الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

CARDIAC ELECTROPHYSIOLOGY & PACING




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PREFACE

- This curriculum represents a vital part of learning. In addition to informing trainees, trainers, and training supervisors regarding the goals and objectives of training, this curriculum will have a major impact on program planning, execution, and quality assurance of training outcomes.
- The Saudi Commission for Health Specialties (SCFHS) is the national regulatory body of postgraduate training programs governing all health professions in Saudi Arabia.
- The primary goal of this document is to enrich the training experience of postgraduate trainees by outlining the learning objectives that will enable them to become independent and competent cardiac electrophysiology practitioners in the future.
- This curriculum may contain sections outlining training regulations; however, such regulations must be sought from the
- "General Bylaws of Training in Postgraduate Programs" and "Executive Policies" published by the SCFHS, which can be accessed online through the official SCFHS website. In case of discrepancies in the regulation statements, the regulations stated in the most updated bylaws and executive policies must be considered.
- As this curriculum is subject to periodic refinement, please refer to the electronic version posted online for the most updated edition at: www.scfhs.org.sa

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The CanMEDS framework is a copyright of the Royal College of Physicians and Surgeons of Canada. Many of the competencies have been acquired from their resources.

(Please refer to: CanMEDS 2015 physician competency framework; Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015.).

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IV. Introduction

1. Context of Practice

Sudden cardiac death (SCD), a significant public health concern, can occur in patients with no history of heart disease and those who do not adhere to the high-risk guidelines recommended by clinical trials and observational studies. SCD accounts for 15–20% of all deaths, with coronary artery disease (CAD), the most common cause of sudden cardiac disease, accounting for up to 80% of deaths. [1, 2]

Sudden cardiac arrest, defined as the sudden cessation of cardiac mechanical function, is characterized by the absence of a detectable pulse, absent or gasping breath, and loss of consciousness. [3] Notably, several studies conducted in the United States and China revealed that the incidence of sudden cardiac arrest ranged from 50 to 100/100,000 individuals in the general population. [4,5]

Sudden cardiac arrest can be classified as in-hospital cardiac arrest (IHCA) or out-of-hospital cardiac arrest (OHCA). IHCA accounts for 1–5 events among 1,000 hospital admissions. The American Heart Association reported that the annual incidence of IHCA and OHCA in the United States was 209,000 and 350,000, respectively, in 2016. [6]

The primary goal of cardiac electrophysiology (EP) is to facilitate primary and secondary prevention of SCD. Cardiac death is the leading cause of death in the Kingdom of Saudi Arabia. A study conducted in 2019 that evaluated the prevalence, risk factors, and outcomes of SCD in the King Abdulaziz University Hospital, Jeddah, Saudi Arabia, revealed that the prevalence of SCD among adults was 7.76 cases per 1,000 hospital admissions, which is higher than that reported by most similar studies. However, the rate of return of spontaneous circulation was 56.8%, which is more favorable than that reported by other studies. [7]

Epidemiology of sudden cardiac death

SCD among older adults commonly occurs in the context of structural heart disease. In contrast, it is often a sentinel isolated event among young adults and children with inherited arrhythmic conditions. The incidence of SCD among young adults and children is estimated to be 1.3–8.5 per 100,000 patients-years [8,9]

Data regarding the epidemiology of SCD in Saudi Arabia are lacking. Nofal et al. investigated 1,273 deaths at a university hospital in Dammam and reported a prevalence of 17.5%. Notably, a previous diagnosis of a cardiovascular disease was only observed in 15% of cases, and 15.2% of cases involved individuals aged 1–40 years.

These data suggest that SCD at a young age is a public health concern in Saudi Arabia, which is expected given that individuals aged <40 years account for 69% of the population [10]. SCD is influenced by factors such as age, with CAD being the most common cause among individuals aged >50 years. However, CAD is observed relatively rarely among those aged <35 years [11].

Primary arrhythmia is the primary cause of SCD among younger patients. CAD has been identified as a factor in patients aged >25 years. Monomorphic ventricular tachycardia, which does not result in loss of consciousness typically, can lead to SCD if it degenerates into ventricular fibrillation or polymorphic ventricular tachycardia or is associated with other medical circumstances. Ventricular fibrillation accounts for 23% of cases of OHCAs that receive emergency care, which may result from initial ventricular tachycardia (VT) degeneration into less-coordinated rhythms.

SCD may be the outcome of primary ventricular fibrillation combined with acute myocardial ischemia or inherited channelopathies such as Brugada syndrome and long QT syndrome (LQTS).

Bradyarrhythmias can lead to SCD in rare cases. Inherited arrhythmic conditions such as hypertrophic cardiomyopathy (HCM), arrhythmogenic right ventricular cardiomyopathy, and LQTS are the predominant causes of SCD among individuals aged <50 years [12,13].

The prevalence of supraventricular tachycardia (SVT), a common type of arrhythmia observed in emergency medical services, is approximately 35 cases per 100,000 person-years. The highest prevalence of SVT is observed among middle-aged individuals; notably, its incidence in women is twice as high as that in men.[14,15] SVT is characterized by regular tachycardia with sudden onset, abrupt termination, and narrow QRS and P waves that may or may not be identifiable on an electrocardiogram.[16] The underlying mechanism involves reentry at the sinoatrial node, atrium, atrioventricular junction, and accessory pathways, as well as enhanced automaticity in the atrium or atrioventricular node.[17,18,19]

Electrocardiography (ECG) helps detect ischemic heart disease, myocardial infarction, and genetic channelopathies, with echocardiograms being used to assess the signs of heart failure, cardiomyopathy, valvular heart disease, and congenital heart disease. Coronary angiography is an invasive procedure used to assess cardiac dysfunction, congenital heart disease, and coronary spasms [13]. These structural heart diseases contribute to cardiac arrhythmias.

The use of common antiarrhythmic drug therapy has not reduced; however, it can lead to increased incidence of SCD in some cases. Implantable cardioverter-defibrillator (ICD) helps improve survival and quality of life in high-risk patients. Thus, early identification of high-risk individuals who will benefit from ICD/cardiac resynchronization therapy (CRT) will aid in the prevention of SCD events and improving patient outcomes.

Radiofrequency catheter ablation has been performed widely in cardiac catheterization laboratories to destroy the substrate of the arrhythmic mechanism since the 1990s. It offers a cure for arrhythmia while avoiding common drug-related side effects; consequently, it has become the first-line treatment. This technique has been used extensively for most varieties of arrhythmias, with a success rate of as high as 95%.

Furthermore, it is associated with low morbidity, low mortality, and a low rate of recurrence, with patients reporting significant improvements in the quality of life following ablation. [20,21].

Practice scope

Cardiac electrophysiology (EP) is a subspecialty of cardiology programs that aims to study and treat cardiac rhythm disorders. Electrophysiologists (Eps) work closely with other cardiac specialists to correct cardiac arrhythmias. The primary focus of cardiac EP is to understand the mechanism, function, and production of the electrical activities of the heart rhythm and their abnormalities. Cardiac Eps perform interventional and surgical procedures, including pacemaker and ICD implantation, for the management of cardiac arrhythmias. The therapeutic modalities employed in this field include antiarrhythmic drug therapy and cardiac interventional ablation procedures.

Cardiac electrophysiology clinics

Cardiac EP services provide ambulatory care in arrhythmia and device clinics that perform cardiac device interrogation and programming. Arrhythmia clinics provide practical hands-on cardiac advice for the evaluation and management of patients with heart rhythm disorders.

The implanted cardiac devices of patients with implanted pacemakers and cardiac defibrillators must be regularly evaluated to ensure proper functioning and prevent future complications. Cardiac device clinics provide comprehensive long-term follow-up care for patients with implanted cardiac devices such as pacemakers, implantable defibrillators, loop recorders, and CRT devices. Cardiac EP clinics also provide other services, such as pre-operative evaluation of devices, home monitoring for pacemakers and 24–48-hour or 2-week Holter or external/internal loop monitoring.

Cardiac electrophysiology in-patient services

EP services encompass device implantation, EP studies, arrhythmia ablation, and cardioversion.

To determine an appropriate diagnosis for all types of cardiac arrhythmias and select an appropriate treatment strategy including:

- Diagnosis of arrhythmias and their underlying mechanisms
- Risk assessment of life-threatening ventricular arrhythmias
- Catheter-based treatment strategies for atrial fibrillation, atrial flutter, supraventricular tachycardia, and VT
- Biventricular pacemaker/defibrillator implantation for patients with heart failure who are eligible to undergo this treatment
- Implantation and management of pacemakers and defibrillators
- Lead extraction in patients with damaged or infected in-dwelling pacemakers and defibrillators
- Management of patients with congenital heart disease or inherited arrhythmia disorders.

Cardiac electrophysiologists (Eps) are cardiologists who have completed ≥2 years of additional training in the field of cardiac EP beyond that required for board-certification. Cardiologists are initially certified in the specialty of cardiovascular diseases by the Board of Internal Medicine. This training focuses on the management of patients with diseases related to the heart and blood vessels such as myocardial infarction, valve disease, and arrhythmias. Following board-certification in the management of cardiovascular diseases and completing an additional 2 years of EP training, the provider is certified in the subspecialty of clinical cardiac EP. Clinical cardiac Eps possess the specialized education and expertise required to perform advanced cardiac-related procedures and interpret their results.

Cardiac Eps must possess an understanding of the electrical mechanism underlying cardiac function and the types of arrhythmias and their causes. They must also be capable of performing different types of cardiac evaluations required to assess arrhythmias and implant special devices into the body to regulate the heartbeat or cardiac function. They also perform several interventional procedures in cardiac catheterization laboratories, such as cardiac electrophysiological studies and ablation, to diagnose or treat diseases related to heart rhythm.

Fellowship trainees pursuing clinical cardiac EP programs must achieve competency in all areas pertaining to the management of cardiac arrhythmia. Trainees must develop expertise in the diagnosis and management of arrhythmias, encompassing invasive and noninvasive testing and therapeutic modalities such as pharmacological management, device implantation and follow-up, and catheter ablation. Furthermore, they must participate in cardiac EP activities in in-patient and outpatient settings to observe, diagnose, manage, and judge the effectiveness of different treatment strategies. Fellowship trainees are given the opportunity to assume continuing and increasing responsibility for the management of patients with acute and chronic illnesses to gain an understanding of the natural history of a wide range of cardiac arrhythmias and their treatment. Fellowship trainees also perform invasive interventional procedures in EP cardiac catheterization laboratories, such as diagnostic EP studies; arrhythmia mapping; catheter ablation for supraventricular and VT; and the implantation of pacemakers, ICDs, and CRT devices. Fellowship trainees also perform noninvasive procedures, such as cardioversion and device tests, and manage patients with arrhythmias and implanted devices in intensive cardiac care units (CCUs) and other in-patient and outpatient units (including device clinics).

This curriculum aims enhance the *competency* of trainees in the specialty of cardiac EP. This goal requires significant effort and coordination from all stakeholders involved in postgraduate training. Fellowship trainees, as *"adult-learners,"* must be proactive and fully engaged. Furthermore, they must possess a careful understanding of learning objectives and engage in self-directed learning and problem-solving. Most importantly, they must exhibit an eagerness to apply the feedback and results of formative assessments to practice and possess self-awareness and willingness to ask for support when required. In addition to the members of the training committee, particularly Program Administrators and Chief Residents, who play significant roles in implementing the program, the Program Director plays a vital role in facilitating the successful implementation of this curriculum. The trainees also share responsibilities for implementing the curriculum.

The Saudi Commission for Health Specialties applies a recognized competency model of training governance to achieve the highest quality of training. Postgraduate programs must encompass research and evidence-based practice in their curriculum. Academic affair committees in-training centers and the regional supervisory training committee also play major roles in-training, supervision, and implementation. The Specialty Scientific *Council/Committee* is responsible for ensuring that the content of the curriculum is constantly updated to meet the highest standards in postgraduate education of cardiac EP.

V. ABBREVIATIONS USED IN THIS DOCUMENT

Advice for Authors

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
F(1)	(First) year of Fellowship
F(2)	(Second) year of Fellowship
CBE	*Competency-based education*
PT	Progress test
OSCE	Objective Structured Clinical Examination
OSPE	Objective Structured Practical Examination
Mini-CEX	Mini-Clinical Experience report
DOPS	Direct Observation of Procedural Skills report
CBD	Case-Based Discussion report
CBE	Competency-Based Education
ITER	In-Training Evaluation Report
COT	Consultation Observation Tool

Abbreviation	Description
RTC	Residency Training Committee
EP	Electrophysiology
AF	Atrial Fibrillation
SVT	Supraventricular Tachycardia
IHCA	In hospital cardiac arrest
OHCA	Out hospital cardiac arrest
AHA	American Heart Association
SCD	Sudden cardiac death
ECG	Electrocardiogram
ICD	Implantable Cardioverter Defibrillator
CRTD	Cardiac resynchronization defibrillator
EP	Electrophysiology
VT	Ventricular Tachycardia

VI. REQUISITES FOR ENTRY INTO THE PROGRAM

Fellowship trainees must be certified by the Saudi Cardiology Board or its equivalent to be eligible for admission to the Cardiac EP Fellowship Program.

Knowledge regarding the diagnosis and management of arrhythmia, a part of core cardiology training, and the ability to function as a cardiologist are prerequisites for cardiac EP training.

VII. LEARNING AND COMPETENCIES

1. Introduction to Learning Outcomes and Competency-Based Education

Training in the specialty of cardiac EP is guided by well-defined "*learning objectives*" driven by targeted "*learning outcomes*" of a particular program to serve specific needs of the specialty. Learning outcomes must reflect the professional "*competencies*" and tasks aimed to be "*entrusted*" and tasks that trainees must engage in upon graduation. This approach ensures that the graduates are capable of meeting the demands of the healthcare system and patient care in relation to their specialties. *Competency-based education* (CBE) is an approach of "*adult-learning*" that places an emphasis on achieving *pre-defined*, *fine-grained, and well-paced* learning objectives derived from complex professional competencies.

Professional competencies related to healthcare are usually complex and comprise a mixture of multiple learning domains (knowledge, skills, and attitudes). CBE has transformed the conventional method of implementing postgraduate education. The duration of training, though a precious resource, is not reflective of *competence*. In other words, the duration of rotation in certain departments is not the primary marker of achieving competence. CBE emphasizes the critical role of informed judgment in ensuring competency progress among the learners, based on a staged and formative assessment driven by multiple workplace-based observations. This curriculum was developed using the CanMEDS model developed by the Royal College of Physicians and Surgeons of Canada and the CBME competency model developed by the Accreditation

Council for Graduate Medical Education (ACGME). The following concepts enhance the implementation of CBE in this curriculum.

- **Competency:** Competency is a cognitive construct that assesses the potential of an individual to perform efficiently in accordance with professional standards in a given situation. Professional roles such as medical experts, health advocates, communicators, leaders, scholars, collaborators, and professionals are used to define competency-roles to make them mendable for learning and assessment.
- **Milestones:** Milestones are the stages of the developmental journey throughout the competency continuum. The candidates will transform from novice/supervised trainees to master/unsupervised practitioners through the course of their training. Milestones do not lessen the role of supervisory/regulatory bodies in curbing malpractice among independent practitioners. Milestones enhance the learning process by pacing training/assessment to match the developmental level of the trainees (junior vs. senior).
- **Learning Domains:** Efforts should be made to annotate learning outcomes with the corresponding domain (K=Knowledge, S=Skills, and A=Attitude) whenever possible. More than one annotation may be assigned for a given learning outcome.
- **Content-area Categorization:** Categorization of the learning outcomes into broad content areas related to the practice of the profession is advised. Examples include diagnostic vs. therapeutic, simple vs. complex, and urgent vs. chronic.

Trainees progress from the novice level to the master level through a certain set of professional competencies. The SCFHS endorses the CanMEDS to articulate professional competencies. The CanMEDS and ACGME are globally accepted frameworks that outlines competency-roles. This curriculum was developed using the principles of competency-based medical education and the CanMEDS 2015/ACGME 2018 framework."

ACGME reference and link

https://www.acgme.org/Portals/0/MilestonesGuidebook.pdf

This reference provides a general outline of CanMEDS competencies (Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada; 2015)

2. Program Duration

The cardiac EP training program is a 2-year program that enables trainees to achieve competency in the noninvasive and invasive management of arrhythmia, including all aspects of device implantation and EP ablation procedures. Practitioners must enroll in this 2-year fellowship program to complete training and receive certification in cardiac EP. Trainees are encouraged to complete an additional 1-year duration of training comprising training in complex EP ablation procedures or research for additional certification in advanced cardiac EP training.

3. Program Rotations

The fellowship program comprises an annual vacation spanning one month. The trainees must complete a total of 3 months of outpatient and in-patient consultation services every year, including clinics, during the first 2 years. The trainees must also attend cardiac catheterization laboratories for a total of 3 months, as well as 3 months in device clinics to learn implantation procedures, to gain proficiency in performing EP procedures. The remaining two months of each year are allocated for research activities and electives. Elective rotations may comprise one of the mandatory core EP rotations or others, such as heart failure, congenital diseases, genetics, cardiac surgery, and anesthesia. Elective rotation, if not a core rotation, must be approved by the Program Director.

The optional third year focuses mainly on advanced ablation procedures in the cardiac EP laboratory, such as atrial fibrillation (AF) and VT ablations, complex 3-dimensional mapping and ablation, leadless device implantation, and laser extraction.

Training year	Mandatory core rotations*			Elective rotations**		
	Rotation name	Duration (months)	Setting	Rotation name	Duration	Setting
F1	• EP cath lab • EP consultation • EP implant	3 3 3	In-patient/Outpatient In-patient/Outpatient In-patient/Outpatient	• Research • Elective (EP cath Lab/ Ep implant/clinics [heart failure, congenital and genetics]) • Vacation	1 1 1	In-patient/Outpatient In-patient/Outpatient
F2	• EP cath lab • EP consultation • EP implant	3 3 3	In-patient/Outpatient In-patient/Outpatient In-patient/Outpatient	• Research • Elective (EP cath Lab/ Ep implant/ clinics [heart failure, congenital and genetics]) • Vacation	1 1 1	In-patient/Outpatient In-patient/Outpatient
F3 (Optional)	• Advanced EP ablation • Advanced EP implant	6 6	In-patient/Outpatient In-patient/Outpatient	• Elective (EP cath Lab/ Ep implant/ clinics [heart failure, congenital and genetics]) • Vacation	2 1	In-patient/Outpatient

*(*Mandatory core rotation: Set of rotations representing core components of the program that are mandatory.*

***Elective rotation: Set of rotations related to the specialty, as determined by the Scientific Council/Committee, some of which the trainee is required to attend.*

****Selective rotation: Set of other rotations that trainees can attend (directed by the Mentor/Program Director) to enhance competency of the specialty.*

4. Mapping of learning objectives and competency-roles to program rotations

This section matches the competencies and objectives of each cardiac electrophysiological rotation. Trainees and trainers should collaborate to achieve these objectives during teaching and formative assessments. Expectations evolve as the training level progresses (training stages and milestones).

The standard workday commences at 7:30 AM and ends at 4:30 PM. The trainees are expected to be present on-site during these hours.

On-call for cardiac electrophysiology: Generally conducted offsite under the supervision of the on-call consultant electrophysiologist. The maximum frequency of on-site on-call electrophysiology per month is eight; however, this limit does not apply if it is offsite without in-hospital visits after working hours. The fellowship trainees are expected to round up the EP in patients and perform EP consultations as required during weekend duty.

Fellowship trainees are involved in the educational process.

Weekly teaching rounds are to be organized to review notable cardiac EP tracings, troubleshoot devices, discuss interesting cases, and review relevant topics. The fellowship trainees are expected to attend these rounds.

Different fellowship trainees acquire technical skills at different rates. Consequently, the technical skills are not evaluated based on the number of procedures performed. The Program Committee and Program Director are responsible for evaluating the technical skills acquired by each trainee. Nevertheless, a minimum number of recommended, but not mandatory, procedures is required to acquire a high level of skill. The recommended optimal number of procedures during the 2-year fellowship training are as follows:

1) Diagnostic electrophysiology studies/procedures: 100 cases
2) Ablations for supraventricular tachycardia (SVT): 50 cases

3) ICD/PPM implantations/procedures: 50 cases
4) Coronary sinus (LV) lead placements: 15 cases
5) Transseptal punctures performed under supervision: 10 cases
6) Procedures performed using the retrograde aortic approach: 10
7) AF ablations performed under supervision: 15 cases
8) VT EP procedures: 15

- Please refer to Appendices A and B for the competency-matrix to map competency, the learning domain, and milestones.
- The following table summarizes the details of each rotation.

Rotation Name: (replicate the table based on the rotations number)

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
In-patient *Outpatient* *In-patient* *Outpatient* *In-patient* *Outpatient*	*F1*	*Consultation*	*3 months*	*Conduct full clinical assessment of arrhythmia.* *Assist colleagues with in-patient consultations. Proficiency in performing external defibrillation and administration of intravenous cardiac medications. Proficiency in the management of anticoagulation-related issues in patients with cardiac arrhythmia* *Supervision of the in-patient electrophysiology service, including admission and discharge of patients admitted to undergo ablation procedures under the electrophysiology service* *Insertion and positioning of all catheters in the heart and completion of diagnostic EP. Catheter placement and interpretation of electrophysiological tracings* *Supervision and evaluation of patients before the procedure; acquisition of informed consent; and admission and discharge of patients admitted to undergo device implantation under the electrophysiology service.*	*K, A* *K, S* *K, S* *K, S, A* *K, A*
		EP Lab	*3 months*		
		Device Implantation *Research* *Elective*	*3 months* *1 month* *1 month*		

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
				Insertion and positioning of the atrial and right ventricular leads in the heart under sterile technique. *Conduct full clinical assessments in arrhythmia and device clinics.* *Assist with outpatient consultations, Holter reading, and/or research activities.* *Attend the EP and device clinics weekly (a total of 1–2 days per week).* *Participate in research through any of the following pathways:* *1) Identify at least one project (ideally, a prospective project that includes data collection, abstract preparation, and completion of a manuscript)* *2) Perform peer-review of articles under the supervision of an attending electrophysiologist* *3) Participate in a retrospective study, case study, registry, (review article, observational or data collection projects, or a book chapter with one of the attending consultants)* *4) Active participation in the clinical studies being conducted at the local electrophysiology department, including ongoing clinical trials*	

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
				EP laboratory/device implantation/research/ activity tailored by the Program Director according to the requirements of the trainee	
	F2 *F2* *F3*	*Consultation*	*3 months*	*High level of proficiency in the management of anticoagulation-related issues in patients with cardiac arrhythmia. Management of patient with arrhythmia (including medical therapy).* *High level of proficiency in performing external defibrillation and administering intravenous cardiac medications.* *Participate in complex ablation procedures, such as three-dimensional mapping and atrial fibrillation; programmed electrical stimulation; transseptal puncture; and ablation procedures in the EP laboratory.* *Early recognition, detection, and management of procedural complications.* *Assist in complex device implantation such as CRT-D implant, left ventricular leads, and leadless devices* *Conduct full clinical assessment and troubleshooting of complex arrhythmias in clinics.*	*K, A* *K, S* *K, S* *K, S* *K, S* *K, A* *K, S* *K, S* *K, S, A* *K* *K, S*
		EP Lab	*3 months*		
		Device Implantation *Research* *Elective* *EP Lab* *Device Implantation* *Research* *Elective*	*3 months* *1 month* *1 month* *5 Months* *5 Months* *1 month* *1 month*		

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
				Supervising and guiding juniors in device clinics. *Early recognition, detection, and management of procedural complications.* *Attend cardiac electrophysiology and arrhythmia clinics twice weekly under the supervision of a consultant electrophysiologist. High level of proficiency in the testing, interrogation, and programming of implantable anti-arrhythmia devices.* *Participate in research through any of the following pathways:* *1) Identify at least one project (ideally, a prospective project that includes data collection, abstract preparation, and completion of a manuscript)* *2) Perform peer-review of articles under the supervision of an attending electrophysiologist.* *3) Participate in a retrospective study, case study, registry, (review article, observational or data collection projects, or a book chapter with one of the attending consultants).* *4) Active participation in the clinical studies being conducted in the local*	

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
				electrophysiology department, including ongoing clinical trials. *EP laboratory/Device implantation/research/activity tailored by the Program Director according to the requirements of the trainee* *Perform advanced ablations procedures such as atrial fibrillation/three-dimensional mapping, and* *Complex ventricular arrhythmia ablation. Perform transseptal puncture. Early recognition, detection, and management of procedural complications.* *Perform Lead extractions (mechanical or laser)* *Perform CRT and leadless device implantation* *Early recognition, detection, and management of procedural complications.* *Participation in other specialized clinics (e.g., congenital, pediatric, heart failure, and genetics) in addition to arrhythmia clinic (tailored according to individual objectives).* *Participate in research through any of the following pathways:*	

Rotation setting	Training stage	Training	Rotation's duration (months/weeks/ block)	Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA)	Competency-roles**
				1) *Identify at least one project (ideally, a prospective project that includes data collection, abstract preparation, and completion of a manuscript)* 2) *Perform peer-review of articles under the supervision of an attending electrophysiologist.* 3) *Participate in a retrospective study, case study, registry, (review article, observational or data collection projects, or a book chapter with one of the attending consultants).* 4) *Active participation in the clinical studies being conducted in the local electrophysiology department, including ongoing clinical trials. Participation in ongoing research activities, with supervised participation in protocol development and manuscript preparation. This includes active participation in screening and follow-up of patients involved in different research protocols.* *EP laboratory/ Device implantation or research or tailored by the Program Director according to trainee needs*	

The optional third year includes one month of vacation and one month of research. The remaining 10 months focus primarily on advanced ablation procedures in the cardiac EP laboratory, such as AF and VT ablations, complex three-dimensional mapping and ablation, leadless devices implantation, and laser extraction. The fellowship trainees must be capable of performing these complex procedures on their own competently.

Important notice:

**** The Saudi Commission for Health Specialties aims to achieve the highest quality of training through the application of the best competency models of training governance. The postgraduate programs must incorporate research and the evidence-based practice in their curriculum. Research and scholarship are domains of the curriculum. All trainees must demonstrate their ability to apply an evidence-based approach to practice, including the adoption of an evidence-based approach for informed decision-making, enhanced patient care, and patient outcomes. Trainers must be capable of critically appraising the literature. They are also encouraged to participate in clinical research or clinical audits contribute to advancements in the fields of science and medicine.

VIII. CONTINUUM OF LEARNING

This section summarizes the knowledge imparted during the key stages of progression within the specialty of cardiac EP. The importance of continuous lifelong professional development (CPD) and its role in ensuring the ability to meet the demands of their profession among healthcare providers are emphasized. The following table shows the expected development of this role throughout the two-year training and consultation level of practice.

For Cardiac Electrophysiology Fellowship program:

EP specialty	F1	F2	F3	Consultant sub specialist
Status	Dependent/supervised practice	Dependent/supervised practice	Independent practice/provide supervision	Independent practice/provide supervision
Consultation	Acquire fundamental knowledge and conduct clinical examination of patients with cardiac arrhythmia.	Apply knowledge related to core clinical problems of cardiac arrhythmia to provide appropriate clinical care	Apply knowledge related to complex clinical problems of cardiac arrhythmia to provide appropriate clinical care	Advanced and up-to-date management of cardiac arrhythmia
EP Procedure	Apply clinical skills such as EP procedures related to the core presenting problems and procedures in the field of Cardiac arrhythmia.	Analyze and interpret the findings from clinical skills to develop appropriate differential diagnoses and management plan for the patient with cardiac rhythm disorders	Analyze and interpret the findings from patients with complex rhythm disorders such as atrial tachycardia, atrial fibrillation and ventricular tachycardia using 3D mapping/ablation techniques	Compare and evaluate challenging, contradictory findings and develop expanded differential diagnoses and management plan

EP specialty	F1	F2	F3	Consultant sub specialist
Device Implantation	Apply clinical skills such as Device implantation related to the core presenting problems and procedures in the field of Cardiac arrhythmia.	Develop appropriate skills for complex implantation including Left ventricular leads and leadless device and manage complications	Develop skills for complex implantation including Left ventricular leads and leadless device and manage complications along with participation in laser extraction	Compare and evaluate challenging, contradictory findings and develop management plan for all complications

IX. TEACHING METHODS

Postgraduate cardiac EP fellowship training programs employ a teaching process based on the principles of adult-learning theory. The trainees must understand the importance of learning and play active roles in the selecting the content and furthering the process of their learning. The training programs implement the concept of adult-learning in each feature of the activities such that the trainees are responsible for their own learning requirements. The formal duration of training must include the following teaching activities:

- Program-Specific Learning Activities
- Universal topics
- General Learning Opportunities

Program-Specific Learning Activities

Program-specific activities are specifically designed educational activities intended to strengthen the abilities of the trainees during their training period. Attending these activities is mandatory, and noncompliance can lead to disciplinary actions. Linking attendance and participation in these activities with the formative assessment tools is recommended (please refer to the formative assessment section below). The program administration committee must aim to allocate a fixed duration of time for the trainees to attend and participate in these activities.

A) Program academic half-day

At least 2–4 hours of formal training (commonly referred to as *academic half-day*) should be reserved every month. Formal teaching time is planned in advance with the assigned tutor(s) to fix the time slots and venue. Formal teaching time excludes bedside teaching and clinical postings. Core specialty topics selected and approved by the

Scientific Council of the specialty that align with specialty-defined competencies and teaching methods are covered on academic half-days. Incorporation of the core cardiac EP topics enables the trainees to gain an in-depth understanding of the important clinical problems of the specialty. Conducting lectures using an interactive, case-based discussion format is recommended. The learning objectives for each core topic must be clearly defined. The core specialty topics should include lectures and team-based learning, wherever applicable. Regional supervisory committees, in coordination with Academic and Training Affairs, Program Directors, and Chief Residents, must work in conjunction to ensure that the planning and implementation of academic activities are conducted as indicated in the curriculum. The trainees must be actively involved in the development and delivery of topics under the supervision of the faculty; their involvement might be in the form of delivery, content development, or research.

Conducting 11–12 sessions per academic training year annually is recommended, with time reserved for other forms of teaching methods such as journal clubs and clinical/practical teaching. Academic half-days must aim to discuss core topics, including basic sciences, SVT, VT, bradycardia, pacemaker ICD, biventricular devices, troubleshooting, and intracardiac tracing interpretations and management.

An example of an academic half-day table is shown in Appendix D.

Academic Month	Section	Date	Time	Sessions	Presenters
1	Orientation and Implantation of Cardiac Devices	Jan	2–4 pm	Assessment system Basic implantation skills	Program Director
2	EP diagnostic procedure	Feb	2–4 pm	Basic interpretation of electrogram	EP Consultants
3	EP Consultation	Mar	2–4 pm	Journal Club	EP fellowship trainees
4	EP tracings	Apr	2–4 pm	Electrogram tracings	EP fellowship trainees
5	EP Device troubleshooting	May	2–4 pm	Case-based discussions	EP Consultants
6	EP Emergencies	June	2–4 pm	Electrical storm	EP fellowship trainees
7	EP Examination	July	2–4 pm	MCQ	Program Director
8	Basic Science	Aug	2–4 pm	Action Potential Mechanism of tachyarrhythmia	EP Consultants
			2–4 pm	Defibrillation	EP fellowship trainees
9	SVT	Sep	2–3 pm	Mechanisms case-based discussions	EP Consultants
			3–4 pm	Maneuvers	EP fellowship trainees
10	VT	Oct	2–3 pm	Mechanisms Case-based discussions	EP Consultants

Academic Month	Section	Date	Time	Sessions	Presenters
			3–4 pm	Maneuvers	EP fellowship trainees
11	EP Exam FITER report discussion	Nov	2–3 pm	MCQ	Program Director
			3–4 pm	OSCE	

B) Practice-based learning:

Bedside training in the CCU, cardiac and in-patient wards, cardiac catheterization laboratory, OR, as well as other outpatient activities such as device and EP clinics, are great opportunities for implementing practice-based learning.

Lectures, courses, and bedside teaching also serve as excellent opportunities for learning. Trainees must build their ability to manage different clinical problems related to cardiac arrhythmias through self-directed learning. Practice-based learning enables educators to supervise trainees to become competent in the required practical skills, thereby ensuring that the fellowship trainees gain knowledge, psychomotor skills, and an appropriate attitude toward learning domains in cardiac EP. Each trainee must maintain a logbook to document the EP procedures observed, those performed under supervision, and those performed independently (including device implantation), as well as the EP procedures in the cardiac catheterization lab. Determining the minimum number of procedures to be performed before training completion and the minimum number of procedures to be performed to maintain competency after certification would be prudent.

C) Morning report:

The morning report, a case-based teaching session, is commonly incorporated in fellowship programs for various purposes and focuses. This session involves discussing the management of interesting cases, which enables trainees to gain an understanding of efficient handover strategies and case presentation skills, thereby enhancing problem-solving and multidisciplinary team skills.

1.1 Universal Topics

Universal topics are optional educational activities developed by the SCFHS and intended for all specialties. The topics possessing the following qualities are prioritized:

- High value
- Interdisciplinary and integrated approach
- Require expertise beyond that available at local clinical training sites

The universal topics developed by the SCFHS are made available in the form of online modules through e-learning that can be accessed by each trainee via personalized access. A self-assessment examination for each universal topic is conducted at the end of the module. As indicated in the "Executive Policies of Formative Assessment and Annual Promotion," universal topics are optional for the fellowship trainees in cardiac EP. Universal topics were distributed throughout the training period.

Module 3:	Diabetes and Metabolic Disorders/4-Abnormal ECG
The fellowship trainees must be able to perform the following activities at the end of the Learning Unit: a) Recognize common and important ECG abnormalities b) Commence immediate management procedures, if necessary	
Module 7:	**Ethics and Healthcare**
Ethical issues: treatment refusal and patient autonomy The fellowship trainees must be able to perform the following activities at the end of the Learning Unit: a) Identify situations wherein the patient or family is likely to decline prescribed treatment b) Describe the concept of 'rational adult' in the context of patient autonomy and treatment refusal c) Analyze key ethical, moral, and regulatory dilemmas influencing treatment refusal d) Recognize the importance of patient autonomy in the decision-making process e) Counsel patients and families declining medical treatment regarding the best interest of the patients	

Role of Doctors in Death and Dying:

The fellowship trainees must be able to perform the following activities at the end of the Learning Unit:

a) Recognize the importance of the role that a doctor plays in the dying process

b) Provide emotional and physical care to the dying patient and family

c) Provide appropriate pain management to the dying patient

d) Identify and refer patients eligible to receive palliative care services

Please refer to Appendix B for Universal Topics

1.2 General Learning Opportunities:

Formal training should be supplemented with the following optional practice-based learning activities:

- Cardiology Journal Club
- Grand rounds
- Involvement in cardiac quality improvement committees and meetings
- CPD activities relevant to cardiac arrhythmia (conferences and workshops)
- Morbidity and Mortality (M&M) meetings

M&M meetings provide trainees with an opportunity to discuss cases wherein errors or complications have resulted in adverse effects. This resource aims to bring the focus on M&M and transform it into a platform for teaching patient safety principles and emphasizing error-reduction strategies. These academic activities constitute Program-Specific Activities *or* General Learning Opportunities, depending on the preferences and vision of the program developers for the program.

X. ASSESSMENT AND EVALUATION

1. Purpose of Assessment

Assessment plays a vital role in ensuring the success of cardiac EP training. Assessments aid trainees and trainers in achieving the defined standards, learning outcomes, and competencies. Furthermore, assessments aid in providing feedback to the learners and faculty regarding the development and implementation of the curriculum, teaching methods, and the quality of the learning environment. A reliable and valid assessment plays an essential role in assessing the extent to which the curriculum aligns with the objectives, learning methods, and assessment tools. Lastly, assessment assure patients a that the health professionals possess the expertise to practice.

Assessments serve the following purposes:

- **Assessment for learning:** Trainers use information regarding the performance of the trainees to inform their learning for improvement, thereby enabling educators to use information regarding the knowledge, understanding, and skills of the trainees to provide feedback about learning and methods to improve.
- **Assessment as learning** involves trainees in the learning process, thereby enabling them to monitor their own progress. Self-assessment and feedback from the educators can be used by the trainees to reflect on their progress. This approach aids in the development of metacognitive skills. Thus, assessment as learning plays a crucial role in helping residents/fellowship trainees become lifelong learners.
- **Assessment of learning** has been used to demonstrate the achievement of learning. It is a graded assessment that counts toward the end-of-training degree.

- **Feedback and evaluation** as assessment outcomes represent quality metrics that can improve the learning experience.

Miller's Pyramid of Assessment serves as a framework for assessing the clinical competencies of the trainees. It acts as a guide for the trainers to select the assessment methods to target different clinical competencies including "knows," "knows how," "shows how," and "does" (please refer to Appendix A for the checklist).

Assessments are further classified into the following main categories for the ease of organization: *Formative* and *Summative*.

2. Formative Assessment

2.1 General Principles

Trainees, as adult-learners, must strive to seek feedback throughout their journey of competency from "novice" to "mastery" levels and aim to improve their performance. Formative assessment, a component of assessment that is distributed throughout the academic year, aims primarily to provide trainees with effective feedback.

At least one hour every three months must be allocated for the trainees to meet with their mentors to review performance reports (e.g., Direct observation for procedural skills [DOPS] mini-CEX). Input from the overall formative assessment tools influences the decision to promote trainees from the current to the subsequent training level at the end of the year. Formative assessment is based on the recommendations of the Scientific Council/Committee that are updated and announced for each individual program at the beginning of the academic year.

According to the executive policy on formative assessment (available online: www.scfhs.org), formative assessment possesses the following features that are used based on Miller's pyramid (please refer to *Appendix A* for the checklist):

a. Multisource: comprises a minimum of four tools.
b. Comprehensive: encompasses all learning domains (knowledge, skills, and attitude).
c. Relevant: focuses on workplace-based observations.

d. Milestone-oriented competency reflects whether the expected competencies match the developmental level of the trainee.

Trainees should strive to seek feedback during training, and trainers should provide timely and formative assessments. An e-portfolio system has been provided by the SCFHS to enhance the communication and analysis of data from formative assessments.

Trainers and trainees must follow the recommendations of the Scientific Council regarding the updated forms, frequency, distribution, and deadlines related to the implementation of the evaluation forms.

2.2 Formative Assessment Tools

Learning Domain	Formative Assessment Tools	Frequency
Knowledge	- Annual written progress test (written and OSCE examinations at the end of the first year arranged by the Program Director of the hospital) - Structured academic activities (participation in academic educational activities, such as lectures, workshops, journal club, and grand rounds, every six months) - Case-based discussion: discussion of the management of patients with arrhythmia every 6 months (e.g., SVT and VT)	Annual Minimum of six per year Minimum of six per year
Skills	- Logbook (procedures including implantation of devices and EP studies) - Mini-CEX - Direct observation for procedural skills (DOPS; for all EP procedures such as device implantation, EP studies, and ablation)	Annual Minimum of six per year Minimum of six per year
Attitude	In-training evaluation report	Annual

The evaluation of each component will be based on the following equation:

Percentage	<50%	50–59.4%	60–69.4%	>70%
Description	Clear fail	Borderline fail	Borderline pass	Clear pass

The candidate must score a minimum of "borderline pass" for all formative assessment tools to achieve unconditional promotion

- In certain situations, the Program Director may recommend the promotion of candidates even if these criteria are not met.
- The scores of "borderline failure" should not belong to the same area of assessment (e.g., both borderline failures should not belong to both skills) if the candidate has scored "borderline failure" in one or two components at maximum.
- The candidate must pass all other components, with a minimum score of clear pass in at least two components.

2. Summative Assessment

3.1 General Principles

Summative assessment primarily aims to make informed decisions regarding the competency levels of the trainees. In contrast to formative assessment, *summative assessment* does not aim to provide constructive feedback. Please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org) for further details. The trainees are granted "Certification of Training Completion" upon successful completion of all training rotations. Only trainees with this certification are eligible to appear for the final examination.

3.2. Final In-training Evaluation Report

The supervising committee approves the completion of clinical requirements by evaluating the logbook maintained by the trainees. In addition, the Program Directors also prepare final in-training evaluation report (FITER) for each fellowship trainee at the

end of their final year of training. The Certificate of Training Program Completion is awarded based on this report. Only trainees with this certification are eligible to appear for the final cardiac EP examination.

3.3 Certification of Training Completion

Each trainee must obtain "*Certification of Training Completion"* to be eligible to appear for the final cardiac EP specialty examination. According to the General Bylaws of Training in Postgraduate Programs and executive policy (please refer to www.scfhs.org), trainees will be granted "Certification of Training Completion" once the following criteria are fulfilled:

a. Successful completion of all training rotations.
b. Completion of training requirements (e.g., logbook, research, and others), as outlined in FITER, approved by the Scientific Council/committee of the specialty.
c. Clearance from the SCFHS training affairs to ensure compliance with tuition payments and completion of mandatory universal topics.

The "Certification of Training Completion" is issued and approved by the supervisory committee or its equivalent in accordance with the SCFHS policies.

3.4 Final Specialty Examinations

The final cardiac EP specialty examination is organized by the SCFHS at the end of the second year. No final specialty examination is conducted at the end of the optional third year. The summative assessment component that grants trainees certification in the specialty comprises two elements:

a) Final written exam: trainees must obtain "Certification of Training Completion" to be eligible to appear for this examination.
b) Final clinical/practical exam: trainees must clear the final written examination to be eligible to appear for the final clinical/practical examination.

FELLOWSHIP TRAINING PROGRAM (AGREEMENTS)

CARDIAC ELECTROPHYSIOLOGY

Final Fellowship (Agreement) Examination 2022

Examination format:

The final fellowship (agreement) written examination comprises one paper with 80–120 multiple-choice questions with four options. The candidates are instructed to select the single best answer. Ten unscored items may be added for pre-testing purposes. The final clinical examination comprises four graded stations, with each encounter spanning 15 minutes. The four stations comprise two structured oral examination (SOE) stations and two objective structured clinical examinations (OSCE), with a total of 4–5 examiners. All stations assess integrated clinical encounters. The SOE stations were designed with preset questions and ideal answers.

Passing score:

The passing score is 70%. However, the passing score is to be lowered by one mark at a time such that a passing rate of 70% or a passing rate of 65%, whichever comes first, is achieved if the percentage of candidates passing the examination before final approval is <70%. The passing score cannot be reduced below 65% under any circumstances.

Blueprint Outlines:

No.	Sections	Percentage (%)
1	Ventricular tachycardia	15%
2	Supraventricular tachycardia	18%
3	Ablation techniques	5%
4	Diagnostic techniques	5%
5	Three-dimensional techniques	5%
6	Pacemakers	15%
7	ICD/CRTs	15%
8	Other mechanisms of tachycardia/bradycardia	7%
9	Mechanisms	5%
10	Bradycardia and syncope	10%
Total		100%

Note:

The blueprint distribution of the examination may differ by up to ±5% in each category.

Suggested references:

Heart Rhythm Society Board Review

Note:

This list is to be used as a study aid. The SCFHS does not intend the list to endorse these specific references nor are the questions necessarily taken solely from these sources.

Sample examination questions are attached in Appendix F

Final Cardiac Electrophysiology Clinical Exam Blueprint*Format

A. The final cardiac electrophysiology clinical examination comprises four graded stations, each with (15) minutes encounter.

B. The four stations comprises two structured oral examination (SOE) stations and two objective structured clinical examination (OSCE) stations, with a total of 4–5 examiners.

C. All stations assess integrated clinical encounters.

D. The SOE stations are designed with preset questions and ideal answers.

Final Clinical Exam Blueprint*

		DIMENSIONS OF CARE				
		Health Promotion & Illness Prevention	Acute	Chronic	Psychosocial Aspects	# Stations
DOMAINS OF INTEGRATED CLINICAL ENCOUNTER	Patient Care		1	1		2
	Patient Safety & Procedural Skills		1			1
	Communication & Interpersonal Skills		1			1
	Professional Behaviors					
	Total Stations		2	2		4

Please refer to the General Bylaws of Training in Postgraduate Programs and General Assessment Bylaws (available online: www.scfhs.org) for further details on the final examination.

Learning Domain	Summative Assessment Tools	Passing Score
Knowledge	- Final written examination	At least borderline pass (60–69.4% score) in each tool according to the standard setting method used by the executive administration of assessment
Skills	- Objective structured clinical examination (OSCE) - Structured oral examination (SOE)	At least borderline pass (60–69.4% score) in each tool according to the standard setting method used by the executive administration of assessment
Attitude	FITER: In-training evaluation report	Successfully pass FITER

XI. PROGRAM AND COURSE EVALUATION

The implementation of the cardiac EP curriculum is evaluated using various measures by the SCHFS. The training outcomes of this program follow the quality assurance framework endorsed by the Central Training Committee of the SCFHS. The results of formative and summative assessments are analyzed and mapped to the curriculum content. Other indicators incorporated include:

- Report of the annual trainees' satisfaction survey.
- Reports from trainee evaluation of faculty members.
- Reports from trainee evaluation of rotations.

Goal-based evaluation: The achievement of the intended milestones is evaluated at the end of each stage to assess the progress of curriculum delivery. Any deficiencies noted are to be addressed in the following stage, utilizing the time devoted to trainee-selected topics and professional sessions.

XII. POLICIES AND PROCEDURES

This cardiac EP curriculum represents the means and materials, and outlines the learning objectives with which trainees and trainers will interact to achieve the required educational outcomes. The SCFHS regulates all training-related processes using a full set of "General Bylaws of Training in Postgraduate Programs" and "Executive Policies" (published on the official SCFHS website). For instance, the general bylaws of training, assessment, and accreditation, as well as executive policies on admission, registration, formative assessment and promotion, examination, trainee representation and support, duty hours, and leaves, are examples of regulations that must be implemented. This curriculum requires trainees, trainers, and supervisors to comply with the most updated bylaws and policies, which can be accessed online (via the official SCFHS website).

XIII. Appendices

A. Competency-matrix

B. Universal topic modules

C. Top conditions and procedures in the specialty

D. Sample academic half-day tables

E. Example of research rotation objective

F. Sample examination questions and answers

G. References

Appendix A

Competency-Matrix: to map competency, learning domain, and milestones

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
F1	Professional Expert	Mastering history-taking and physical examination K, S	High-risk delivery, initial steps, and CCU care K, S, A	Clinical and laboratory evaluation, hydration, NPO, and risk assessment K, S	Assessment and management of acute cardiac arrhythmia K, S	Evaluation and management of unstable patients K, S	Relevant documentation of daily patient care, prescriptions, and discharge summaries K, S, A
	Communicator	Effective communication with the patient and guardians K, S, A	Effective communication with the parents and team members K, S, A	Informed consent K, S	Effective communication with the patient, guardians, and team members K, S, A	Effective communication with the patient, guardians, and team members K, S, A	Writing, dictation, and presentation skills K, S

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
	Collaborator		Multidisciplinary team work S, A	Multidisciplinary team work S, A	Seek support from senior physicians when required K, S, A	Seek support from senior physicians when required K, S, A	Interprofessional communication A
	Advocate	Holistic approach and preventive medicine K, S, A		Patient safety K, S, A	Patient safety K, S, A	Patient safety K, S, A	Quality improvement K, S, A
	Leader	Time management S	Leading the team S, A		Lead the situation in the best interest of the patient S, A	Lead the situation in the best interest of the patient S, A	Quality assurance K, S, A

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
	Scholar			Evidence-based practice K, S	Evidence-based practice K, S	Evidence-based practice K, S	
	Professional		Confidentiality and interprofessional relation A			Interprofessional relation A	Interprofessional relation A
F2	*Competency-Roles* (with annotation of learning domains involved: K: knowledge, S: Skills, A: Attitude)	Professional Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
	Professional Expert	Mastering history-taking and physical examination K, S	High-risk delivery, initial steps, and CCU care K, S, A	Clinical and laboratory evaluation, hydration, NPO, and risk assessment K, S	Assessment and management of acute cardiac arrhythmia K, S	Evaluation and management of unstable patients K, S	Relevant documentation of daily patient care, prescriptions, and discharge summaries K, S, A
	Communicator	Effective communication with the patient and guardians K, S, A	Effective communication with the parents and team members K, S, A	Informed consent K, S	Effective communication with the patient, guardians, and team member K, S, A	Effective communication with the patient, guardians, and team member K, S, A	Writing, dictation, and presentation skills K, S

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
	Collaborator		Multidisciplinary team work S, A	Multidisciplinary team work S, A	Seek support from senior physicians when required K, S, A	Seek support from senior physicians when required K, S, A	Interprofessional communication A
	Advocate	Holistic approach and preventive medicine K, S, A		Patient safety K, S, A	Patient safety K, S, A	Patient safety K, S, A	Quality improvement K, S, A
	Leader	Time management S	Leading the team S, A		Lead the situation in the best interest of the patient S, A	Lead the situation in the best interest of the patient S, A	Quality assurance K, S, A

Training Year level	*Competency-Roles* (with annotation of the learning domains involved: K: knowledge, S: Skills, A: Attitude)	Activities Related to the Specialty					
		Conducting complete clinical assessment	Management of high-risk patients in CCU	Management of patients undergoing procedures	Management of patients with cardiac arrhythmias	Management of unstable cardiac rhythm disorders	Compliance with documentation and proper reporting standards
	Scholar			Evidence-based practice K, S	Evidence-based practice K, S	Evidence-based practice K, S	
	Professional		Confidentiality and interprofessional relation A			Interprofessional relation A	Interprofessional relation A

Appendix-B

Universal Topics

Intent:

These are high value interdisciplinary topics of utmost importance to trainees. These topics are delivered centrally to ensure that each trainee receives high-quality teaching and gains essential core knowledge. These topics are common across all specialties.

The topics included must meet ≥1 of the following criteria:

- Impactful: topics that are common or life-threatening
- Interdisciplinary: topics that are difficult to teach within a single discipline
- Orphan: topics that are poorly represented in the undergraduate curriculum
- Practical: topics that trainees will encounter in-hospital practice

Development and Delivery:

Core topics for the cardiac EP curriculum are developed and delivered centrally by the commission through an e-learning platform. A set of preliminary learning outcomes are developed for each topic, and these outcomes are modified by content experts in collaboration with the central team.

The topics are didactic in nature, with a focus on the practical aspects of care. These topics are more content-intensive when compared with workshops or other planned face-to-face interactive sessions. The suggested duration for each topic is 1.5 hours.

Assessment:

Topics are to be delivered in a modular format. An online formative assessment is conducted at the end of each Learning Unit. A combined summative assessment is conducted in the form of a context-rich MCQ after the completion of all topics. All trainees must achieve a minimum competency in the summative assessment. These topics can also be assessed in a summative manner, along with a specialty examination (e.g., case studies, high-quality images, worked examples of prescribing drugs in disease states, and internet resources).

Module 3: Diabetes and Metabolic Disorders/4-Abnormal ECG:

The trainees must be capable of the following at the end of the Learning Unit:

a) Recognize common and important ECG abnormalities

b) Commence immediate management procedures, if necessary

Module 7: Ethics and Healthcare

1. Ethical issues: treatment refusal and patient autonomy
2. Role of doctors in death and dying

Ethical Issues: Treatment Refusal and Patient Autonomy:

The trainees must be capable of the following at the end of the Learning Unit:

a) Identify situations wherein the patient or family is likely to decline prescribed treatment

b) Describe the concept of 'rational adult' in the context of patient autonomy and treatment refusal

c) Analyze key ethical, moral, and regulatory dilemmas influencing treatment refusal

d) Recognize the importance of patient autonomy in the decision-making process

e) Counsel patients and families declining medical treatment regarding the best interest of the patient

Role of Doctors in Death and Dying:

The trainees must be capable of the following at the end of the Learning Unit:

a) Recognize the importance of the role that a doctor plays in the dying process

b) Provide emotional and physical care to the dying patient and family

c) Provide appropriate pain management to the dying patient

d) Identify and refer patients eligible to receive palliative care services

Appendix-C

Top Conditions and procedures in the Specialty

Top Conditions And Procedures In The Specialty			
Top Ten Causes of Mortality in Saudi Arabia*			
	Top Ten Causes of Outpatient Consultations Related to this Specialty in Saudi Arabia		
	Disease/Conditions	Relative	Cumulative
		Frequency	Frequency
1.	Palpitation		
2.	Syncope		
3.	Abnormal ECG		
	Top Ten Causes of In-patient Admissions Related to this Specialty in Saudi Arabia		
	Disease/Conditions	Relative	Cumulative
		Frequency	Frequency
1.	Bradycardia		
2.	Tachycardia		
3.	Syncope		
Top Ten Procedures/Surgeries Performed by this Specialty			
	Name of the procedure/surgery	Approximate Frequency	
	Device implantation		

Electrophysiology study and ablation	
Elective cardioversion	
Examples of Core Specialty Topics: Case Discussions and Interactive Lectures	
Topics	**Comments**
Approach toward a patient with wide complex tachycardia	
Approach toward a patient with syncope	
Examples of Core Specialty Topics: Workshops/Simulation	
Topics	**Comments**
Supraventricular tachycardia (electrophysiology study)	
Device interrogation	

	1	1	2

Appendix-D

Teaching

The following table presents sample topics that illustrate the half-day activities spanning over the course of one year (or a cycle of teaching if more than one year is required to cover all topics).

Repetition of sessions and topics in each training year is discouraged. Each half-day is dedicated to one theme. Presenters included Program Directors, EP consultants, and EP fellowship trainees.

Academic Month	*Section*	*Date*	*Time*	*Sessions*	*Presenters*
1	*Orientation and Implantation of Cardiac Devices*	*Jan*	*2–4 pm*	*Assessment system Basic implantation skills*	*Program Director*
2	*EP diagnostic procedure*	*Feb*	*2–4 pm*	*Basic interpretation of electrogram*	*EP Consultants*
3	*EP Consultation*	*Mar*	*2–4 pm*	*Journal Club*	*EP fellowship trainees*
4	*EP tracings*	*Apr*	*2–4 pm*	*Electrogram tracings*	*EP fellowship trainees*
5	*EP Device troubleshooting*	*May*	*2–4 pm*	*Case-based discussions*	*EP Consultants*
6	*EP Emergencies*	*June*	*2–4 pm*	*Electrical storm*	*EP fellowship trainees*
7	*EP Examination*	*July*	*2–4 pm*	*MCQ*	*Program Director*
8	Basic Science	Aug	*2–4 pm*	Action Potential Mechanism of tachyarrhythmia	EP Consultants
			2–4 pm	Defibrillation	EP fellowship trainees

Academic Month	*Section*	*Date*	*Time*	*Sessions*	*Presenters*
9	SVT	Sep	*2–3 pm*	Mechanisms Case-based discussions	EP Consultants
			3–4 pm	Maneuvers	EP fellowship trainees
10	VT	Oct	*2–3 pm*	Mechanisms Case-based discussions	EP Consultants
			3–4 pm	Maneuvers	EP fellowship trainees
11	EP Exam FITER report discussion	Nov	*2–3 pm*	MCQ	Program Director
			3–4	OSCE	

- Journal club activities were held in the evening or during the half-day
- ** Case-based study was conducted in the evening or during the half-day
- SVT: Supraventricular Tachycardia
- VT: Ventricular Tachycardia

Appendix E

2.2.6 RESEARCH ROTATION

Number of rotation months	First year	Second year	Total
	1	1	2

The third optional year may also include one month of research rotation

The fellowship trainees participate in research in any of the following pathways:

1) *Identify at least one project (ideally, a prospective project that includes data collection, abstract preparation, and completion of a manuscript).*
2) *Perform peer-review of articles under the supervision of attending Eps.*
3) *Participate in a retrospective study, case study, registry, (review article, observational or data collection projects, or a book chapter with one of the attending consultants).*
4) *Active participation in clinical studies being conducted in the local electrophysiology department, including ongoing clinical trials. Participation in ongoing research activities, with supervised participation in protocol development and manuscript preparation. This includes active participation in screening and follow-up of patients involved in different research protocols.*

MEDICAL EXPERT

Goals:

- To demonstrate an in-depth understanding of the basic principles of research, study design, methodology, data analysis, and clinical epidemiology, as well as the advantages and disadvantages from the perspective of radiology.
- To identify the ethical requirements of the research and demonstrate an understanding of the responsible use of informed consent.
- To utilize appropriate methods for drafting research proposals, manuscripts, data collection, and result analysis and discussion.

- To gain awareness regarding current research topics in radiology using available medical informatics systems.
- To present scientific presentations and participate in public discussions.

Training Methods

- Specify the period dedicated to research or full-time rotation in the research to be conducted.
- Attend dedicated courses or workshops that enhance research skills required by the program.
- The completion of work should be conducted in parallel to subsequent rotations as the projected is expected to span more than a month.
- The trainee must select a supervisor to help access essential resources that facilitate the appropriate utilization of research skills and periodically discuss progress.
- The trainee must get the research proposal approved by the Institutional Review Board by the end of the first six months.
- The oral abstract of the study results must be presented at a specified time point (e.g., end of the final year before entering the final exam) on Research Day of the Specialty.
- The research paper must be sent at least two weeks before the Research Day of the Specialty.
- Trainees must aim to present research results at national and/or international meetings and publish their work in indexed journals.

Evaluation

- Attendance at designated courses/lectures/workshops is monitored and incorporated into annual evaluation scores.
- Panel scoring of the research abstract presentation is conducted at the end of the pre-specified point year on Research Day of the Specialty. This score is considered as the rotation score for that month.

COMMUNICATOR

- Demonstrate skills in conveying and discussing scientific research to scientific communities through the use of posters, abstracts, teaching slides, manuscripts, or other scientific communication modalities.
- Communicate and collaborate with research supervisor in an effective manner to conduct the research.

COLLABORATOR

- Identify, consult, and collaborate with appropriate experts, research institutions, and organizational bodies to facilitate research.

LEADER

- Identify an area of research interest and research supervisors to engage in scholarship on scientific inquiry and dissemination.
- Utilize available resources and consult with an identified research mentor at regular intervals.
- Set realistic priorities and improve time management to optimize professional performance.
- Utilize health care resources in a cost-effective manner.

HEALTH ADVOCATE

- Recognize the role of scientific research in improving the health of patients and communities.

SCHOLAR

- Pose appropriate research questions, recognize and identify gaps in knowledge and expertise, formulate research questions, and develop an appropriate study design to address these gaps.
- Conduct the research as outlined in the proposal.

- Conduct data collection and analysis utilizing appropriate methods.
- Prepare abstracts and manuscripts suitable for publication in peer-reviewed journals and/or international scientific meetings.
- Identify the limitations of the research and scope for further research.

PROFESSIONAL

- Uphold ethical and professional expectations, such as the maintenance of meticulous data and conduct of ethical research, consistent with the guidelines set forth by the Institutional Review Board.
- Demonstrate personal responsibility for setting research goals and working in conjunction with the supervisors to set and achieve research timeline objectives.
- Ensure appropriate attribution of authorship and contributions during the publication of the results.
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) while conducting the research and disseminating its results.

Appendix F

SAMPLE K1 QUESTION

Which of the following phases of the action potential corresponds to the relative refractory period of the ventricular myocardium?

A) 0

B) 1

C) 2

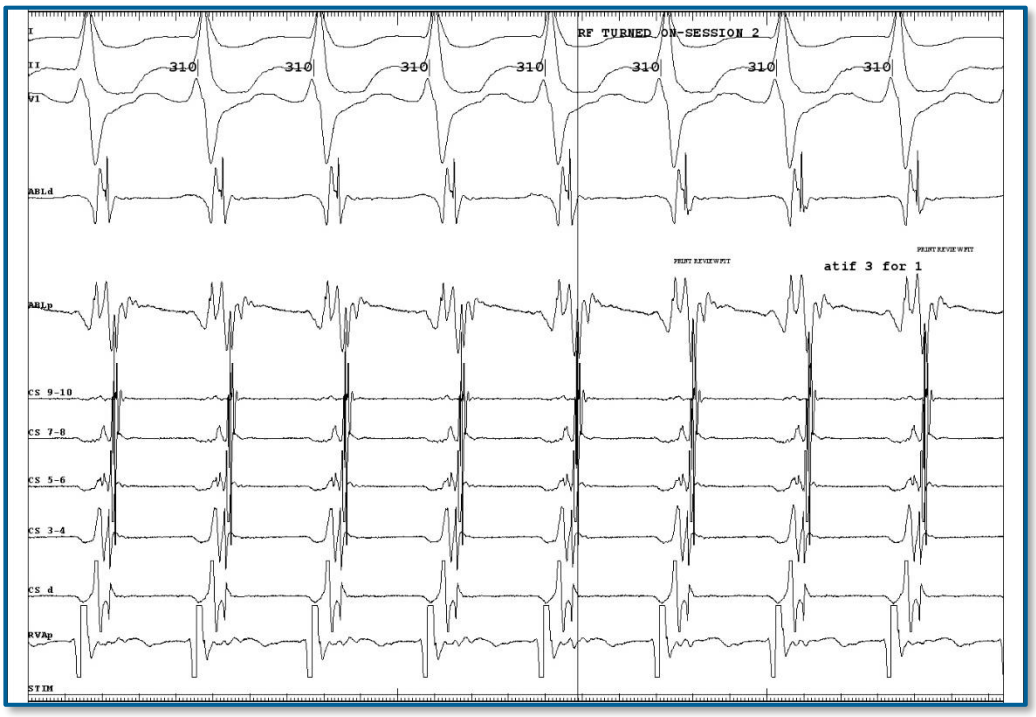
D) 3

Answer: D

Sample questions

SAMPLE K2 QUESTION

A 28-year-old man presented with palpitations. Electrophysiological study yielded the following tracing:



What is the diagnosis?

A) Antidromic AVRT

B) Ventricular tachycardia

C) Orthodromic AVRT

D) Normal finding

Answer: C

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