography and use of perfusion and metabolism imaging agents.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-IMAG-NC-PC1	Skills to select appropriate imaging studies and integrate the findings in patient evaluation and management.	X	
L-IMAG-NC-PC2	Skill to discern high-risk findings on stress testing.	X	
L-IMAG-NC-PC3	Skills to perform and interpret gated stress-rest perfusion studies.		X
L-IMAG-NC-PC4	Skills to perform and interpret radionuclide ventriculography.		X

TABLE 10 Cardiovascular Computed Tomography Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-IMAG-CCT-MK1	Know the technology and physics of cardiovascular computed tomography.		X
L-IMAG-CCT-MK2	Know the appropriate indications for and radiation-associated risks of cardiovascular computed tomography for screening or evaluating symptoms in patients with known or suspected cardiac diseases and the strategies to minimize exposure of patients, operators, and staff.	X	
L-IMAG-CCT-MK3	Know the safety measures applicable to cardiovascular computed tomography, including strategies to minimize exposure of patients, operators, and staff to radiation.		X
L-IMAG-CCT-MK4	Know the potential adverse effects of iodinated contrast agents used in cardiovascular computed tomography and approaches to preventing and treating complications.	X	
L-IMAG-CCT-MK5	Know the indications and protocols for and contraindications to administration of beta-adrenergic blocking drugs and nitroglycerin in conjunction with cardiovascular computed tomography.		X
L-IMAG-CCT-MK6	Know the principles of acquisition, processing, and reconstruction of cardiovascular computed tomographic images.		X
L-IMAG-CCT-MK7	Know the principles of quantitative coronary artery calcium scoring.	X	
L-IMAG-CCT-MK8	Know the cardiovascular computed tomographic imaging findings in patients with normal chest anatomy, cardiac chambers, great vessels, coronary arteries and veins, and common variants.		X
L-IMAG-CCT-MK9	Know the characteristic cardiovascular computed tomographic imaging findings associated with coronary atherosclerosis, including plaque morphology and assessment of stenosis severity.		X
L-IMAG-CCT-MK10	Know the characteristic cardiovascular computed tomographic imaging findings in patients with anomalous coronary arteries and other common congenital anomalies.		X
L-IMAG-CCT-MK11	Know the characteristic cardiovascular computed tomographic imaging findings in post-operative cardiac surgical patients, including internal mammary artery and saphenous vein bypass grafts.		X
L-IMAG-CCT-MK12	Know the characteristic cardiovascular computed tomographic imaging findings in patients with valvular heart disease.		X
L-IMAG-CCT-MK13	Know the characteristic cardiovascular computed tomographic imaging findings in patients with left atrial, pulmonary, and coronary venous abnormalities.		X
L-IMAG-CCT-MK14	Know the characteristic cardiovascular computed tomographic imaging findings in patients with pericardial diseases.		X
L-IMAG-CCT-MK15	Know the characteristic cardiovascular computed tomographic imaging findings in patients with cardiomyopathies, infiltrative myocardial diseases, and cardiac masses.		X
L-IMAG-CCT-MK16	Know the characteristic cardiovascular computed tomographic imaging findings in patients with common diseases of the aorta and great vessels.		X
L-IMAG-CCT-MK17	Know the characteristic cardiovascular computed tomographic imaging findings in patients with pulmonary embolism and primary and acquired pulmonary vascular diseases.		X
L-IMAG-CCT-MK18	Know the characteristic cardiovascular computed tomographic imaging findings that define the anatomy of the left atrium, left atrial appendage, and pulmonary veins in patients undergoing catheter-based procedures for atrial fibrillation.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-IMAG-CCT-PC1	Skill to appropriately refer and prepare patients with known or suspected cardiovascular disease for cardiovascular computed tomographic imaging and apply the findings in clinical evaluation and management.	X	
L-IMAG-CCT-PC2	Skill to diagnose and manage adverse reactions to radiographic contrast and beta blockers that may arise during cardiovascular computed tomographic imaging.	X	
L-IMAG-CCT-PC3	Skill to independently perform and interpret cardiovascular computed tomographic imaging.		X

TABLE 11 Cardiovascular Magnetic Resonance Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-IMAG-CMR-MK1	Know the imaging technology and associated physics of cardiovascular magnetic resonance imaging.		X
L-IMAG-CMR-MK2	Know the indications for cardiovascular magnetic resonance imaging at rest and in response to pharmacological stress in patients with known or suspected ischemic heart disease.	X	
L-IMAG-CMR-MK3	Know the indications for, contraindications to, and potential side effects of gadolinium-based contrast agents in cardiovascular magnetic resonance imaging.	X	
L-IMAG-CMR-MK4	Know the risks of and contraindications to cardiovascular magnetic resonance imaging.	X	
L-IMAG-CMR-MK5	Know the characteristic cardiovascular magnetic resonance imaging findings associated with ischemic heart disease.		X
L-IMAG-CMR-MK6	Know the characteristic cardiovascular magnetic resonance imaging findings associated with hypertrophic and other cardiomyopathies and myocarditis.		X
L-IMAG-CMR-MK7	Know the characteristic cardiovascular magnetic resonance imaging findings associated with pericardial diseases.		X
L-IMAG-CMR-MK8	Know the characteristic cardiovascular magnetic resonance imaging findings associated with valvular heart disease.		X
L-IMAG-CMR-MK9	Know the indications for cardiovascular magnetic resonance imaging in patients with myocardial masses or intracardiac thrombus.		X
L-IMAG-CMR-MK10	Know the characteristic cardiovascular magnetic resonance imaging findings associated with diseases of the aorta or peripheral arteries.		X
L-IMAG-CMR-MK11	Know the indications for cardiovascular magnetic resonance imaging in patients with adult congenital heart disease.		X
L-IMAG-CMR-MK12	Know the characteristic cardiovascular magnetic resonance imaging findings that define the anatomy of the left atrium, left atrial appendage, and pulmonary veins in patients undergoing catheter-based procedures for atrial fibrillation.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-IMAG-CMR-PC1	Skills to appropriately order cardiovascular magnetic resonance imaging and integrate the results in patient evaluation and management.	X	
L-IMAG-CMR-PC2	Skill to interpret cardiovascular magnetic resonance tissue characterization (late gadolinium enhancement) to distinguish the etiology of cardiomyopathy and acute myocardial injury.		X
L-IMAG-CMR-PC3	Skill to interpret regional and global left and right ventricular wall motion and ejection fraction by magnetic resonance imaging.		X
L-IMAG-CMR-PC4	Skill to interpret magnetic resonance images in patients with diseases of the aorta (e.g., intramural hematoma, dissection, coarctation, and aneurysm).		X
L-IMAG-CMR-PC5	Skill to identify and characterize myocardial masses by magnetic resonance imaging.		X
L-IMAG-CMR-PC6	Skill to identify and characterize pericardial diseases by magnetic resonance imaging.		X
L-IMAG-CMR-PC7	Skill to identify and characterize adult congenital heart diseases by magnetic resonance imaging.		X
L-IMAG-CMR-PC8	Skills to perform and interpret cardiovascular magnetic resonance stress testing.		X

TABLE 12 Invasive Cardiology Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-INV/INT-MK1	Know the indications for, contraindications to, and potential complications of cardiac catheterization for assessment of patients with coronary, valvular, myocardial, and basic adult congenital heart diseases.	X	
L-INV/INT-MK2	Know the principles of radiation safety in the cardiac catheterization laboratory, including strategies to minimize exposure of patients, operators, and staff.		X
L-INV/INT-MK3	Know the use and complications of radiographic contrast media and the measures available for renal protection in the cardiac catheterization laboratory.	X	
L-INV/INT-MK4	Know the indications for and clinical pharmacology of antiplatelet and anticoagulant drugs, vasopressor and vasodilator agents, and inotropic drugs used in the cardiac catheterization laboratory.		X
L-INV/INT-MK5	Know the principles of waveforms, pressure, flow, resistance, and cardiac output measurements obtained by cardiac catheterization.	X	
L-INV/INT-MK6	Know normal cardiovascular hemodynamics and the characteristic changes associated with myocardial, valvular, pericardial, and pulmonary vascular diseases.	X	
L-INV/INT-MK7	Know the methods to detect and estimate the magnitude of intracardiac and extracardiac shunts.		X
L-INV/INT-MK8	Know coronary anatomy, coronary blood flow physiology, and common coronary anomalies.	X	
L-INV/INT-MK9	Know the characteristic angiographic features associated with coronary artery disease and the methods available to assess its anatomic and physiological severity.	X	
L-INV/INT-MK10	Know the indications for, contraindications to, and potential complications of peripheral vascular angiography.	X	
L-INV/INT-MK11	Know the characteristic angiographic features associated with peripheral artery disease and the methods available to assess its anatomic and physiological severity.		X
L-INV/INT-MK12	Know the indications for and potential complications of percutaneous interventions for coronary and peripheral artery as well as valvular and nonvalvular structural heart disease.	X	
L-INV/INT-MK13	Know the indications for, contraindications to, and potential complications of endomyocardial biopsy.	X	
L-INV/INT-MK14	Know the indications for, contraindications to, and potential complications of pericardiocentesis.	X	
L-INV/INT-MK15	Know the physiological basis and indications for mechanical circulatory support devices.		X
L-INV/INT-MK16	Know the indications for and complications of vascular access and closure strategies and devices.		X
L-INV-INT-MK17	Know the indications for fluid challenge, vasodilator testing, and post-exercise measurements during right heart catheterization.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-INV/INT-PC1	Skills to conduct pre-procedural evaluation for, assess appropriateness of, obtain informed consent from, and plan procedure strategy for patients undergoing cardiac catheterization and angiography.		X
L-INV/INT-PC2	Skills to perform venous and arterial access and obtain hemostasis in patients undergoing cardiac catheterization and angiography.		X
L-INV/INT-PC3	Skill to perform right heart catheterization.		X
L-INV/INT-PC4	Skill to integrate hemodynamic, ventriculographic, and angiographic data in patient evaluation and management.	X	
L-INV/INT-PC5	Skill to coordinate post-procedural management for patients undergoing cardiac catheterization, including recognition and treatment of complications.	X	
L-INV/INT-PC6	Skill to perform endomyocardial biopsy.		X

TABLE 12 Invasive Cardiology, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-INV/INT-PC7	Skill to perform elective pericardiocentesis.		X
L-INV/INT-PC8	Skills to perform diagnostic left heart catheterization, contrast ventriculography, and coronary angiography.		X
L-INV/INT-PC9	Skill to place an intra-aortic balloon pump.		X

TABLE 13 Stable Ischemic Heart Disease Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ISCHEM-MK1	Know the epidemiology, pathophysiology, and natural history of atherosclerotic vascular disease and the characteristic features and clinical implications of stable and unstable coronary artery plaque.	X	
L-ISCHEM-MK2	Know the determinants of coronary blood flow and myocardial oxygen consumption.	X	
L-ISCHEM-MK3	Know the differential diagnosis of chest pain syndromes and the characteristic clinical features of patients with typical angina, atypical angina, and noncardiac chest pain.	X	
L-ISCHEM-MK4	Know the clinical features and natural history of angina pectoris in women and special populations, including the elderly and patients with diabetes mellitus.	X	
L-ISCHEM-MK5	Know the causes of angina pectoris not related to atherosclerotic coronary disease (including valvular heart disease, hypertrophic cardiomyopathy, cocaine use, congenital coronary anomalies, vasculitis, and coronary spasm).	X	
L-ISCHEM-MK6	Know the medical conditions that can provoke or exacerbate angina pectoris.	X	
L-ISCHEM-MK7	Know the differential diagnosis and prognosis of myocardial ischemia in patients with nonobstructive coronary disease.	X	
L-ISCHEM-MK8	Know the characteristic ECG features associated with myocardial ischemia.	X	
L-ISCHEM-MK9	Know the indications for, contraindications to, and limitations of noninvasive testing in the context of the pre-test likelihood of disease and the predictive value of positive and negative tests in the evaluation of patients with known or suspected coronary disease.	X	
L-ISCHEM-MK10	Know the role of noninvasive testing in risk assessment, including the clinical, functional capacity, ECG, and hemodynamic findings on stress testing indicative of advanced coronary disease or high-risk states.	X	
L-ISCHEM-MK11	Know the lifestyle, activity, and exercise recommendations and risk factor treatment targets for patients with stable ischemic heart disease.	X	
L-ISCHEM-MK12	Know the indications for, contraindications to, and clinical pharmacology of medications used for management of patients with stable ischemic heart disease.	X	
L-ISCHEM-MK13	Know the significance of left ventricular systolic and diastolic function in the management of patients with ischemic heart disease.	X	
L-ISCHEM-MK14	Know the indications for, limitations of, and risks associated with coronary angiography in patients with known or suspected ischemic heart disease.	X	
L-ISCHEM-MK15	Know the findings at cardiac catheterization indicating hemodynamically significant coronary artery obstruction and the angiographic features indicative of high-risk conditions.	X	
L-ISCHEM-MK16	Know the treatment options for patients with ischemic heart disease and symptoms refractory to pharmacological therapy.	X	

TABLE 13 Stable Ischemic, continued

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ISCHEM-MK17	Know the indications for and risks and benefits of percutaneous or surgical revascularization compared with medical therapy in patients with stable ischemic heart disease.	X	
L-ISCHEM-MK18	Know the indications for noninvasive and invasive evaluation following revascularization in patients with ischemic heart disease.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ISCHEM-PC1	Skills to obtain and utilize the clinical history, physical examination, and ECG findings in patients with chest pain to establish the probability of symptomatic coronary disease.	X	
L-ISCHEM-PC2	Skill to distinguish stable from unstable coronary syndromes.	X	
L-ISCHEM-PC3	Skill to select evidence-based, cost-effective noninvasive testing strategies for diagnosis and risk assessment in patients with chest pain.	X	
L-ISCHEM-PC4	Skill to integrate data from noninvasive testing in the management of patients with stable ischemic heart disease.	X	
L-ISCHEM-PC5	Skills to perform and interpret exercise ECG stress tests.	X	
L-ISCHEM-PC6	Skill to establish effective anti-ischemic and antithrombotic medical regimens for patients with coronary disease.	X	
L-ISCHEM-PC7	Skill to identify appropriate candidates for coronary angiography and percutaneous or surgical revascularization.	X	
L-ISCHEM-PC8	Skill to integrate diagnostic cardiac catheterization findings into patient management.	X	
L-ISCHEM-PC9	Skill to implement guideline recommendations for lifestyle modification, physical activity, and pharmacological interventions to control risk factors in patients with ischemic heart disease.	X	
L-ISCHEM-PC10	Skills to provide pre-operative risk assessment and perioperative management for patients with cardiovascular disease undergoing noncardiac surgery.	X	
L-ISCHEM-PC11	Skill to perform diagnostic cardiac catheterization and coronary angiography.		X

ECG = electrocardiography.

TABLE 14 Acute Coronary Syndromes Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ACS-MK1	Know the epidemiology, etiology, pathophysiology, and natural history of acute coronary syndromes, including the roles of plaque rupture, erosion, platelet activation, vasospasm, and thrombosis.	X	
L-ACS-MK2	Know the disorders that can simulate or mask acute coronary syndromes.	X	
L-ACS-MK3	Know the risk assessment tools applicable to patients with acute coronary syndromes.	X	
L-ACS-MK4	Know the indications for, clinical pharmacology of, and contraindications to antiplatelet, anticoagulant, and other pharmacological therapies in patients with ischemic heart disease.	X	
L-ACS-MK5	Know the principles and timing of rehabilitation and secondary prevention measures for patients with acute coronary syndromes.	X	
	ST Elevation Myocardial Infarction (STEMI):		
L-ACS-MK6	Know the characteristic symptoms, physical findings, ECG patterns, and biomarker findings in patients with STEMI.	X	
L-ACS-MK7	Know the effects and time course of ischemic injury on ventricular function and remodeling in patients with STEMI.	X	
L-ACS-MK8	Know the potential hemodynamic complications (including hypotension, low cardiac output, heart failure, and shock) in patients with STEMI.	X	
L-ACS-MK9	Know the potential arrhythmia and conduction complications associated with STEMI.	X	
L-ACS-MK10	Know the potential mechanical complications (including papillary muscle rupture and myocardial rupture) associated with STEMI.	X	
L-ACS-MK11	Know the characteristic clinical findings and potential complications of right ventricular infarction.	X	
L-ACS-MK12	Know the indications for, contraindications to, and risks of reperfusion therapies and the clinical, ECG, and angiographic signs of reperfusion in patients with STEMI.	X	
L-ACS-MK13	Know the relative benefits and risks of fibrinolysis and primary percutaneous coronary intervention as initial reperfusion strategies.	X	
L-ACS-MK14	Know the indications for transfer, coronary angiography, and revascularization in patients with STEMI who have not received primary percutaneous coronary intervention, including those treated or untreated with initial reperfusion therapy.	X	
	Non-ST Elevation Acute Coronary Syndromes (NSTE-ACS):		
L-ACS-MK15	Know the differential diagnosis and characteristic clinical, ECG, myocardial imaging, and biomarker features used for diagnosis and risk stratification in patients with NSTE-ACS.	X	
L-ACS-MK16	Know the relative risks and benefits of an initial invasive versus ischemia-guided strategy for angiography and revascularization in patients with NSTE-ACS.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ACS-PC1	Skills to evaluate patients with STEMI and initiate appropriate reperfusion therapy within guideline-recommended timeframes.	X	
L-ACS-PC2	Skill to employ appropriate antiplatelet, anticoagulant, and other pharmacological therapies for patients with acute coronary syndromes.	X	
L-ACS-PC3	Skills to identify the cause of and treat hemodynamic disturbances (including hypotension, low cardiac output, heart failure, acute pulmonary edema, and shock) in patients with acute coronary syndromes.	X	
L-ACS-PC4	Skills to identify and treat arrhythmias and conduction disturbances in patients with acute coronary syndromes.	X	
L-ACS-PC5	Skill to diagnose mechanical complications (including papillary muscle rupture and myocardial rupture) in patients with acute coronary syndromes.	X	

TABLE 14 Acute Coronary, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ACS-PC6	Skill to implement mechanical support for patients with complications of acute coronary syndromes (including papillary muscle rupture and myocardial rupture).		X
L-ACS-PC7	Skills to diagnose and treat patients with right ventricular infarction.	X	
L-ACS-PC8	Skills to assess ventricular function in patients with acute coronary syndromes and integrate this information in clinical management.	X	
L-ACS-PC9	Skills to assess risk in patients with NSTE-ACS, establish an optimal medical regimen, and identify candidates for invasive evaluation and treatment.	X	
L-ACS-PC10	Skill to integrate invasive hemodynamic data and angiographic findings in the management of patients with acute coronary syndromes.	X	
L-ACS-PC11	Skill to perform and interpret the results of coronary angiography in patients with acute coronary syndromes.		X
L-ACS-PC12	Skill to insert intra-arterial and pulmonary artery catheters and integrate the findings in the management of patients with acute coronary syndromes.		X
L-ACS-PC13	Skill to identify patients with acute coronary syndromes who benefit from mechanical circulatory support.		X
L-ACS-PC14	Skill to initiate and appropriately escalate therapies for secondary prevention in patients with acute coronary syndromes.	X	

ECG = electrocardiography.

TABLE 15 Valvular Heart Disease Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-VALV-MK1	Know the characteristic features and natural history of congenital bicuspid aortic valve disease and associated aortopathy.	X	
L-VALV-MK2	Know the etiology, natural history, pathophysiology, and differential diagnosis of rheumatic and other forms of acquired aortic, mitral, pulmonic, and tricuspid valve diseases.	X	
L-VALV-MK3	Know the characteristic clinical features of rheumatic valvular heart disease.	X	
L-VALV-MK4	Know the cardinal symptoms and physical signs of aortic and mitral stenosis and their roles in management decisions.	X	
L-VALV-MK5	Know the cardinal symptoms and physical signs of chronic aortic and chronic mitral regurgitation and their roles in management decisions.	X	
L-VALV-MK6	Know the causes and distinguishing clinical and hemodynamic characteristics of acute versus chronic mitral and aortic regurgitation.	X	
L-VALV-MK7	Know the indications for mitral valve intervention in patients with primary and secondary mitral regurgitation.	X	
L-VALV-MK8	Know the indications for and characteristic findings of echocardiography during evaluation and follow-up of patients with native and prosthetic valve diseases, including endocarditis and its complications.	X	
L-VALV-MK9	Know the role of stress testing in assessment of patients with valvular heart disease.	X	
L-VALV-MK10	Know the indications for magnetic resonance and computed tomographic imaging in the assessment of patients with valvular heart disease.	X	
L-VALV-MK11	Know the indications for and characteristic findings at cardiac catheterization in patients with valvular heart disease.	X	
L-VALV-MK12	Know the indications for and clinical pharmacology of drugs used for treatment of patients with valvular heart disease and prosthetic heart valves, including anticoagulation and antibiotic prophylaxis.	X	
L-VALV-MK13	Know the effects of arrhythmias, particularly atrial fibrillation, on the clinical manifestations of, risks of complications in, and management of patients with valvular heart disease.	X	
L-VALV-MK14	Know the indications for and expected outcomes and potential complications of surgical therapy for patients with valvular heart disease, including repair versus replacement and selection of prostheses.	X	
L-VALV-MK15	Know the indications for and expected outcomes and potential complications of transcatheter therapy for patients with valvular heart disease.	X	
L-VALV-MK16	Know the etiology, natural history, physical findings, differential diagnosis, complications, and treatment of patients with native and prosthetic valve endocarditis.	X	
L-VALV-MK17	Know the effects of pregnancy on the clinical manifestations of valvular heart disease (native and prosthetic) and implications for patient management.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-VALV-PC1	Skill to identify the cardinal clinical ECG and chest x-ray findings in patients with valvular heart disease.	X	
L-VALV-PC2	Skill to distinguish innocent from pathological heart murmurs.	X	
L-VALV-PC3	Skill to manage patients with combined valvular and coronary heart disease.	X	
L-VALV-PC4	Skill to select appropriate testing, including exercise testing, and integrate results with clinical findings in the evaluation and management of patients with valvular heart disease.	X	
L-VALV-PC5	Skill to distinguish aortic stenosis from hypertrophic obstructive cardiomyopathy and other causes of left ventricular outflow tract obstruction.	X	
L-VALV-PC6	Skill to identify and manage ventricular dysfunction in patients with valvular heart disease.	X	

TABLE 15 Valvular Heart, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-VALV-PC7	Skill to identify and manage pulmonary hypertension in patients with valvular heart disease.	X	
L-VALV-PC8	Skill to determine candidacy for and optimal timing of cardiac surgical or transcatheter treatments in patients with valvular heart disease.	X	
L-VALV-PC9	Skill to perform and interpret transesophageal echocardiography in patients with valvular heart disease.		X
L-VALV-PC10	Skill to perform and interpret diagnostic cardiac catheterization in patients with valvular heart disease.		X

TABLE 16 Heart Failure Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-HF-MK1	Know the pathophysiology, differential diagnosis, stages, and natural history of heart failure.	X	
L-HF-MK2	Know the effects of heart failure on pulmonary, renal, and hepatic function, the nutritional and metabolic implications of heart failure, and the interactions of heart failure with other systemic diseases.	X	
L-HF-MK3	Know the characteristic history and physical examination findings, and their limitations in the evaluation of patients with heart failure.	X	
L-HF-MK4	Know the pathophysiology and cardinal clinical findings of pulmonary arterial hypertension.	X	
L-HF-MK5	Know the indications for, contraindications to, clinical pharmacology of, and potential adverse effects of drugs used to treat patients with heart failure.	X	
L-HF-MK6	Know the management of cardiac arrhythmias and conduction disturbances in patients with heart failure, including the indications for and risks of implantable cardioverter-defibrillator and cardiac resynchronization devices.	X	
L-HF-MK7	Know the indications for referral of patients with advanced heart failure for mechanical support devices and cardiac transplantation.	X	
L-HF-MK8	Know the pathophysiology of heart failure at the molecular, cellular, and organ levels, with emphasis on the roles of neurohormonal activation and left ventricular remodeling in disease progression.		X
L-HF-MK9	Know the diagnostic and management strategies for patients with heart failure due to nonischemic forms of heart disease, including infiltrative and restrictive cardiomyopathies, inherited cardiomyopathies, and cardiomyopathies associated with pregnancy and cancer chemotherapy.		X
L-HF-MK10	Know the management strategies and complications of therapy for heart failure in special populations, including patients with congenital heart disease and chronic pulmonary disease.		X
L-HF-MK11	Know the indications for, contraindications to, and clinical pharmacology of intravenous vasoactive and inotropic drugs used for cardiovascular support in patients with advanced or refractory heart failure.		X
L-HF-MK12	Know the indications for, contraindications to, and potential complications of endomyocardial biopsy.	X	
L-HF-MK13	Know the types of and indications for mechanical circulatory support in patients with severe heart failure.		X
L-HF-MK14	Know the rationale and indications for pharmacological management of patients with implanted mechanical circulatory support devices.		X
L-HF-MK15	Know the clinical pharmacology and use of immunosuppressive and other medications in heart transplant recipients developing acute rejection.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-HF-PC1	Skill to incorporate data from the clinical history, laboratory studies, and imaging modalities in the evaluation and management of patients with heart failure.	X	
L-HF-PC2	Skills to evaluate and manage patients with new onset, chronic, and acutely decompensated heart failure.	X	
L-HF-PC3	Skill to manage comorbidities in patients with heart failure.	X	
L-HF-PC4	Skill to use the clinical history and findings on physical examination to accurately assess volume status and systemic perfusion in patients with heart failure.	X	
L-HF-PC5	Skill to integrate hemodynamic measurements and data from physiological monitoring in the management of patients with decompensated heart failure.	X	

TABLE 16 Heart Failure, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-HF-PC6	Skills to evaluate and treat cardiac arrhythmias and conduction disturbances in patient with heart failure and identify candidates for implantable cardioverter-defibrillators, cardiac resynchronization therapy, or arrhythmia ablation procedures.	X	
L-HF-PC7	Skill to manage depression and anxiety as part of the overall care of patients with heart failure and appropriately seek psychiatric consultation.	X	
L-HF-PC8	Skills to effectively utilize an interdisciplinary approach to monitor the progress of ambulatory patients with heart failure, maintain stability, and avoid preventable hospitalization.	X	
L-HF-PC9	Skill to select and appropriately refer patients with heart failure for advanced therapies, including cardiac transplantation.	X	
L-HF-PC10	Skill to identify appropriate candidates with advanced heart failure for palliative and hospice care.	X	
L-HF-PC11	Skill to interpret the results of cardiopulmonary exercise testing and incorporate physical activity and exercise recommendations into the management of patients with heart failure.		X
L-HF-PC12	Skill to integrate imaging data into the evaluation and management of patients with heart failure.	X	
L-HF-PC13	Skill to evaluate and manage patients with refractory heart failure.		X
L-HF-PC14	Skill to integrate hemodynamic and physiological monitoring data in the management of complex patients with advanced heart failure.		X
L-HF-PC15	Skill to perform invasive hemodynamic monitoring in patients with heart failure.		X
L-HF-PC16	Skill to appropriately implement anti-arrhythmic drug therapy, implantable cardioverter-defibrillators, cardiac resynchronization devices, and substrate ablation procedures in patients with heart failure.		X
L-HF-PC17	Skill to identify and manage patients with heart failure who require transition from hospital to home or to a care facility while receiving intravenous infusion of inotropic or vasoactive agents.		X

TABLE 17 Pericardial Disease Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-PERI-MK1	Know the pathophysiology, differential diagnosis, and natural history of acute and relapsing pericarditis.	X	
L-PERI-MK2	Know the pathophysiology, differential diagnosis, and natural history of pericardial effusion and pericardial tamponade.	X	
L-PERI-MK3	Know the pathophysiology, differential diagnosis, and natural history of constrictive pericarditis.	X	
L-PERI-MK4	Know the characteristic symptoms and physical findings of acute pericarditis, pericardial tamponade, and constrictive pericarditis.	X	
L-PERI-MK5	Know the indications for and potential complications of pericardiocentesis.	X	
L-PERI-MK6	Know the indications for, clinical pharmacology of, and potential toxicity of drugs used for treatment of acute and relapsing pericarditis.	X	
L-PERI-MK7	Know the effects of pericardial diseases on other organ systems.	X	
L-PERI-MK8	Know the anatomy and structural abnormalities of the pericardium, including pericardial cysts and congenital absence of the pericardium.	X	
L-PERI-MK9	Know the indications for and characteristic findings of imaging studies used to evaluate patients with pericardial diseases.	X	
L-PERI-MK10	Know the indications for, expected outcomes of, and potential complications of surgery in patients with pericardial diseases.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-PERI-PC1	Skill to clinically evaluate and manage patients with acute and relapsing pericarditis.	X	
L-PERI-PC2	Skill to identify and elicit the cardinal physical findings of pericardial effusion, tamponade, and chronic constrictive pericarditis.	X	
L-PERI-PC3	Skill to identify cardinal physical findings and evaluate and manage patients with constrictive pericarditis.	X	
L-PERI-PC4	Skill to appropriately select and incorporate data from laboratory testing and noninvasive imaging in the management of patients with diseases of the pericardium.	X	
L-PERI-PC5	Skill to perform elective pericardiocentesis.		X
L-PERI-PC6	Skill to differentiate constrictive pericarditis from restrictive cardiac disease.	X	
L-PERI-PC7	Skill to identify patients with pericardial disease who are candidates for cardiac catheterization in the evaluation of pericardial disease.	X	
L-PERI-PC8	Skill to identify and appropriately refer patients with constrictive pericarditis who are candidates for cardiac surgery.	X	

TABLE 18 Vascular Medicine Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-VASC-MK1	Know the causes, pathophysiology, and natural history of aortic, cerebrovascular, renal, mesenteric, and extremity peripheral artery diseases.	X	
L-VASC-MK2	Know the cardinal symptoms and physical findings of aortic, cerebrovascular, renal, mesenteric, and extremity peripheral artery diseases.	X	
L-VASC-MK3	Know the indications for duplex ultrasonography of the carotid, extremity, renal, and mesenteric arteries; arterial bypass grafts and stents; aortic endografts; and intracranial vessels.	X	
L-VASC-MK4	Know the indications for and contraindications to computed tomographic angiography and magnetic resonance angiography in patients with known or suspected vascular diseases.	X	
L-VASC-MK5	Know the indications for medical, surgical, and endovascular therapies in patients with peripheral artery disease, renal and mesenteric artery disease, and extracranial cerebrovascular disease.	X	
L-VASC-MK6	Know the indications for medical and surgical management of thoracic aortopathy in patients with Marfan syndrome and inherited forms of connective tissue disease, bicuspid aortic valves, and aortitis.	X	
L-VASC-MK7	Know the causes and clinical manifestation of acute aortic syndromes, including dissection, intramural hematoma, and penetrating ulcer.	X	
L-VASC-MK8	Know the indications for use of noninvasive imaging in patients at risk for or with known abdominal aortic aneurysm.	X	
L-VASC-MK9	Know the indications for risks and expected outcomes of surgical and endovascular interventions for patients with abdominal aortic aneurysmal disease.	X	
L-VASC-MK10	Know the causes, pathophysiology, and natural history of deep vein thrombosis and pulmonary embolism.	X	
L-VASC-MK11	Know the cardinal symptoms and physical findings of deep vein thrombosis and pulmonary embolism.	X	
L-VASC-MK12	Know the cardinal symptoms and physical signs of chronic venous insufficiency and varicose veins.	X	
L-VASC-MK13	Know the indications for, contraindications to, risks, clinical pharmacology, and interactions of antithrombotic medications used for therapy of venous thromboembolism (pulmonary embolism and deep vein thrombosis).	X	
L-VASC-MK14	Know the indications for, contraindications to, risks, and expected outcomes of thrombolytic therapy for patients with venous thromboembolism.		X
L-VASC-MK15	Know the differentiating features of arterial, venous, and neurotrophic leg ulcers.	X	
L-VASC-MK16	Know the causes, cardinal findings, and treatment of lymphedema.		X
L-VASC-MK17	Know the indications for laboratory testing for inherited and acquired forms of thrombophilia.	X	
L-VASC-MK18	Know the indications and laboratory tests for vasculitis.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-VASC-PC1	Skill to perform a comprehensive physical examination of the peripheral circulation.	X	
L-VASC-PC2	Skill to perform and interpret the results of physical examination maneuvers for detection of arterial compression syndromes (e.g., thoracic outlet and popliteal artery entrapment syndromes).		X
L-VASC-PC3	Skill to measure the ankle-brachial index.	X	
L-VASC-PC4	Skill to interpret segmental limb blood pressure measurements, pulse volume recordings, Doppler waveforms, and treadmill exercise test results in patients with known or suspected peripheral artery disease.		X

TABLE 18 Vascular Medicine, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-VASC-PC5	Skill to interpret duplex ultrasound examinations of the extracranial carotid arteries, peripheral arteries, abdominal aorta, renal and mesenteric arteries, and peripheral veins.		X
L-VASC-PC6	Skill to evaluate and manage patients with lower extremity peripheral artery disease.	X	
L-VASC-PC7	Skill to evaluate and manage patients with extracranial carotid and vertebral artery disease.	X	
L-VASC-PC8	Skill to coordinate management for patients with arterial access complications, including arteriovenous fistula and arterial pseudoaneurysm.	X	
L-VASC-PC9	Skill to evaluate patients with aortic aneurysms and identify appropriate candidates for surgical or endovascular intervention.	X	
L-VASC-PC10	Skill to evaluate and medically stabilize patients with acute aortic syndromes and refer appropriate candidates for surgical or endovascular intervention.	X	
L-VASC-PC11	Skill to evaluate and manage patients with peripheral and visceral artery aneurysms and identify appropriate candidates for surgical or endovascular intervention.		X
L-VASC-PC12	Skill to conduct pre-operative cardiac risk assessment and manage patients undergoing vascular surgery.	X	
L-VASC-PC13	Skill to evaluate and manage patients with venous thromboembolism.	X	
L-VASC-PC14	Skill to evaluate and manage patients with chronic peripheral venous disorders, including varicose veins and chronic venous insufficiency.	X	
L-VASC-PC15	Skill to evaluate and manage patients with lymphedema.		X
L-VASC-PC16	Skill to evaluate and manage patients with lower extremity ulcers.		X
L-VASC-PC17	Skill to evaluate and manage patients with temperature-related vascular disorders, including Raynaud's phenomenon, acrocyanosis, pernio, and erythromelalgia.		X
L-VASC-PC18	Skill to evaluate and manage patients with uncommon vascular disorders, including vascular compression syndromes, fibromuscular dysplasia, and congenital vascular malformations.		X

TABLE 19 Cardiac Arrhythmias and Electrophysiology Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ARR-MK1	Know the mechanism and characteristics of normal sinus rhythm and sinus node dysfunction.	X	
L-ARR-MK2	Know the pathophysiology, differential diagnosis, and approach to management of patients with re-entrant tachycardia (atrioventricular nodal re-entrant tachycardia, atrioventricular reciprocating tachycardia), ectopic atrial tachycardia, and accelerated atrioventricular junctional rhythm.	X	
L-ARR-MK3	Know the pathophysiology, differential diagnosis, clinical significance, and approach to management of patients with atrial fibrillation and atrial flutter.	X	
L-ARR-MK4	Know the risk factors for stroke and bleeding in patients with atrial fibrillation or atrial flutter and the indications for and use of anticoagulant drugs.	X	
L-ARR-MK5	Know the pathophysiology, differential diagnosis, clinical significance, and approach to management of patients with sustained and nonsustained ventricular tachyarrhythmias.	X	
L-ARR-MK6	Know the pathophysiology and differential diagnosis of approaches to risk stratification for and management of survivors of cardiac arrest and sudden death.	X	
L-ARR-MK7	Know the risk factors for syncope and sudden death in athletes and individuals engaging in vigorous physical activity.	X	
L-ARR-MK8	Know the types, mechanisms, differential diagnosis, clinical significance, and approach to management of patients with atrioventricular dissociation and first-, second-, and third-degree atrioventricular block.	X	
L-ARR-MK9	Know the characteristic physical findings associated with specific cardiac arrhythmias (e.g., atrioventricular dissociation).	X	
L-ARR-MK10	Know the significance of underlying congenital or acquired structural heart disease in patients with cardiac arrhythmias and sudden death.	X	
L-ARR-MK11	Know the indications for, contraindications to, and clinical pharmacology of antiarrhythmic medications, including drug-drug and drug-device interactions, QT-interval prolongation, and pro-arrhythmic potential.	X	
L-ARR-MK12	Know the indications for and limitations of the ECG; exercise testing; ambulatory, event, and implantable loop recorders; and orthostatic testing in the evaluation and management of patients with known or suspected cardiac arrhythmias.	X	
L-ARR-MK13	Know the indications for and limitations and complications of invasive electrophysiological testing in patients with known or suspected cardiac arrhythmias and the indications for and risks of catheter ablation.	X	
L-ARR-MK14	Know the indications for and contraindications to implantation of permanent pacemakers, cardiac resynchronization devices, and cardioverter-defibrillators.	X	
L-ARR-MK15	Know the pathophysiology, differential diagnosis, natural history, and approach to management of patients with syncope.	X	
L-ARR-MK16	Know the mechanisms, findings, clinical significance, and approach to management of patients with ventricular pre-excitation.	X	
L-ARR-MK17	Know the pathology and clinical significance of, and the approach to evaluation and management of patients with inherited causes of cardiac arrhythmias, including ion channel abnormalities and structural changes in the heart (including long QT syndrome, Brugada syndrome, arrhythmogenic right ventricular dysplasia, hypertrophic and dilated cardiomyopathy, and myotonic dystrophy), and the role of genetic testing.		X
L-ARR-MK18	Know the indications for interrogation of implanted cardiac electronic devices.	X	

TABLE 19 Cardiac Arrhythmias, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ARR-PC1	Skill to evaluate and manage patients with palpitation.	X	
L-ARR-PC2	Skill to evaluate and manage patients with syncope.	X	
L-ARR-PC3	Skill to evaluate and manage patients with supraventricular tachyarrhythmias.	X	
L-ARR-PC4	Skill to evaluate and manage patients with atrial fibrillation and atrial flutter, including rate control, rhythm control, and anticoagulation strategies.	X	
L-ARR-PC5	Skill to evaluate and manage patients with wide-QRS tachycardia.	X	
L-ARR-PC6	Skill to manage patients with nonsustained and sustained ventricular arrhythmias.	X	
L-ARR-PC7	Skill to evaluate and manage patients with bradycardia and/or conduction block.	X	
L-ARR-PC8	Skill to perform electrical cardioversion.	X	
L-ARR-PC9	Skill to perform defibrillation.	X	
L-ARR-PC10	Skill to perform tilt-table testing.		X
L-ARR-PC11	Skill to insert temporary transvenous pacemakers.		X
L-ARR-PC12	Skill to select and appropriately refer patients for implantation of permanent pacemakers, cardioverter-defibrillators, or cardiac resynchronization devices.	X	
L-ARR-PC13	Skill to integrate information from cardiac electrophysiology consultation, diagnostic electrophysiological procedures, and device interrogation into the management of patients with cardiac tachyarrhythmias or bradyarrhythmias.	X	
L-ARR-PC14	Skill to interrogate, program, and monitor the performance of cardiac pacemakers and implanted cardioverter-defibrillators.		X
L-ARR-PC15	Skill to implant permanent single- and dual-chamber cardiac pacemakers and manage complications of these procedures, including device pocket and bloodstream infections, venous thrombosis, pneumothorax, device-related arrhythmias, and lead failure.		X
L-ARR-PC16	Skill to implant loop recorders, interpret data generated by these devices to guide patient management, and manage complications.		X
L-ARR-PC17	Skill to monitor, interrogate, and troubleshoot implanted pacemakers, cardioverter-defibrillators, cardiac resynchronization devices, and loop recorders, including remote interrogation.		X
L-ARR-PC18	Skill to evaluate and manage hospitalized survivors of cardiac arrest.		X
L-ARR-PC19	Skill to select appropriate ambulatory arrhythmia monitoring technology and integrate the results in patient management.	X	

TABLE 20 Critical Care Cardiology Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-CCC-MK1	Know the pathophysiology, differential diagnosis, and characteristic clinical, hemodynamic, radiographic, and laboratory findings of cardiogenic, hypovolemic, septic, and mixed circulatory shock and the systemic inflammatory response syndrome.	X	
L-CCC-MK2	Know the indications for and characteristic findings of bedside noninvasive and invasive hemodynamic monitoring.	X	
L-CCC-MK3	Know the indications for, contraindications to, and clinical pharmacology of vasoactive and inotropic medications used to treat patients with heart failure, hypotension, or shock.	X	
L-CCC-MK4	Know the indications for, contraindications to, and clinical pharmacology of anticoagulant, antiplatelet, and fibrinolytic agents.	X	
L-CCC-MK5	Know the indications for, contraindications to, and clinical pharmacology of agents used to treat patients with hypertensive urgencies and emergencies.	X	
L-CCC-MK6	Know the indications for, contraindications to, and clinical pharmacology of agents used to treat patients with pulmonary hypertension, including inhalational agents.		X
L-CCC-MK7	Know the indications for, contraindications to, clinical pharmacology and potential toxicity of antiarrhythmic drugs in the clinical care setting.	X	
L-CCC-MK8	Know the indications for, contraindications to, and risks of catheter-based interventions for patients with supraventricular and ventricular arrhythmias.	X	
L-CCC-MK9	Know the characteristic clinical, ECG echocardiographic, and radiographic findings associated with pulmonary embolism, aortic dissection, pericardial tamponade, acute decompensated heart failure, and myocardial infarction.	X	
L-CCC-MK10	Know the indications for oxygen supplementation, noninvasive ventilation, endotracheal intubation, and mechanical ventilatory support for patients with hypoxia and/or respiratory failure.	X	
L-CCC-MK11	Know the differential diagnosis and characteristic laboratory findings associated with oliguria and acute kidney injury and the indications for renal replacement therapy.	X	
L-CCC-MK12	Know the characteristic physical examination, echocardiographic, angiographic, and hemodynamic findings associated with mechanical complications of myocardial infarction (e.g., ventricular septal defect, mitral regurgitation, ventricular pseudoaneurysm, right ventricular infarction and myocardial rupture).	X	
L-CCC-MK13	Know the types of, indications for, and contraindications to mechanical circulatory support, including intra-aortic balloon counterpulsation, percutaneous and surgical ventricular assist devices, and extracorporeal membrane oxygenation.		X
L-CCC-MK14	Know the principles of treatment of hypotension in patients with cardiogenic shock, hypertrophic obstructive cardiomyopathy, right ventricular infarction, massive pulmonary embolism, pericardial tamponade, and distributive shock.	X	
L-CCC-MK15	Know the indications for immediate and delayed surgery in patients with aortic dissection.	X	
L-CCC-MK16	Know the differential diagnosis of heart failure or shock following cardiac transplantation.		X
L-CCC-MK17	Know the prognostic factors used to assess patients with acute coronary syndromes and advanced heart failure.	X	
L-CCC-MK18	Know the risk factors for major bleeding in patients receiving antithrombotic medications.	X	
L-CCC-MK19	Know the principles of post-resuscitation care and the indications for hypothermia.	X	

TABLE 20 Critical Care, continued

Competency ID	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-CCC-PC1	Skills to manage patients with acute myocardial infarction and associated rhythm, conduction, hemodynamic, and mechanical complications.	X	
L-CCC-PC2	Skill to integrate findings from clinical, ECG, imaging, and hemodynamic assessments into the management of unstable cardiac patients.	X	
L-CCC-PC3	Skills to insert arterial, central venous, and pulmonary artery catheters and temporary transvenous pacemakers.		X
L-CCC-PC4	Skill to coordinate renal replacement therapy in conjunction with nephrology consultants.	X	
L-CCC-PC5	Skill to employ therapeutic hypothermia protocols in survivors of cardiac arrest.		X
L-CCC-PC6	Skill to evaluate and manage patients with hemodynamic instability following cardiac surgery.		X
L-CCC-PC7	Skills to evaluate and manage patients with supraventricular and ventricular arrhythmias and conduction disturbances in unstable patients in collaboration with electrophysiology consultants.	X	
L-CCC-PC8	Skill to utilize vasopressor and inotropic therapy appropriately in patients with various types of shock.	X	
L-CCC-PC9	Skill to implement mechanical circulatory support in the management of critically ill patients.		X
L-CCC-PC10	Skill to perform and lead cardiopulmonary resuscitation.	X	
L-CCC-PC11	Skill to recognize the clinical signs of pericardial tamponade.	X	
L-CCC-PC12	Skill to perform elective pericardiocentesis.		X
L-CCC-PC13	Skill to collaborate effectively with heart failure specialists, interventional cardiologists, and surgical consultants in the management of patients with heart transplantation or ventricular assist devices.	X	
L-CCC-PC14	Skill to manage patients with hypertensive urgencies and emergencies.	X	
L-CCC-PC15	Skills to manage critically ill patients with aortic dissection, massive or submassive pulmonary embolism, acute severe valvular regurgitation, and advanced pulmonary hypertension with right ventricular dysfunction.		X
L-CCC-PC16	Skill to manage patients with acute bleeding, including bleeding related to vascular access.	X	
L-CCC-PC17	Skill to incorporate noninvasive and mechanical ventilatory support in patient management in the critical care setting.		X
L-CCC-PC18	Skill to perform endotracheal intubation.		X

ECG = electrocardiography.

TABLE 21 Adults With Simple Congenital Heart Disease (Atrial Septal Defects, Ventricular Septal Defects, Patent Ductus Arteriosus, Pulmonary Stenosis, Bicuspid Aortic Valve, Coarctation) Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ACHD(S)-MK1	Know the anatomy, pathophysiology, associated conditions, and natural history of defects in cardiac septation, including patent foramen ovale, atrial septal aneurysm, atrial septal defects (primum, secundum, and sinus venosus), and ventricular septal defects.	X	
L-ACHD(S)-MK2	Know the anatomy, pathophysiology, associated lesions, and natural history of aortic valve and aortic defects including bicuspid valve, sinus of Valsalva aneurysm, pulmonic stenosis, coarctation, and patent ductus arteriosus.	X	
L-ACHD(S)-MK3	Know the pathophysiology of and risks associated with pulmonary arterial hypertension in adults with congenital heart disease.	X	
L-ACHD(S)-MK4	Know the potential risks associated with noncardiac surgery, pregnancy, contraception, and exercise in adults with congenital heart disease and pulmonary arterial hypertension.		X
L-ACHD(S)-MK5	Know the reproductive and genetic implications of adult congenital heart disease for the patient, fetus, and offspring.		X
L-ACHD(S)-MK6	Know the indications for patient referral to an adult congenital heart disease center.	X	
L-ACHD(S)-MK7	Know the characteristic symptoms, signs, and ECG and chest x-ray findings associated with simple congenital heart diseases in adults.	X	
L-ACHD(S)-MK8	Know the indications for noninvasive and invasive testing in the evaluation of adult patients with simple congenital heart disease.	X	
L-ACHD(S)-MK9	Know the indications for and contraindications to surgical and percutaneous interventions for congenital heart disease in adults.		X
L-ACHD(S)-MK10	Know the indications for endocarditis prophylaxis in adult patients with congenital heart disease.	X	

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ACHD(S)-PC1	Skill to obtain a comprehensive clinical history and perform a physical examination in adult patients with simple congenital heart disease.	X	
L-ACHD(S)-PC2	Skills to order appropriate imaging studies and integrate the results with other clinical findings in the evaluation and management of adult patients with simple congenital heart disease.	X	
L-ACHD(S)-PC3	Skills to evaluate and manage adult patients with simple congenital heart disease after reparative intervention.	X	
L-ACHD(S)-PC4	Skills to identify and manage cardiovascular complications of pregnancy in women with simple congenital heart disease.		X
L-ACHD(S)-PC5	Skill to detect pulmonary arterial hypertension.	X	
L-ACHD(S)-PC6	Skills to evaluate the safety of exercise and counsel adults with simple congenital heart disease about participation in sports and other strenuous physical activities.		X
L-ACHD(S)-PC7	Skills to evaluate and manage adults with simple congenital heart disease and determine the appropriate timing of surgical and/or catheter-based interventional procedures.		X

TABLE 22 Adults With Complex Congenital Heart Disease (Ebstein's Anomaly, Tetralogy of Fallot, Complex Cyanotic Congenital Heart Disease, Transposition of the Great Arteries, Single-Ventricle Physiology/Fontan) Lifelong Learning Competencies

Competency ID	MEDICAL KNOWLEDGE	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-ACHD(C)-MK1	Know the basic anatomy and pathophysiology of Ebstein's anomaly, transposition of the great arteries, and tetralogy of Fallot.	X	
L-ACHD(C)-MK2	Know the anatomy, natural history, and pathophysiology of complex congenital heart diseases encountered in adults.		X
L-ACHD(C)-MK3	Know the risks associated with cardiac arrhythmias and their management in adults with complex congenital heart disease.		X
L-ACHD(C)-MK4	Know the systemic, hematologic, renal, pulmonary, orthopedic, and neurological complications of complex congenital heart disease.		X
L-ACHD(C)-MK5	Know the risks associated with routine, noncardiac procedures in patients with complex congenital heart disease, including systemic air embolism from intravenous lines.	X	
L-ACHD(C)-MK6	Know the risks associated with pregnancy and estrogen-based contraceptive agents in patients with complex congenital heart disease, particularly those with pulmonary hypertension.		X

	PATIENT CARE AND PROCEDURAL SKILLS	All	Practice Focused
L-ACHD(C)-PC1	Skill to appropriately refer adult patients with complex congenital heart disease to an adult congenital heart disease center.	X	
L-ACHD(C)-PC2	Skills to integrate findings from the physical examination and imaging, angiographic, and hemodynamic data in the evaluation and management of adults with congenital heart disease.		X
L-ACHD(C)-PC3	Skill to ensure that patients with complex congenital heart disease receive appropriate counseling about contraception and pregnancy.	X	
L-ACHD(C)-PC4	Skill to establish a collaborative relationship with an adult congenital heart disease team or center to facilitate prompt access to advice or urgent transfer of patients with complex congenital heart disease.	X	

TABLE 23 Additional Professional Behavior Competencies Relevant to All Clinical Areas

Competency ID	SYSTEMS-BASED PRACTICE	All Clinical Cardiologists
L-ALL-SBP1	Incorporate risk/benefit analysis, cost, and resource and value considerations in the care of patients with cardiovascular diseases.	X
L-ALL-SBP2	Practice in a manner that balances appropriate utilization of finite resources with net clinical benefit for individual patients.	X
L-ALL-SBP3	Identify and address financial, cultural, and social barriers to evaluation, management, recommendations, and adherence.	X
L-ALL-SBP4	Collaborate effectively with members of the cardiovascular care team to ensure patient-centered care.	X
L-ALL-SBP5	Participate in practice-based continuous quality improvement and safety initiatives.	X
L-ALL-SBP6	Effectively utilize and document the meaningful use of electronic health record systems, clinical protocols, and evaluation and treatment prompts.	X
L-ALL-SBP7	Maintain continuity during transitions of care.	X
L-ALL-SBP8	Appropriately refer patients for new therapies, including participation in clinical trials.	X
L-ALL-SBP9	Appropriately activate local hospital protocols for immediate care of patients with cardiovascular emergencies, including ST-elevation acute myocardial infarction and acute ischemic stroke.	X
	PRACTICE-BASED LEARNING AND IMPROVEMENT	**All**
L-ALL-PBL1	Identify personal knowledge gaps and seek educational opportunities to improve performance.	X
L-ALL-PBL2	Utilize decision support tools at the point of care to access clinical practice guidelines, appropriate use criteria, performance measures, and other information resources.	X
L-ALL-PBL3	Solicit feedback on clinical performance and interactions from patients, colleagues, and other members of the health care team.	X
L-ALL-PBL4	Utilize available hospital and registry data to assess outcomes and clinical performance in an ongoing manner.	X
	INTERPERSONAL AND COMMUNICATION SKILLS	**All**
L-ALL-ICS1	Communicate with patients and families in an effective and timely manner, utilizing patient-centered educational aids and strategies.	X
L-ALL-ICS2	Communicate effectively with patients, families, and the public across a broad range of ethnic, social, cultural, socioeconomic, and religious backgrounds.	X
L-ALL-ICS3	Engage in shared decision making with patients in selecting among options for evaluation and management on the basis of balanced presentation of potential risks and benefits and sensitivity to individual values and preferences.	X
L-ALL-ICS4	Complete medical records and communicate results of diagnostic and therapeutic measures to collaborating health care professionals in an effective and timely manner.	X
	PROFESSIONALISM	**All**
L-ALL-PROF1	Interact respectfully with patients, families, and all members of the health care team, including ancillary and support staff.	X
L-ALL-PROF2	Demonstrate sensitivity, respect, and responsiveness to diverse patient populations.	X
L-ALL-PROF3	Practice within the scope of one's expertise and technical skill.	X
L-ALL-PROF4	Appropriately seek and integrate advice from consultants in a timely manner.	X
L-ALL-PROF5	Know evidence-based clinical practice guidelines, data standards, appropriate use criteria, and performance measures and promote adherence.	X
L-ALL-PROF6	Identify, disclose, and manage relationships with industry and other entities to avoid bias in clinical decision making, patient care, and research.	X
L-ALL-PROF7	Exhibit sensitivity to patients' values, preferences, and end-of-life concerns.	X

3. LEADERSHIP AND ADMINISTRATIVE COMPETENCIES

In addition to clinical competency, cardiologists are expected to function effectively as leaders in allied efforts to assure high-quality care and promote individual and population health. Some of these activities and attributes fall outside the realm of clinical knowledge and skill and instead involve administrative roles in clinical practice, hospitals, health systems, professional societies, or other organizations. Specific competencies expected of all general cardiologists and selected competencies that should be maintained by those whose careers involve greater involvement in administrative, managerial, or advocacy positions are delineated in Table 24.

TABLE 24 Leadership and Administrative Competencies

Competency ID	LEADERSHIP SKILLS	All Clinical Cardiologists	Selected Cardiologists Based on Practice Focus
L-LA-LEAD1	Skill to identify opportunities for and participate in initiatives to improve the patient care experience and efficiency of care.	X	
L-LA-LEAD2	Skill to advocate for the needs of individual patients.	X	
L-LA-LEAD3	Skill to function effectively as a team leader.	X	
L-LA-LEAD4	Skill to communicate constructive feedback to colleagues about patient care services.	X	
L-LA-LEAD5	Skill to promote an environment of collaboration that encourages input from patients and all members of the healthcare team.	X	
L-LA-LEAD6	Skill to work swiftly and effectively to resolve interpersonal conflict.	X	
L-LA-LEAD7	Skills to manage staff and provide coworkers with effective performance evaluations.		X
L-LA-LEAD8	Skill to adapt effectively to changes in local and national systems of healthcare delivery and efforts to improve population health.	X	
L-LA-LEAD9	Skill to participate meaningfully in strategic planning to improve population health and enhance the delivery of care.	X	
L-LA-LEAD10	Skill to negotiate effectively with hospital and health system administrators to improve population health and enhance the delivery of care.		X
L-LA-LEAD11	Skill to negotiate effectively with representatives of health insurance companies, government agencies, and healthcare networks to improve population health and enhance the delivery of care.		X
L-LA-LEAD12	Skill to develop expertise in communicating healthcare-related information through public media.		X

	PROFESSIONAL IDENTITY	All	Practice Focused
L-LA-PROFID1	Maintain a commitment to and engage in lifelong learning.	X	
L-LA-PROFID2	Value diversity in appearance, thought, and perceptions among patients and members of the healthcare team.	X	
L-LA-PROFID3	Manage resources to optimize net clinical benefit for individual patients.	X	
L-LA-PROFID4	Regularly employ self-directed assessment to identify gaps in competency and opportunities for individualized learning.	X	
L-LA-PROFID5	Know the evolution of financial, legal, and regulatory policies affecting health care.	X	
L-LA-PROFID6	Serve as a mentor and role model for trainees and other physicians.	X	
L-LA-PROFID7	Maintain current credentialing (e.g., professional licensure, hospital affiliation, board certification or recertification, societal affiliations) as required for professional practice.	X	
L-LA-PROFID8	Actively solicit feedback from patients and administrative and professional staff about the quality of operations and services.	X	
L-LA-PROFID9	Promote adherence to clinical practice guidelines, appropriate use criteria, and performance measures to ensure high-value care.	X	

TABLE 24 Leadership and Administrative, continued

Competency ID	PROFESSIONAL IDENTITY	All	Practice Focused
L-LA-PROFID10	Appropriately evaluate and report or disclose information related to negative outcomes and to medical errors.	X	
L-LA-PROFID11	Exercise good judgment when using social media with particular attention to preserving patient confidentiality.	X	
L-LA-PROFID12	Recognize, disclose, and manage relationships with industry and other entities in administrative and educational activities.	X	
L-LA-PROFID13	Recognize and avoid situations in which illness or fatigue could impair performance.	X	

	OPERATIONAL SKILLS	All	Practice Focused
L-LA-OPER1	Skills to manage and facilitate meetings within one's scope of practice.		X
L-LA-OPER2	Skill to develop expertise in office and personnel management.		X
L-LA-OPER3	Skills to promote and effectively participate in organizational efforts to comply with regulatory requirements and maintain accreditation (e.g., Intersocietal Accreditation Commission, The Joint Commission, ACGME).		X
L-LA-OPER4	Skill to partner effectively with the hospital administration in management and leadership of service lines.		X
L-LA-OPER5	Skill to develop leadership skills in interdisciplinary care.		X

	PERSONAL BALANCE (PBAL)	All	Practice Focused
L-LA-PBAL1	Prioritize tasks and responsibilities and delegate authority appropriately.	X	
L-LA-PBAL2	Maintain appropriate balance between personal and professional endeavors.	X	
L-LA-PBAL3	Implement strategies for personal financial management and retirement planning.	X	

PRESIDENT AND STAFF

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KEY WORDS ACC Competency Statement, clinical competency, general cardiologist, interpersonal and communication skills, lifelong learning, maintenance of competence, medical knowledge, patient care, practice-based learning and improvement, procedural care, professionalism, systems-based practice

APPENDIX 1. AUTHOR RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—2016 ACC LIFELONG LEARNING COMPETENCIES FOR GENERAL CARDIOLOGISTS

Committee Member	Employment	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional/ Organizational or Other Financial Benefit	Expert Witness
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This table reflects authors' relationships with industry and other entities that were reported and deemed to be relevant to this document, as well as employment and reporting categories. Names are listed in alphabetical order within each category of review. The table does not necessarily reflect relationships with industry at the time of publication. A person is deemed to have a significant interest in a business if the interest represents ownership of ≥5% of the voting stock or share of the business entity, or ownership of ≥$5,000 of the fair market value of the business entity; or if funds received by the person from the business entity exceed 5% of the person's gross income for the previous year. Relationships in this table are modest unless otherwise noted. 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.

APPENDIX 2. REVIEWER RELATIONSHIPS WITH INDUSTRY AND OTHER ENTITIES (RELEVANT)—2016 ACC LIFELONG LEARNING COMPETENCIES FOR GENERAL CARDIOLOGISTS

Name	Employment	Representation	Consultant	Speakers Bureau	Ownership/ Partnership/ Principal	Personal Research	Institutional/ Organizational or Other Financial Benefit	Expert Witness
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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 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.

ABIM = American Board of Internal Medicine; ACC = American College of Cardiology; COCATS = Core Cardiovascular Training Statement.

APPENDIX 3. ECG CORE COMPETENCIES: PATTERN AND ARRHYTHMIA RECOGNITION

General Features
- Normal ECG
- Normal variant
- Incorrect electrode placement
- Artifact

Atrial Abnormalities
- Left atrial abnormality
- Right atrial abnormality
- Biatrial abnormality

Sinoatrial Rhythm
- Normal sinus rhythm
- Sinus tachycardia
- Sinus bradycardia
- Sinus arrhythmia
- Sinoatrial pause or arrest
- Sinoatrial exit block

Atrial Rhythms
- Atrial premature complexes (conducted; nonconducted)
- Atrial tachycardia (ectopic)
- Atrial tachycardia with atrioventricular block
- Atrial fibrillation
- Atrial flutter (typical and atypical forms)
- Atrial tachycardia, multifocal

Atrioventricular (AV) Junctional Rhythms
- Premature junctional complexes
- AV node re-entrant tachycardia (AVNRT-common and uncommon types)
- Nonparoxysmal junctional tachycardia/Accelerated junctional rhythm
- AV re-entrant tachycardia (AVRT) with an accessory pathway
- AV junctional escape complex or escape rhythm

Ventricular Rhythms
- Ventricular ectopic complexes
- Accelerated idioventricular rhythm
- Ventricular tachycardia: uniform (monomorphic), multiform (pleomorphic or polymorphic), sustained, nonsustained, bidirectional, and torsades de pointes
- Ventricular fibrillation
- Ventricular escape complexes or rhythm

AV Relationship and Conduction

AV dissociation due to:
- Slowing of dominant pacemaker
- Acceleration of subsidiary pacemaker
- Third-degree atrioventricular block
- Isorhythmic atrioventricular dissociation

AV Block
- First degree
- Second degree: 2:1, Mobitz type I (Wenckebach), Mobitz type II, high-degree atrioventricular block
- Third-degree atrioventricular block (complete)

QRS Voltage and Axis
- Low voltage
- Left axis deviation
- Right axis deviation
- Left ventricular hypertrophy
- Right ventricular hypertrophy
- Biventricular hypertrophy
- Electrical alternans

Intraventricular Conduction Disturbances
- Incomplete and complete left bundle branch block
- Incomplete and complete right bundle branch block
- Left anterior and left posterior fascicular blocks
- Indeterminate (nonspecific) intraventricular conduction defects
- Aberrant intraventricular conduction (rate related; Ashman)
- Ventricular pre-excitation syndromes (Wolff-Parkinson-White pattern)

Myocardial Ischemia and Infarction
- ST-T-wave changes due to ischemia
- Acute current of injury
- ST elevation myocardial infarction
- Q-wave myocardial infarction
- Abnormal Q waves not associated with infarction
- Time course of ECG changes in MI (acute/recent; age-undetermined/old)
- ECG localization of myocardial infarction

Miscellaneous ST-T, U-wave Abnormalities
- Nonspecific ST-T-wave abnormalities
- Prolonged Q-T interval
- Prominent U waves
- ST-T-wave abnormalities secondary to hypertrophy

Pacemaker
- Fixed-rate pacemaker
- Atrial pacing
- Ventricular demand pacing
- Atrial-triggered ventricular pacing
- AV dual pacing
- Biventricular pacing
- Malfunctioning: demand acting as fixed rate, failure to sense, slowing of rate, acceleration of rate, failure to capture, failure to pace (inappropriate inhibition)

Clinical Diagnoses (Selected)
- Hyperkalemia
- Hypokalemia
- Hypercalcemia
- Hypocalcemia
- Long QT syndromes (congenital and acquired)
- Atrial septal defect, secundum
- Atrial septal defect, primum
- Dextrocardia
- Mitral stenosis
- Acute cor pulmonale, including pulmonary embolus
- Pericardial effusion
- Acute pericarditis
- Hypertrophic cardiomyopathy
- Brugada disease
- Arrhythmogenic right ventricular dysplasia
- Central nervous system disorder
- Myxedema
- Hypothermia
- Sick sinus syndrome
- Digitalis effect
- Digitalis toxicity
- Effects of other drugs (e.g., tricyclic or antiarrhythmic agents)

APPENDIX 4. ABBREVIATIONS

ABIM = American Board of Internal Medicine

ABMS = American Board of Medical Specialties

ACC = American College of Cardiology

ACGME = Accreditation Council for Graduate Medical Education

CME = continuing medical education

COCATS = Core Cardiovascular Training Statement

ECG = electrocardiography

EPA = Entrustable Professional Activities

MET = metabolic equivalent

NSTE-ACS = Non–ST-elevation acute coronary syndrome

STEMI = ST-elevation myocardial infarction