الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

Advanced Cardiac Imaging Fellowship

2022


بسم الله الرحمن الرحيم

PREFACE

- The primary goal of this document is to enrich the training experience of postgraduate trainees by outlining the learning objectives to become independent and competent future practitioners.
- This curriculum may contain sections outlining some regulations of training; however, such regulations need to be sought from the “General Bylaws” and “Executive Policies” of training, published by the Saudi Commission for Health Specialties (SCFHS), which can be accessed online through the official SCFHS website. In the occasion of discrepancy in regulation statements, the one stated in the recently updated bylaws and executive policies will be the reference to apply.
- As this curriculum is subjected to periodic refinements, please refer to the electronic version posted online for the most updated edition at www.scfhs.org.sa.

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II. COPYRIGHT STATEMENTS

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III. FOREWORD

The Advanced Cardiac Imaging Fellowship curriculum development team acknowledges the valuable contributions and feedback from the scientific committee members in the development of this program. We extend special appreciation and gratitude to all the members who have been pivotal in the completion of this booklet, especially the Curriculum Group, the Curriculum Specialists, and the Scientific Council. We would also like to acknowledge that the CanMEDS framework is a copyright of the Royal College of Physicians and Surgeons of Canada, and several of the descriptions' competencies have been acquired from their resources.

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V. INTRODUCTION

1. Context of Practice

The Saudi Commission for Health Specialties (SCFHS) has recently adopted Canadian Medical Education Directions for Specialists (CanMEDS) as a standard framework for training with respect to all medical specialties. CanMEDS has the advantage of providing trainees with the necessary skills to become highly professional in their respective fields of expertise. The CanMEDS competency framework provides a good balance between medical knowledge, clinical skills, scholarly activities, communication skills, interpersonal and interprofessional collaborations, managerial skills, and patient advocacy skills, and aims to produce a generation of holistic medical professionals. The mandate for creating this “Advanced Cardiac Imaging Fellowship” training program curriculum comes in line with the continuous efforts of the SCFHS to establish high quality and well-structured national training programs.

Ischemic heart disease is one of the top ten causes of death in Saudi Arabia. Cardiovascular disease accounts for more than 45% of all deaths in Saudi Arabia (4). The need for imaging training programs has arisen due to advances in multiple cardiovascular imaging modalities, specifically computed tomography (CT), magnetic resonance imaging (MRI), and nuclear cardiology (NC). The implementation of this curriculum is expected to provide trainees with the appropriate exposure to all advanced cardiac imaging

modalities (cardiac MR [CMR], cardiac CT [CCT], and NC) covering the theoretical knowledge of physics, clinical application, and psychomotor skills to perform hands-on examinations independently, which would guarantee that they have the highest level of professional competencies. The Advanced Cardiac Imaging Fellowship (ACIF) offers access to state-of-the-art CT, MRI, and NC of the heart.

The high-resolution CMR techniques provide a comprehensive visualization of heart motion without radiation and without obstruction caused by chest structures that may hinder echocardiography. Recently, CMR was considered as class 1 in the assessment of the left ventricle and right ventricle size, volume, and function as a guideline for early valvular intervention. CMR has the propensity to determine the viability of myocardium, evaluate coronary perfusion and contractile reserve, and approximate the extent of ischemia and scar burden. The rapid evolution of CMR techniques for the evaluation of coronary anatomy and myocardial metabolism is highly promising (1). Tissue characterization of the myocardium is a unique feature of CMR, which aids in the identification of underlying cardiomyopathy more effectively than other imaging tools and delineates any obscure findings demonstrated during echocardiography, such as intracardiac masses (2).

The multi-detector CT has the ability to non-invasively evaluate the coronary arteries and provide diagnoses comparable to invasive coronary angiography; therefore, CCT can be substituted for cardiac catheterization in suitable patients with an intermediate risk of coronary artery disease, according to the American Heart Association
(2). In view of the high-resolution imagery, CCT has become an important tool for the evaluation of structural heart disease; pre-

procedural planning, such as trans-catheter aortic valve replacement (TAVR) and mitral/tricuspid valve clipping; the determination of the size requirements for inter-atrial septum devices; and the assessment of post-procedural outcomes.

NC is cardiac imaging with radiotracers, and gamma cameras have important diagnostic and prognostic value in evaluating cardiac patients. Stress myocardial perfusion imaging noninvasively evaluates coronary artery disease as an alternative to the invasive fractional flow reserve and provides a significant diagnostic value; gated blood pool imaging permits the bi-ventricular functional evaluation, and imaging of infarct-avid radiotracers permits the assessment of myocardial necrosis and viability. The guidelines for specific training in cardiac positron emission tomography (PET) have been developed by the American College of Cardiology and the American Society of Nuclear Cardiology. Training in PET may be concurrent with training in conventional NC and may include aspects unique to PET (2). The overall sensitivity, specificity, and diagnostic accuracy of rubidium-82 myocardial perfusion PET-CT are comparable to those of CT coronary angiography, and higher than those reported with either stress SPECT or stress echocardiography, particularly in patients with single vessel disease, women, and obese patients (3). Cardiac PET/CT metabolic studies that use 18F-fluorodeoxyglucose (FDG) to evaluate the glucose uptake in the heart are used to determine whether an area of the heart muscle is living (viable) or is inflamed in conditions such as sarcoidosis (2).

The current technologies of CMR, CCT, and PET/CT provide community clinicians with a faster diagnostic approach and guidance for the optimization of therapy.

There are several tertiary referral cardiac centers throughout the Kingdom of Saudi Arabia (KSA) that provide specialized and advanced

cardiac care, in addition to structural heart procedures and complex cardiac surgeries that cannot be performed without the support of advanced cardiac imaging modules. It is necessary to establish a national Saudi ACIF program under the auspices of the SCFHS, which seeks to accredit certified specialized cardiologists that meet current and future needs as a part of the Saudi 2030 vision.

The aim of this curriculum is to standardize the structure, requirements, syllabus, and assessment format of the ACIF training program in Saudi Arabia, which aims to ensure high-quality and consistent training outcomes among all the local training centers.

2. 2. Goals and Responsibilities of Curriculum Implementation

This curriculum ultimately seeks to guide trainees to become *competent* in their respective specialties. Accordingly, this goal requires a significant amount of effort and coordination from all stakeholders involved in the postgraduate training. As *"adult-learners,"* the trainees must be proactive and fully engaged, and should exhibit the following: a careful understanding of the learning objectives, self-directed learning, aptitude for problem solving, an eagerness to apply learning by means of reflective practice from feedback and formative assessment, and self-awareness and willingness to ask for support when needed. The program director plays an essential part in ensuring the ideal functioning of this curriculum. Moreover, the training committee members, particularly the program administrator and chief resident, have a significant impact on program implementation. The trainees should be called on to share responsibility in curriculum implementation. The SCFHS applies the best models of training governance to achieve the highest quality of training. Additionally, academic affairs in training centers

and the regional supervisory training committee play major roles in training supervision and implementation. The Specialty Scientific Committee will guarantee that the content of this curriculum is constantly updated to match the highest standards in postgraduate education of the specialty of each trainee.

General Learning Outcomes of the Program:

1- To train Board Certified or eligible cardiologist in all technical and clinical aspects of advanced cardiac imaging modules (CT, MRI, and NC).
2- To gain in-depth knowledge of the applications, basics, and physics of CT, MRI, and NC.
3- To understand the principles, new technologies, and future of advanced cardiac imaging.
4- To utilize published research and guidelines with participate in research activity.
5- The ability to perform hands-on examination: CMR/CCT/NC.
6- The ability to detect extra-cardiac pathology for optimal patient care and safety.
7- Work effectively as consultants consolidate the roles of the SCFHS, and achieved the optimal ethical and clinical care of patients as a leader in the field of advanced cardiac imaging.

VI. ABBREVIATIONS USED IN THIS DOCUMENT

Abbreviation	Description
SCFHS	Saudi Commission for Health Specialties
F(1)	(First) year of Fellowship
F(2)	(Second) year of Fellowship
CDC	Curriculum Development Committee
ACIF	Advanced Cardiac Imaging Fellowship
CT	Computed tomography
CCT	Cardiac Computed Tomography
MRI	Magnetic Resonance Imaging
CMR	Cardiovascular Magnetic Resonance Imaging
NC	Nuclear Cardiology
PET	Positron Emission Tomography
CPD	Continuous professional Development
TBL	Team –Based Learning
PT	Progress Test

Abbreviation	Description
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
RTC	Residency Training Committee
SCCT	Society of Cardiovascular Computed Tomography
SCMR	Society of Cardiovascular Magnetic Resonance
ASNC	American Society of Nuclear Cardiology
BLS	Basic Life Support
ER	Emergency Room
ACLS	Advanced Cardiovascular Life Support

VII. PROGRAM ENTRY REQUIREMENTS

Requirements for Program Entry

1. Graduate of the Saudi Board of Adult Cardiology or equivalent degree with background in internal medicine training, according to the SCFHS standard for adult cardiology qualification.
2. Provide written permission from their sponsoring institution, to allow the candidate to participate in full time training for the whole program period.
3. Pass the interview successfully.
4. Provide three letters of recommendation from consultants with whom the candidate has recently worked with.
5. Registration as a Trainee at the Saudi Council for Health Specialties.

VIII. LEARNING AND COMPETENCIES

1. Introduction to the Learning Outcomes and Competency-Based Education

The training should be guided by well-defined “learning objectives” that are driven by targeted “learning outcomes” of a particular program to serve specific specialty needs. The learning outcomes are supposed to reflect the professional “competencies” and tasks that are aimed to be “entrusted” to the trainees upon graduation. This will ensure that the graduates meet the expected demands of the healthcare system and patient care in relation to their particular specialty. Competency-based education (CBE) is an approach of “adult-learning” that is based on achieving pre-defined, fine-grained, and well-paced learning objectives that are driven from complex professional competencies.

The professional competencies related to healthcare are usually complex and are a composite of various learning domains (knowledge, skills, and attitude). CBE is expected to change the traditional way of postgraduate education. For instance, the time of training, though a precious resource, should not be considered as a proxy for *competence* (e.g., time of rotation in certain hospital areas is not the primary marker of competence achievement). Furthermore, CBE emphasizes the critical role of informed judgment of learners’ competency progress, which is based on a staged and formative

assessment that is driven by multiple workplace-based observations. Several CBE models have been developed for postgraduate education in healthcare (e.g., CanMEDS by the Royal College of Physicians and Surgeons of Canada (RCPSC), the CBME-Competency model by the Accreditation Council for Graduate Medical Education (ACGME), Tomorrow's Doctor in the UK, and several others). The following concepts enhance CBE implementation in this curriculum:

- Competency: Competency is a cognitive construct that assesses the potential to perform efficiently in a given situation based on the standard of the profession. Professional roles (e.g., experts, advocates, communicators, leaders, scholars, collaborators, and professionals) are used to describe the competencies of a given role, making it amenable for learning and assessment.
- Milestones: Milestones are the stages of the developmental journey throughout the competency continuum. Throughout their learning journey, trainees from junior through senior levels will be assisted in their transformation from being (novice/supervised) to (master/unsupervised) practitioners. This should not undermine the role of supervisory/regulatory bodies in the malpractice of independent practitioners. The milestones are expected to enhance the learning process by pacing training/assessment to match the developmental level of trainees (junior vs. senior).
- Learning Domains: Whenever possible, efforts should be directed to annotate the learning outcomes with the corresponding domain (K=Knowledge, S=Skills, and A=Attitude). You might have more than one annotation for a given learning outcome.
- Content-area Categorization: It is advisable to categorize the learning outcomes in broad content areas related to the practice

of the profession, such as diagnostic versus therapeutic, simple versus complex, and urgent versus chronic.

- Trainees are expected to progress from the novice to the mastery level in a certain set of professional competencies. The SCFHS endorsed CanMEDS to articulate their professional competencies.

This curriculum applies the principles of competency-based medical education. The “CanMEDS 2015 framework” has been adopted in this curriculum; it represents a globally accepted framework outlining competency roles that identifies and describes the abilities physicians require to effectively meet the health care needs of the people they serve. These abilities are thematically grouped into seven roles. A competent physician seamlessly integrates the competencies of all seven CanMEDS roles.

Upon completion of the Advanced Cardiac Imaging (CMR/CCT/NC) training, the Fellow will function effectively as a:

1- Medical expert:

Definition:

As medical experts, the highly specialized cardiologist in advanced cardiac imaging integrates all of the CanMEDS roles, applying medical knowledge, clinical skills, and professional values in their standard of high-quality and safe patient-centered care. A medical expert is the central physician role in the CanMEDS framework and defines the clinical scope of practice of the clinician.

Key and Enabling Competencies	F1	F2
1. Perform consultations relevant to the advanced cardiac imaging applications, which may include the presentation of well-documented assessments and recommendations in the written and/or verbal form, in response to a request from another health care professional.		X
2. Demonstrate the ability to prioritize their professional duties when faced with multiple patients and problems during routine, daily workflow.		X
3. Identify and explore the issues related to advanced cardiac imaging to be effectively addressed during a patient encounter, including the patient's demands and preferences.	X	
4. Obtain a detailed history that is relevant for the purposes of diagnosis, management, health promotion, and disease prevention.	X	X
5. Perform a focused physical examination that is relevant to the cardiac imaging study: e.g., patients with congestive heart failure who cannot tolerate the procedure of CMR, patients with Atrial Fibrillation before CCT, and patients with acute coronary syndrome and active bronchial asthma prior to NC study.	X	X
6. Choose the appropriate advanced cardiac imaging diagnostic modality methods in a resource-effective and ethical manner.		X
7. Address patient problems through problem-solving, including the interpretation of available data and integrating information to generate differential diagnoses and management plans.	X	X
8. Ensure that appropriate informed consent is obtained in the advanced cardiac imaging lab as per standard policies and procedures.	X	
9. Demonstrate the effective, appropriate, and timely interpretation and application of the results of the following diagnostic and therapeutic procedures: CMR, CCT, NC imaging (rest and stress perfusion imaging and radionuclide angiography), and PET.	X	X

Key and Enabling Competencies	F1	F2
10. Demonstrate an awareness of their own limitations with regard to their expertise in other fields of medicine.	X	X
11. Demonstrate the ability to conduct effective, appropriate, and timely consultations with other health professionals, as needed, to provide optimal medical care.		X
12. Arrange appropriate follow-up advanced cardiac imaging studies for patients, as needed.		X

2- Communicator:

Definition:

As communicators, the advanced cardiac imaging cardiologists effectively facilitate the doctor-patient inter professional relationship and the dynamic exchanges that occur before, during, and after the medical encounter.

Key and Enabling Competencies:	F1	F2
1. Recognize that being a good communicator is an essential clinical skill for physicians, and that effective physician-patient communication can foster patient satisfaction, physician satisfaction, adherence to treatment practices, and improved clinical outcomes	X	X
2. Respect patient confidentiality, privacy, and autonomy.	X	X
3. Effectively facilitate structured clinical encounters.	X	X
4. Relay information to patients and their families, colleagues, and other professionals in a humane manner and in such a way that it is understandable and encourages discussion and participation in decision-making.	X	X
5. Respect diversity and differences, including the impact of gender and cultural beliefs, on decision-making and the ability to comply with a therapeutic program.	X	X

Key and Enabling Competencies:	F1	F2
6. Encourage discussion, questions, and interaction during encounters with patients.	X	X
7. Engage patients, families, and relevant health professionals in shared decision-making to develop a plan of care.		X
8. Address challenging communication issues effectively, including obtaining informed consent; delivering bad news; and addressing anger, confusion, and misunderstandings.	X	X
9. Maintain clear, accurate, and appropriate records (e.g., written or electronic) of clinical encounters and plans.	X	X
10. Present verbal reports of clinical encounters and plans.	X	X
11. Convey medical information appropriately to ensure the safe transfer of care.	X	X
12. Obtain and synthesize relevant information from other sources, such as the patient's family, caregivers, and other professionals, while respecting the privacy and confidentiality of the individual.	X	X

3- Collaborator:

Definition:

As collaborators, the advanced cardiac imaging cardiologists effectively work within a health care team to achieve optimal patient care.

Key and Enabling Competencies	F1	F2
1. Describe the roles and responsibilities of other professionals within the health care team	X	X
2. Recognize and respect the diversity of roles, responsibilities, and competences of other professionals in relation to their own	X	X
3. Work with others to assess, plan, provide, and integrate care for individual patients/or groups of patients	X	X

Key and Enabling Competencies	F1	F2
4. Work with others to assess, plan, provide, and review other tasks, such as a research problem, educational work, program reviews, and/or administrative responsibilities	X	X
5. Participate in inter-professional team meetings	X	X
6. Enter into interdependent relationships with other professions for providing quality care		X
7. Respect team ethics, including confidentiality, resource allocation, and professionalism	X	X
8. Demonstrate leadership within a healthcare team		X
9. Work with other professionals to prevent conflicts	X	X
10. Employ collaborative negotiations to resolve conflicts	X	X
11. Respect differences and address other professionals' misunderstandings and limitations.	X	X
12. Reflect on the functions of an inter professional team	X	X

4- Leader:

Definition:

As leaders, the advanced cardiac imaging cardiologists are integral participants in healthcare organizations and in organizing sustainable practices, making decisions about allocating resources, and contributing to the effectiveness of the health care system.

Key Enabling Competencies	F1	F2
1. Work collaboratively with others within their organization	X	X
2. Participate in systemic quality process evaluations and improvements, such as radiation safety for patients and staff, and maintain high levels of key performance indicators (KPIs)		X
3. Describe the role of advanced cardiac imaging in the structure and function of the health care system.		X

Key Enabling Competencies	F1	F2
4. Set priorities and manage time to balance patient care, practice requirements, outside activities, and personal life	X	X
5. Implement processes to ensure personal practice improvement	X	X
6. Employ information technology appropriately for patient care	X	X
7. Demonstrate an understanding of the importance of just allocation of health care resources, balancing effectiveness, efficiency, and access to optimal medical care	X	X
8. Chair or participate effectively in committees and meetings		X
9. Plan relevant elements of health care delivery (e.g., educate family health providers on the role of advance cardiac imaging in the early detection of coronary artery disease)		X

5- Health advocate:

Definition:

As health advocates, advanced cardiac imaging cardiologists use their expertise and influence to advance the health and well-being of individual patients, communities, and populations.

Key and Enabling Competencies	F1	F2
1. Identify the health needs of an individual patient	X	X
2. Identify opportunities for advocacy, health promotion, and disease prevention in individuals to whom they provide care		X
3. Describe the communities that their practice serves	X	X
4. Identify opportunities for advocacy, health promotion, and disease prevention in communities that are at risk for cardiovascular disease and its complications		X
5. Apply knowledge of advance cardiac imaging for primary and secondary prevention of cardiovascular disease	X	X

Key and Enabling Competencies	F1	F2
6. Appreciate the possibility of competing interests between the communities they serve and other populations		X
7. Identify the biological, psychosocial, environmental, and economical determinants of health in the population they serve, including barriers to access of care and resources		X
8. Utilize this information in a management and prevention plan, and ensure access to appropriate health and social services when managing the health of individual patients	X	X
9. Identify vulnerable and/or marginalized populations within those served and respond appropriately	X	X
10. Describe an approach to implement a change in a determinant of health of the populations they serve		X
11. Describe how public policy impacts the cardiovascular health of the populations served by advanced cardiac imaging		X
12. Identify points of influence in the health care system	X	X
13. Describe the ethical and professional issues inherent in health advocacy, including altruism, social justice, autonomy, integrity, and idealism	X	X
14. Demonstrate an appreciation of the possibility of conflict inherent in their roles as a health advocate for a patient or community and a manager or gatekeeper		X

6- Scholar:

Definition:

As scholars, the advanced cardiac imaging cardiologists demonstrate a lifelong commitment to reflective learning, as well as to the creation, dissemination, application, and translation of medical knowledge.

Key Enabling Competencies	F1	F2
1. Recognize the principles for maintaining competency	X	X
2. Describe the planning required to implement personal knowledge and management strategies	X	
3. Recognize the learning issues related to advanced cardiac imaging	X	X
4. Access, interpret, and integrate the relevant evidence into practice	X	X
5. Critically appraise retrieved evidence to address a clinical question	X	X
6. Integrate conclusions of critical appraisals into clinical care	X	X
7. Recognize the principles of medical education and learning	X	X
8. Select effective teaching strategies and content that can facilitate learning	X	X
9. Conduct lectures or presentations related to advanced cardiac imaging	X	X
10. Identify the principles of ethics	X	X
11. Identify the principles of research and scholarly inquiry	X	X
12. Recognize the policy pertaining to ethical research	X	X
13. Demonstrate a scholarly question	X	X
14. Distribute the findings of a study by presentation or publication	X	X

7- Professional:

Definition:

As professionals, the advanced cardiac imaging cardiologists are committed to the health and well-being of individuals and society through ethical practice, profession-led regulation, and high personal standards of behavior.

Key Enabling Competencies	F1	F2
1. Provide health care services with honesty, integrity, commitment, compassion, respect, and altruism	X	X
2. Maintain professional interpersonal relationships with patients, co-workers, and students	X	X
3. Demonstrate commitment to the highest quality of care and professional competencies		X
4. Respond appropriately to the ethical issues encountered in practice related to advance cardiac imaging	X	X
5. Recognize and manage the potential and actual conflicts of interest	X	X
6. Understand the principles and limits of patient confidentiality based on professional practice and the law	X	X
7. Maintain professional relations with patients	X	
8. Show commitment to professional, legal, and ethical codes of practice	X	X
9. Execute the legal obligations required of current practice	X	X
10. Demonstrate accountability to professional regulatory bodies	X	X
11. Participate in peer review		X
12. Assess professional and private priorities to ensure personal health and maintenance of quality practice	X	X
13. Recognize other professionals in need and respond appropriately	X	X

2. Program Duration

The total training period will be of 2 years.

3. Program Rotations

- The trainee will rotate through CMR/CCT/NC labs and all related clinical areas where the training objectives can be fulfilled. Owing

to the overlapping nature of inpatient, outpatient, and emergency room (ER) procedures, which usually run in parallel, it is impractical to dedicate a specific rotation for each service.

- The radiology rotation is an important component of the advanced cardiac imaging program. Radiology labs are the source of patients for targeted exposure to extracardiac pathology.
- The trainee will be evaluated at the end of each rotation according to the CanMEDS-based competency checklist, which also includes the expected number of hands-on procedures and study interpretations required by the trainee at the end of each rotation. To ensure adequate exposure to all the advanced cardiac modalities in a stepwise manner, the trainee is recommended to follow the proposed training rotation plan shown in the table below.
- During the program, a total of eight weeks of leave is provided, in addition to the national day and one of the official Eid Holidays.

	CMR	CCT	NC	Radiology rotation	CMR	CCT	NC	Vacation	Total
First year (F1)	10 weeks	10 weeks	11 weeks	2 weeks	4 weeks	7 weeks	4 weeks	4 weeks to be taken at any rotation	52 weeks
Second year (F2)	9 weeks	4 weeks	9 weeks	2 weeks	9 weeks	7 weeks	8 weeks	4 weeks to be taken at any rotation be taken at any rotation	52 weeks

Table 2:

Rotation Sitting	Training years	Training years	Rotation's duration (weeks)	Rotation specific objectives/topics	Competency roles
Inpatient/ Outpatient/ ER	Junior	F1	CMR (10 weeks)	- Basic CMR: Understand the safety, physics, principles, and indications - Gain knowledge of the imaging scanner machine / post processing software and associated pitfalls and limitations (5)	Medical expert Professional Communicator
Inpatient/Out patient/ER			CCT (10 weeks)	- Basic CCT: Understand the safety, physics, principles, indications, and non-indications - Gain knowledge of the imaging scanner machine / post processing software and associated pitfalls and limitations - Conduct preliminary CCT reports (7)	Medical expert Professional Communicator
Inpatient/Out patient/ER			NC (11 weeks)	- Basics of NC: Understand the principles of radiation safety, the physics of SPECT, and skills of image acquisition - Learn the technical functionality of pharmacologic stress agents and their routes of administration (8)	Medical expert Professional Communicator
Radiology-lab			Radiology rotation (2 weeks)	- Learn how to detect extracardiac pathology by comparison to normal morphology	Medical expert
Inpatient/ Outpatient/			CMR (4 weeks)	- Learn how to measure intra-cardiac structure/function	Medical expert

Rotation Sitting	Training stage	Training years	Rotation's duration (weeks)	Rotation specific objectives/ topics	Competency roles
ER				- Identify abnormalities in CMR images, pertaining to all aspects of cardiovascular disease, including adult congenital heart disease, and obtain hands-on experience in scanning (6)	
Inpatient/Outpatient/ ER			CCT (7 weeks)	- Learn how to utilize CCT in evaluating and managing patients with cardiovascular disease or adult congenital heart disease - Develop the ability to detect extra cardiac pathology (7)	Medical expert
Inpatient/ Outpatient/ ER			NC (4 weeks)	- Obtain experience in hands-on radiopharmaceutical preparation and pre-procedure evaluation of patients - Conduct studies with and without attenuation correction - Perform calibration and setup of the gamma camera and CT system in SPECT/CT studies - Interpret studies after setup of the imaging data (8)	Medical expert

Table 3:

Rotation Sitting	Training stage	Training years	Rotation's duration (weeks)	Rotation specific objectives	Competency roles
Inpatient/Outpatient/ER	Senior	F2	CMR(9 weeks)	- Understand the guidelines and indicated criteria - Work within the scope of expertise and technical skills (6)	Professional
Inpatient/Outpatient/ER			CCT(4 weeks)	- Understand the protocols and the measurement of the intra-cardiac pre-structural heart disease procedure with the ability to discuss with the interventionist - Report the adult congenital cases (7)	Medical expert Communicator
Inpatient/Outpatient/ER			NC(9 weeks)	- Skills to interpret all NC imaging findings, correlating with the catheterization or CT angiographic data and relay the critical findings to the referred physician - Follow the guidelines and usage criteria. - Demonstrate the skill of quantifying PET absolute myocardial blood flow and metabolism (8)	Medical expert Communicator Professional
Radiology-lab			Radiology rotation (2 weeks)	- Learn how to detect the extra cardiac pathology by comparison to normal morphology	Medical expert

Rotation Sitting	Training stage	Training years	Rotation's duration (weeks)	Rotation specific objectives	Competency roles
Inpatient/Outpatient/ER			CMR (9 weeks)	- Demonstrate the ability to report the CMR image of complex cardiovascular disease and the adult congenital cases independently (6)	Practice-based learning and improvement Medical expert
Inpatient/Outpatient/ER			CCT (7 weeks)	- Report the complex cardiovascular disease independently (7)	Practice-based learning and improvement Medical expert
Inpatient/Outpatient/ER			NC (8 weeks)	- Report all types of NC images related to cardiovascular disease independently and construct the hybrid SPECT/CT and PET/CT imaging (8)	Practice-based learning and improvement Medical expert

IX. CONTINUUM OF LEARNING

This includes the learning that should take place at each key stage of progression within the advanced cardiac imaging program. The trainees are reminded of lifelong continuous professional development (CPD). The trainees should keep in mind the necessity of CPD for every healthcare provider to meet the demands of their vital profession. The following table shows how this role is progressively expected to develop throughout the junior, senior, and consultant levels of practice.

Specialty General Practice	F1 (Junior Level)	F2 (Senior Level)	Consultant sub specialist
Sub- specialty Non-practicing	Dependent/supervised practice	Dependent/supervised practice	Independent practice/provide supervision
Obtain the basic health science and foundational level of core discipline knowledge	Obtain fundamental knowledge related to the core clinical problems of the specialty	Apply knowledge to provide the appropriate clinical care related to the core clinical problems of the specialty	Acquire advanced and up-to-date knowledge related to the core clinical problems of the specialty
Internship to the practice of discipline	Apply the clinical skills and practical procedures related to the core presenting problems and procedures of the specialty	Analyze and interpret the findings to develop appropriate differential diagnoses and management plans for the patient	Compare and evaluate challenging, contradictory findings and develop expanded differential diagnoses and management plans

X. TEACHING METHODS

The training programs implement the adult learning concept on each feature of the activities in which the fellows are responsible for their own learning requirements. The formal training time includes the following three formal teaching activities:

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

1.1 Program Specific learning activities:

The program-specific activities are educational activities that are specifically designed and intended for the trainees' teaching during their training time. The trainees are required to participate in these activities. Additionally, non-compliance can subject the trainees to disciplinary action.

A) Program Academic half-day:

- The half-day activity will be conducted once weekly for a duration of 3–4 hours, throughout the two years of the training program. The journal club and case-based study will be conducted during the half-day activity; all fellows of the centers included in the ACIF training program should share that activity. The performance of the fellows and their interactions will be observed by the program director of each center and considered as part of a regular evaluation.
- The academic half-day covers the core specialty topics determined and approved by the scientific committee of the

specialty aligned with specialty-defined competencies and teaching methods.

- The core specialty topics will ensure that important clinical cardiovascular diseases, with related advanced cardiac images, are well taught such as myocardial infarction; scarring; viability assessment; stress testing; vascular pathology, including aortic disease , valvular heart disease , cardiomyopathies and heart failure; coronary anatomy by CTA; calcium score; cardiac masses; and PET in infective endocarditis and vascular disease.
- Adult congenital cardiac disease should be covered such as the application of advanced cardiac imaging in congenital heart disease, shunt calculation, and image guide intervention.
- Common non-cardiac pathologies that may occur during daily work and can affect patient outcomes such as masses in lung, mediastinum, breast, liver, and kidney (the radiological topic should be presented by a radiologist at alternative week in the schedule of half-day activity).
- The physics of CT, MRI, and NC should be reviewed as a chapter review, of 30-60 minutes duration, with the physicist every other week.
- Supervisors should ensure that the discussion of each topic is stratified into three categories of the learning domain: knowledge, skill, and attitude.
- The recommended number of half-days conducted annually will be 20 sessions per training academic year, “with time reserved for other forms of teaching methods, such as journal club and clinical/practical teaching” (Appendix A shows an example).

B) Practice-based learning:

- The training exposure during daily scanning of patients in the CMR/CCT/NC labs and daily reporting of cardiac and non-cardiac pathology, as a preliminary reporter with finalization after review with the assigned consultant, should include the following:
  1. Extracardiac pathology should be described as an abnormal finding in a report, but not as a diagnostic pathology.
  2. The extracardiac pathology should be discussed with the radiologist, and this information should be relayed to the primary/referred physician.
  3. The fellow should attend the teaching at morning meetings and weekly half-day activities that doing by radiologist to build up their experience in detecting extra-cardiac pathology.
  4. The Radiology rotation will build up the experience of the fellow.
  5. The skills of the fellow in detecting extra-cardiac pathology should be monitored by the program director and should be included in the academic evaluation.
- Trainees are expected to build their capacity based on self-directed learning. Conversely, practice-based learning allows educators to supervise trainees to become competent in the required program practical skills that ensure fulfilling the knowledge, psychomotor, and/or attitude learning domains.
- Each trainee needs to maintain a logbook documenting the procedures observed, performed under supervision, and performed independently.
- Other work-related activities, including courses and workshops, represent excellent targets for learning.

C) Morning report:

The morning report is a case-based teaching session expected to be conducted two to three times per week.

The goals of the morning report are to teach the fellows the following skills:

1- Describe abnormal CMR/CCT/NC pathology and understand how imaging findings enhance clinical outcomes.

2-Review a similar case in the literature.

3-Discuss the techniques of the imaging modules and related pitfalls and how to improve the image quality.

4-Describe the non-cardiac pathology ; If there is any doute , the case should be discussed with the radiologist to facilitate a learning experience for the trainee.

5-Review the basics and physics component of each module as a chapter review with the physicist, internally or with a supervised assigned trainer.

D) Research rotation will be part of the assigned program rotation, and fellows should do the following:

- Report any rare case throughout their daily work as a challenge case and subsequently submit it to a local or international journal.
- The fellow should write a research proposal.
- Fellows should be part of the research group.
- The fellow should participate in abstract presentations at the local or international-level. conference guided by the program director.

1.1 Universal Topics

Universal topics are educational activities developed by the SCFHS and intended for all specialties. Priority is given to the following topics:

- High value topics
- Topics that are interdisciplinary and integrated
- Topics that require expertise beyond the availability of local clinical training sites.

Universal topics have been developed by SCFHS and are available, such as e-learning via personalized access for each trainee (to access the online modules via the SCFHS website).

Training Year	Modules		Topics name	
	Number	Name	Number	Name
F1	Module-1	Introduction	Topic-1 Topic –2	Safe drug prescription Hospital acquired infections
	Module-3	Diabetes and metabolic disorders	Topic-11 Topic -14	Recognition and management of diabetic emergencies Abnormal Electrocardiogram
	Module-4	Medical and surgical emergencies	Topic-15 Topic-16 Topic-17 Topic-18	Management of acute chest pain Management of acute breathlessness Management of altered sensorium Management of hypotension and hypertension

Training Year	Modules		Topics name	
	Number	Name	Number	Name
F2	Module-5	Acute care	Topic-21 Topic-23 Topic-25 Topic-26	Pre-operative assessment Acute pain management Management Of fluid in the hospitalized patient Management of Electrolyte imbalance
	Module-7	Ethics and Healthcare	Topic-31 Topic-32 Topic-33 Topic-34 Topic-35 Topic-36	Occupational hazards of health care workers (HCW) Evidence based approach to smoking cessation Patient advocacy Ethical issue: Transplantation/organ harvesting; Withdrawal of care Ethical issue: Treatment refusal; Patient autonomy Role of doctors in death and dying

1.2 General Learning Opportunities:

A formal training time should be supplemented by other practice-based learning (PBL), such as follows:

- Journal club every two weeks as an adult cardiology educational activity .
- A grand round is held in the adult cardiology department every month.
- The involvement in the quality improvement committees and meeting of adult cardiology department.
- Continuous professional activities (CPD) relevant to specialty (conferences and workshops), such as the annual Saudi Heart

Meeting, American Society of Nuclear Cardiology Meeting, Society for Cardiovascular Magnetic Resonance meeting, and Society of Cardiovascular Computed Tomography meeting.

- Morbidity and Mortality (M&M) held regularly in the adult cardiology department, where everybody is involved.

Educational activities

Teaching and learning activities linked to CanMEDS roles:

ACTIVITY	OBJECTIVES	CanMEDS COMPETENCIES
Case presentation	- Improve the skills of the presenter - To share knowledge with other colleagues - To obtain the expert opinion from senior staff - Improve the decision-making skills	Leader Medical expert, Professional Scholar
Morbidity and mortality	- Improve the patient care by identifying the area of potential improvement. - Learn how to avoid future events based on the current patient mortality. - To demonstrate professional integrity and patient advocacy	Professional Leader Medical expert
Grand rounds	- Improve the medical knowledge and skills in the field of interest - Learn the latest advances guidelines in the field of interest - Discuss the controversial topics related to the field of interest	Medical expert, Professional
Journal clubs	- Promote continuing professional development - Remain up to date with evidence-based knowledge and guidelines - Disseminate information and debate good practices	Medical expert, Scholar, Health advocate

5. LEARNING PORTFOLIO, WORKSHOPS, AND COURSES

1. Logbook

1. Fellows are expected to document all cases and procedures completed in a logbook to be presented at the end of each academic year.
2. Feedback will be given to the fellows at the end of each rotation by the program director, and instructions will be given to fulfil the deficient procedures.

Logbook for the advanced cardiac imaging Fellowship program First & Second year		
Type of cases	Number of cases first year	Number of cases second year
CMR hands-on scanning	50 scanned cases	50 scanned cases
The CMR case report is divided as follows: - Viability - Stress MRI - Cardiomyopathy - Pericarditis /constrictive pericarditis - Myocarditis - Vulvar heart disease - Adult congenital heart disease with shunt assessment - Aorta - Cardiac masses	Total = 200 cases 50 30 50 15 10 15 10 10 10	Total = 200 cases 50 30 50 15 10 15 10 10 10

CCT hands-on scanning	50 scanned cases	50 scanned cases
The CCT case report is divided as follows: - Calcium score - Coronary artery disease - Coronary anomaly - Pericardial disease - Valve assessment - Trans catheter aortic valve replacement (TAVR) - Pre-trans catheter mitral valve repair - Pre-tricuspid valve therapy assessment - Aorta - Cardiac masses	Total = 300 cases 20 100 20 15 30 50 20 20 15 10	Total = 150 cases 0 40 0 10 30 20 20 20 5 5
NC hands-on scanning including both the following: - Myocardial perfusion imaging and PET myocardial perfusion imaging	75 scanned cases	75 scanned cases
The NC cases report is divided as follows: - Interpret the gated stress-rest perfusion study - Interpret the radionuclide ventriculography study - Interpret the hybrid SPECT/CT and PET/CT imaging - Quantify the PET absolute myocardial blood flow and metabolism - Interpret cardiac innervation, first pass, and planar studies	Total = 150 cases 50 30 20 30 20	Total = 150 cases 50 30 20 30 20

Workshops and Courses

Mandatory

- Valid BLS and ACLS certification

- Minimum of two CMRs/CCTs/NCs and safety courses or workshops per academic year

Optional

- Attendance of the Annual International Conference: American Society of Nuclear Cardiology (ASNC), Society of Cardiovascular Magnetic Resonance (SCMR), Society of Cardiovascular Computed Tomography (SCCT)

Self-directed learning (SDL):

SDL describes a process in which a fellow takes the initiative, with or without the help of a program director, in diagnosing their learning needs, formulating learning goals, identifying resources for learning, and choosing and implementing appropriate learning strategies.

Fellows should be encouraged to perform the following:

- Adhere to a variety of SDL activities
- Implement activities and teaching related to higher levels of learning
- Participate with other teams to achieve a common goal

Rules

- The fellows have to document the SDL activity.
- The program director should review SDL activities and evaluate the level of achievement and the score on the portfolio-evaluation sheet accordingly at the end of each rotation.

Example of SDL activities

1. Reading textbooks
2. Reviewing articles
3. Attending journal clubs

4. Searching for reports of cases similar to scanned CMR/CCT/NC cases and learning how to describe the image and correlate clinically.
5. Teaching other fellows, technologists, and residents
6. Observing quality improvement as a part of teamwork
7. Conducting research activities: write abstract, case report, and research project
8. Being a junior speaker in local and international meetings

XI. ASSESSMENT AND EVALUATION

1. Purpose of Assessment

Assessment plays a vital role in the success of postgraduate training. The assessment will guide trainees and trainers to achieve defined standards, learning outcomes, and competencies. Conversely, the assessment will provide feedback to learners and faculty regarding curriculum development, teaching methods, and quality of the learning environment. A reliable and valid assessment is an excellent tool for assessing the curriculum alignments between objectives, learning methods, and assessment methods. Finally, the assessment assures the patients and the public that the health professionals are safe and competent to practice.

The assessment can serve the following purposes:

a. Assessment for learning: As trainers use information from the trainees' performance to inform their learning for improvement. It enables the educators to use information about trainees' knowledge, understanding, and skills to provide feedback to trainees about learning and how to improve.
b. Assessment of learning involves trainees in the learning process, which enables them to monitor their own progress. The trainees use self-assessment and educators' feedback to reflect on their progression. It develops and supports the trainees' metacognitive skills. The assessment of learning is crucial in helping the residents/fellows become lifelong learners.

c. The assessment of learning is used to demonstrate the achievement of learning. This is a graded assessment and usually counts toward the trainee's end-of-training degree.
d. Feedback and evaluation: The assessment outcomes will represent quality metrics that can improve the learning experience.

The Miller's Pyramid of Assessment provides a framework for assessing the trainees' clinical competences, which acts as a road map for the trainers to select the assessment methods to target different clinical competencies including "knows," "knows how," "shows how," and "does" (Appendix B).

For the sake of organization, the assessment will be further classified into two main categories: formative and summative.

2. Formative Assessment

2.1 General Principles

The trainees, as an adult learner, should strive for feedback throughout their journey of competency from "novice" to "mastery" levels. Formative assessment (also referred to as continuous assessment) is the component of assessment that is distributed throughout the academic year aiming primarily to provide trainees with effective feedback. It is highly recommended to assign at least an hour of meeting time by the end of each rotation for trainees to discuss and review performance reports with their mentors.

Input from the overall formative assessment tools will be utilized at the end of the year to determine whether individual trainees will be promoted from the current to the subsequent training level. The formative assessment will be defined based on the scientific committee recommendations that are usually reviewed, updated, and

announced for each individual program at the start of the academic year.

According to the executive policy on continuous assessment (available online: www.scfhs.org), the formative assessment will have the following features that will be used based on Miller's pyramid (Appendix B):

a. Multisource: minimum four tools.
b. Comprehensive: covering all learning domains (knowledge, skills, and attitude).
c. Relevant: focusing on workplace-based observations.
d. Competency-milestone oriented: reflecting the trainee's expected competencies that match the trainee's developmental level.

The trainees should play an active role in seeking feedback during training. However, trainers are expected to provide timely and formative assessments. The SCFHS will provide an e-portfolio system to enhance communication and analysis of data arising from formative assessments.

The trainers and trainees are directed to 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	Important detail (e.g frequency ,Specifications related to the tool)
Knowledge	Structured Oral Exam (SOE) &written Exam	At the end of second year
	Annual Promotion Exam	At the end of the first year
	Structure Academic Activities	At the half day academic activity
	Case Based Discussion (CBD)	At the morning meeting
Skills	OSCE: Objective structured Clinical Examination	The end of second year
	Logbook	At the end of first and second year
	DOPS: Direct observation for procedural skills	At the end of each rotation
	Mini-CEX: mini-clinical Evaluation Exercise	At the end of each rotation
	Research activities & Writing research proposal	At the end of first year
	Present research project at the national /international meeting	At the end of second year
Attitude	ITER: In -Training Evaluation Report	At the end of each rotation

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

To achieve unconditioned promotion, the candidate must score a minimum of “borderline pass” in all five components.

- The program director can still recommend the promotion of candidates if the above is not met in some situations.
- If the candidate scored “borderline failure” in one or two components at maximum, and these scores should not belong to the same area of assessment (for example, both borderline failures should not belong to both skills).
- The candidate must have passed all the other components and scored a minimum of clear pass in at least two components.

3. Summative Assessment

3.1 General Principles

Summative assessment is a component of assessment that aims primarily to make informed decisions on the trainees’ competency. In comparison to formative assessment, summative assessment does not aim to provide constructive feedback. For further details on this section, please refer to the general bylaws and executive policy of assessment (available online: www.scfhs.org). To be eligible to set for the final exams, trainees will be granted “Certification of Training Completion” upon successful completion of all training rotations.

3.2 Annual written test:

To be conducted at the end of the second year as a final written exam and promotion exam.

Blueprint Outlines: The content of the following table is for demonstration purposes only. Please refer to the most updated version published on the SCFHS website.

The blueprint of the first part exam is shown in the following table:

Example of Written Exam Blueprint

Contents						
Categories	**Sections**	**Proportions**	**Medical science**	**Diagnosis**	**Management**	**Investigations**
CMR (clinical) 20%	Visibility	6%	0	3	1	2
	Stress CMR	4%	0	2	1	1
	Cardiomyopathy	7%	0	3	2	2
	Valves	2%	0	1	1	0
	Cardiac mass	2%	0	1	1	0
	Adult Congenital Heart disease	1%	0	1	0	0
	Aorta	1%	0	1	0	0
	LV/RV volume assessment	2%	0	1	1	0
CMR (basic) 10%	Physics and the Clinical Application	5%	2	1	0	1
	Techniques	5%	0	3	0	2
CCT 20%	Calcium score	2%	0	1	1	0
	Coronaries	6%	0	3	2	1
	Valves	2%	0	1	1	0
	CT for Structural Heart Image	5%	0	3	1	1
	Pericardium	1%	0	1	0	0
	Aorta	1%	0	1	0	0
	Masses	1%	0	1	0	0
	Basic (physics, technology, and patient care)	2%	1	1	1	0
NC 35%	Radiation safety	3%	3	0	0	0
	Physics	3%	3	0	0	0
	Myocardial perfusion	15%	0	5	5	5
	Viability	5%	0	2	2	1

Contents						
Categories	Sections	Proportions	Medical science	Diagnosis	Management	Investigations
	Coronary and aortic calcification	2%	0	1	1	0
	Coronary flow reserve	5%	0	2	2	1
	Technique	2%	2	0	0	0
Scholarly activities and others 10%	Research, ethics, professionalism, and patient safety	10%	5	0	5	0
	Total	100%				

*Main blueprint framework adapted from the American Board of Pediatrics.

3.3. Final In-training Evaluation Report (FITER)

In addition to approval of the completion of clinical requirements (sub-specialized fellowship logbook) by the supervising committee, FITER is also prepared by the program directors for each fellow at the end of his or her final year of training. This report shall be the basis for obtaining the certificate of training program completion and the qualification to set for the final specialty examinations.

3.4 Certification of Training-Completion

To be eligible for the final specialty examinations, each trainee is required to obtain “Certification of Training-Completion.” Based on the training bylaws and executive policy (please refer to www.scfhs.org) trainees will be granted a “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, others) as outlined in FITER, which is approved by the scientific committee of specialty.
c) Clearance from SCFHS training affairs ensures compliance with tuition payments and the completion of universal topics.
d) Passing the annual promotion exam.

A “Certification of Training-Completion” will be issued and approved by the supervisory committee or its equivalent, according to the SCFHS policies.

3.5 Final Specialty Examinations

The final specialty examination is the summative assessment component that grants trainees the certification of the specialty. It has two elements:

a) Final written exam: To be eligible for this exam, the trainees are required to have “Certification of Training-Completion”
b) Final clinical/practical exam: The trainees are required to pass the final written exam to be eligible to set for the final clinical/practical exam, e.g., Oral, OSCE.

Blueprint Outlines: The content of the following table is for demonstration purposes only. Please refer to the updated version published on the SCFHS website.

The blueprints of the final written and clinical/practical examinations are shown in the following table:

Example of Final Clinical Exam Blueprint

		DIMENSIONS OF CARE				
		CMR 1±1 Station(s)	CCT 5±1 Station(s)	NC 3±1 Station(s)	Psychological Aspects 1±1 Station(s)	# Station(s)
DOMAINS FOR INTEGRATED CLINICAL ENCOUNTER	Patient Care 7±1 Station(s)	1	1	1	1	4
	Patient Safety and Procedural Skills 1±1 Station(s)					
	Communication and Interpersonal Skills 2±1 Station(s)					
	Professional Behavior 0±1 Station(s)					0
	Total Stations	1	1	1	1	4

*Main blueprint framework adapted from the Medical Council of Canada Blueprint Project.

For further details on the final examinations, please refer to the general bylaws and executive policy of assessment (available online: www.scfhs.org).

Learning Domain	Summative Assessment Tools	Passing Score
Knowledge	- Final Written Examination/end of second year	At least borderline pass in each tool in accordance with the standard setting method used by the executive administration of assessment
Skills	- Objective Structured Clinical Examinations (OSCE) /at end of the second year - SOE at the end of the first and second year	At least borderline pass in each tool in accordance with the standard setting method used by the executive administration of assessment
Attitude	FITER: In-Training Evaluation Report/3 months	Successfully pass FITER

XII. PROGRAM AND COURSES EVALUATION

SCFHS applies variable measures to evaluate the implementation of this curriculum. The training outcomes of this program will undergo the quality assurance framework endorsed by the Central Training Committee at the SCFHS. The trainees' assessment (both formative and summative) results will be analyzed and mapped to the curriculum content. Other indicators that will be incorporated are as follows:

- Report of the annual trainees' satisfaction survey.
- Reports from the trainees' evaluation of faculty members.
- Reports from the trainees' evaluation of rotations.
- Reports from the annual survey of program directors.
- Data available from program accreditations.
- Reports from direct field communications with trainees and trainers.

Goal-based Evaluation: The intended achievement of milestones will be evaluated at the end of each stage to assess the progress of the curriculum delivery, and any deficiency will be addressed in the following stage utilizing the time devoted to trainee-selected topics and professional sessions.

In addition to the subject-matter opinion and best practices from benchmarked international programs, SCFHS will apply a robust method to ensure that this curriculum will utilize all the data that will be available during the revision of this curriculum in the future.

XIII. POLICIES AND PROCEDURES

This curriculum represents the means and materials that outline the learning objectives with which trainees and trainers will interact to achieve the identified educational outcomes. The SCFHS has a full set of “General Bylaws” and “Executive Policies” (published on the official SCFHS website) that regulate all training-related processes. The general bylaws of training, assessment, and accreditation, as well as the executive policies on admission, registration, continuous assessment and promotion, examination, trainees’ representation and support, duty hours, and leaves are examples of the regulations that need to be implemented. Under this curriculum, trainees, trainers, and supervisors must comply with the most updated bylaws and policies that can be accessed online (via the official SCFHS website).

XIV. APPENDICES

A. Examples of academic half day table
B. Miller's Pyramid of Assessment
C. Glossary
D. Example of the research rotation objective
E. References

Appendix-A

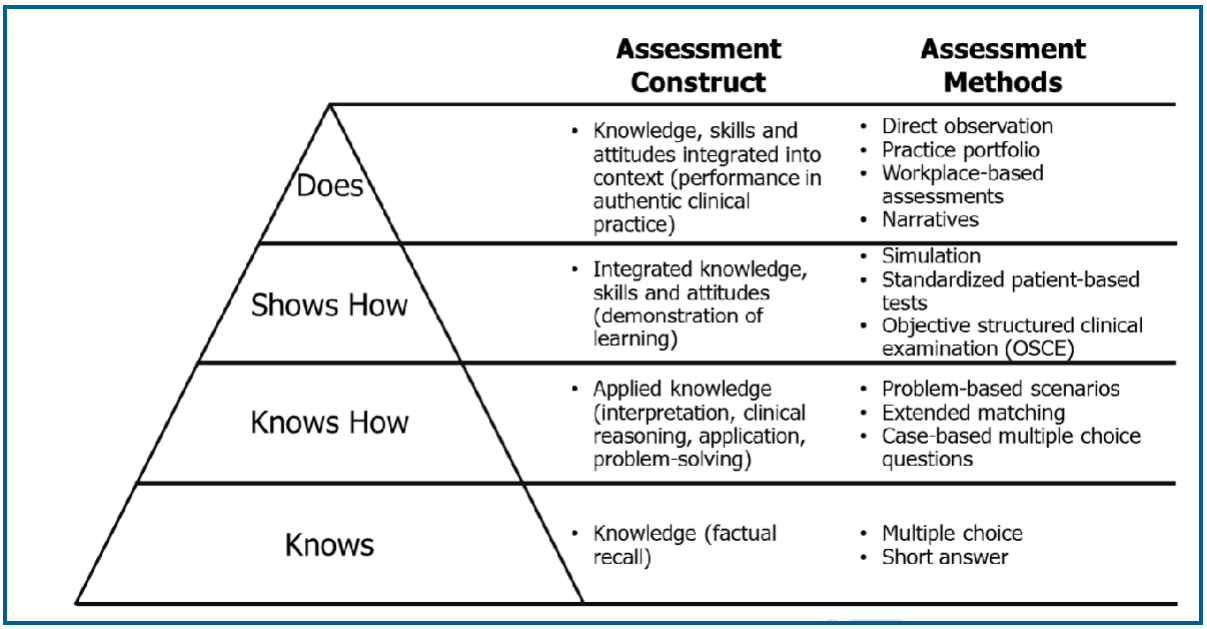
The following is a table with example topics that illustrate the half-day activities of the Advanced Cardiac Imaging Fellowship program.

Academic week	Section	Date	Time	Sessions	Presenters
1	Fundamentals Advanced Cardiac Imaging Fellowship Program	January – 1	13:00-15:00	The principle and structure of the program-/ objective / the responsibility of the fellow and training center	Program director
			15:00-16:00	Open discussion between program director and fellows	Program director
2	The LV and RV function and related physics of white blood image	January – 8	13:00-14:00	Topic 1 (the role of CMR in LV/RV function)	A
			14:00-15:00	Journal club/ the guidelines of NC	B

Academic week	Section	Date	Time	Sessions	Presenters
			15:00-16:00	Chapter review: the physics of white blood image	Physicist
3	Viability	January – 15	13:00-14:00	Topic 1 (the role of CMR/NC in viability /part 1)	C
			14:00-15:00	Case base study/CT cases	E
			15:00-16:00	The common extra cardiac pathology (part 1): Lung	Radiologist
4	Coronaries	January – 22	13:00-14:00	Journal club* (the role of CCT in the assessment of coronary artery disease)	A
			14:00-15:00	Case base study	B
			15:00-16:00	Chapter review (Basic physics of gated CTA)	Physicist

Appendix-B

Miller's Pyramid of Assessment provides a framework for assessing the trainees' clinical competences, which acts a road map for the trainers to select the assessment methods to target different clinical competencies including "knows," "knows how," "shows how," and "does" (2).



(Figure 1. Miller's Pyramid)

1. Adapted from: Walsh CM. In-training gastrointestinal endoscopy competency assessment tools: Types of tools, validation, and impact. Best Prac Res Clin Gastroenterol. 2016;30(3):357–74.
2. Miller GE. The assessment of clinical skills/competence/performance. Acad Med. 1990;65(9 Suppl):S63–7

Appendix-C

Glossary

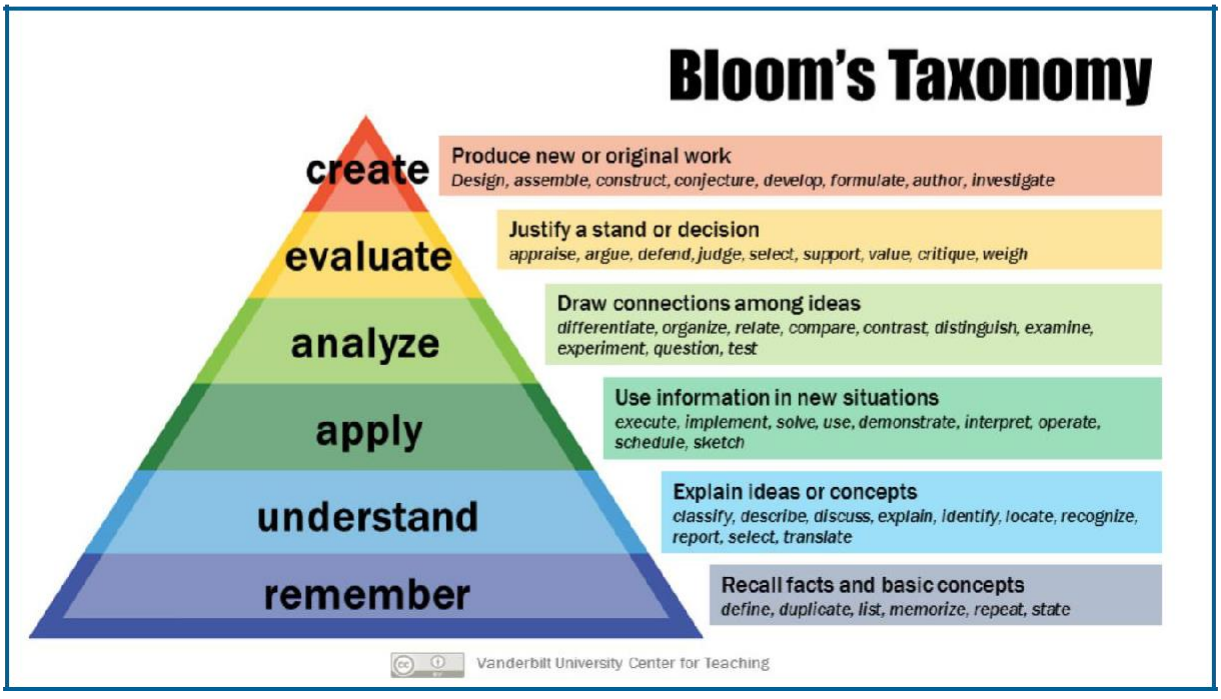
Glossary	
Blueprint	Description correlating educational objectives with assessment contents. For example, a test blueprint defines the proportion of test questions allocated to each learning domain and/or content.
Competency	Capability to function within a defined professional role that implies the entrustment of a trainee by graduation of the program with the required knowledge, skills, and attitude needed to practice unsupervised.

Glossary	
Specialty Core Content (skills, knowledge, and professional attitude)	A specific knowledge or skill or professional attitude that is specific and integral to the given specialty.
Formative assessment	An assessment that is used to inform the trainer and learner of what has been taught and learned, respectively, for the purpose of improving learning. Typically, the results of formative assessment are communicated through feedback to the learner. Formative assessments are not intended primarily to make judgments or decisions (though it can be as a secondary gain).
Mastery	Exceeding the minimum level of competency to the proficient level of performance indicating rich experience with possession of great knowledge, skills, and attitude.
Portfolio	A collection of evidence of progression toward competency. It may include both constructed components (defined by mandatory continuous assessment tools in curriculum) and unconstructed components (selected by the learner).
Summative assessment	An assessment that describes the composite performance of the development of a learner at a particular point in time and is used to make informed judgment and decisions about the level of learning and certification.
Universal Topic	A knowledge, skills, or professional behavior that is not specific to the given specialty but universal for the general practice of a given healthcare profession.

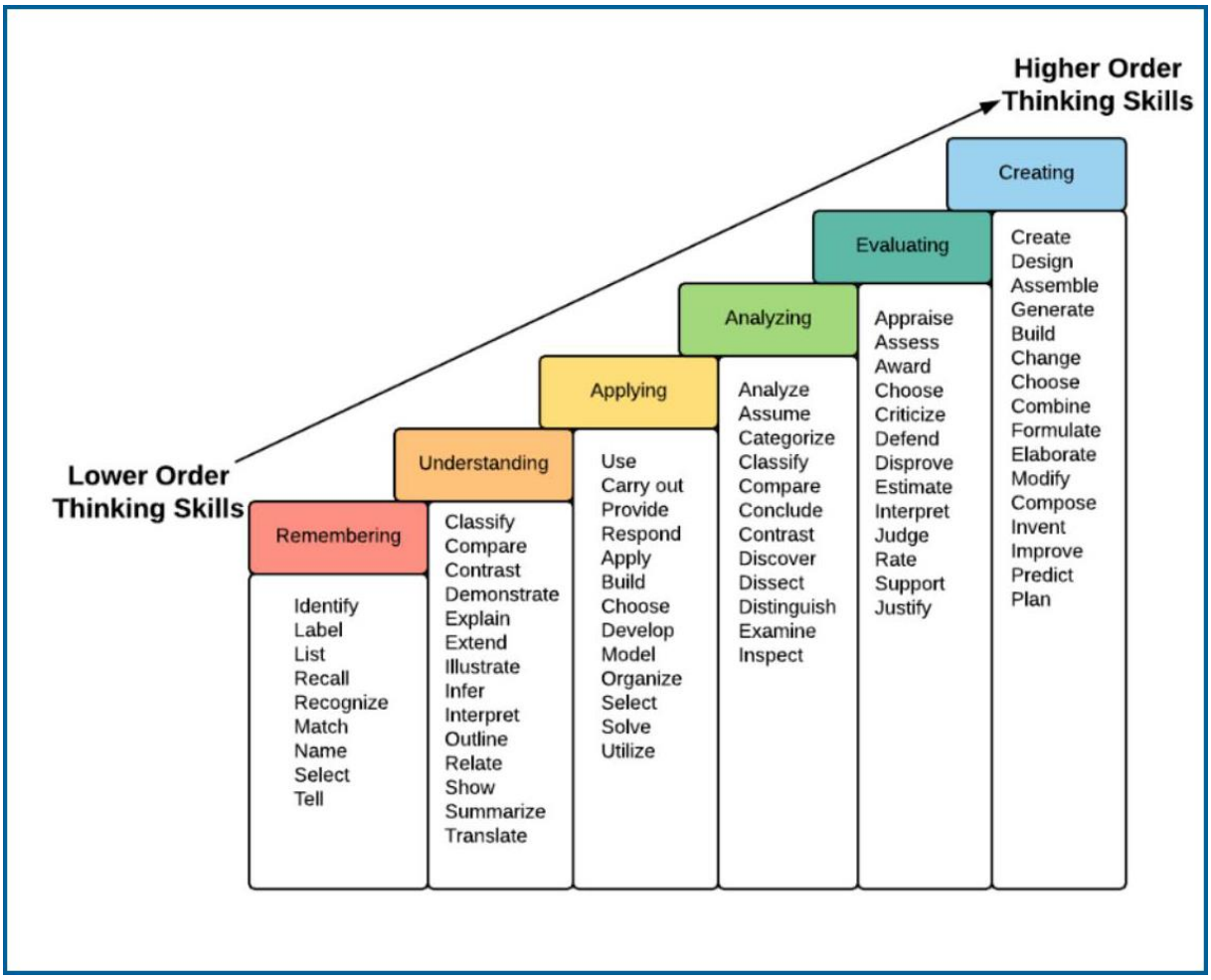
1) Bloom’s taxonomy action verbs

Bloom’s Taxonomy Action Verbs

Level	Definition	Sample verbs					Sample behaviors
KNOWLEDGE	Student recalls or recognizes information, ideas, and principles in the approximate form in which they were learned.	arrange define describe duplicate	identify label list match	memorize name order outline	recognize relate recall repeat	reproduce select state	The student will define the 6 levels of Bloom's taxonomy of the cognitive domain.
COMPREHENSION	Student translates, comprehends, or interprets information based on prior learning.	explain summarize paraphrase describe illustrate classify	convert defend describe discuss distinguish	estimate explain express extend generalized give example(s)	identify indicate infer locate paraphrase predict	recognize rewrite review select summarize translate	The student will define the 6 levels of Bloom's taxonomy of the cognitive domain.
APPLICATION	Student selects, transfers, and uses data and principles to complete a problem or task with a minimum of direction.	use compute solve demonstrate apply construct	apply change choose compute demonstrate discover dramatize	employ illustrate interpret manipulate modify operate	practice predict prepare produce relate schedule	show sketch solve use write	The student will write an instructional objective for each level of Bloom's taxonomy.
ANALYSIS	Student distinguishes, classifies, and relates the assumptions, hypotheses, evidence, or structure of a statement	analyze categorize compare contrast separate apply	change discover choose compute demonstrate dramatize	employ illustrate interpret manipulate modify operate	practice predict prepare produce relate schedule	show sketch solve use write	The student will compare and contrast the cognitive and affective domains.
SYNTHESIS	Student originates, integrates, and combines ideas into a product, plan or proposal that is new to him or her.	create design hypothesize invent develop arrange assemble	categorize collect combine comply compose construct create	design develop devise explain formulate generate plan	prepare rearrange reconstruct relate reorganize revise	rewrite set up summarize synthesize tell write	The student will design a classification scheme for writing educational objectives that combines the cognitive, affective, and psychomotor domains.
EVALUATION	Student appraises, assesses, or critiques on a basis of specific standards and criteria.	Judge Recommend Critique Justify Appraise Argue	Assess Attach Choose Compare Conclude Contrast	Defend Describe Discriminate Estimate Evaluate	Explain Judge Justify Interpret Relate	Predict Rate Select Summarize Support Value	The student will judge the effectiveness of writing objectives using Bloom's taxonomy.



Examples of verbs to use in writing objectives



Appendix-D

2.2.6 RESEARCH ROTATION

No research rotation, it is part of daily work

Number of rotation months	First year	Second year	Total
	0	0	0

MEDICAL EXPERT

Goals:

- To demonstrate an understanding of the basic principles of research design, methodology, data analysis, and clinical epidemiology. In addition,

they have both advantages and disadvantages from the perspective of radiology.

- To familiarize themselves with the ethical requirements of research and demonstrate an understanding of the responsible use of informed consent.
- To understand and practice the appropriate methods for writing the research manuscript, data collection, analysis of the results, and discussion.
- To demonstrate the awareness of current research topics in radiology using available medical informatics systems.
- To acquire the skills for scientific presentations and public discussions.

Training Methods

- A dedicated 1-month, full-time rotation in research is conducted.
- The project is expected to span more than a month. Therefore, the completion of the work should be parallel to other subsequent rotations.
- The fellow must choose a supervisor to help access essential resources that will allow an appropriate understanding of research skills and periodically discuss progress.
- Attendance at dedicated courses or workshops that enhance research skills may be required by the program.
- The fellow must finish the research proposal by the end of the first six months and should be accepted by the Neuroradiology Research Committee.
- The oral abstract of the study results should be presented in the second year of the Fellows Neuroradiology Research Day.
- The research paper should be sent for at least two weeks before Neuroradiology Research Day.

- It is highly desirable for fellows to work on presenting research results at national and/or international meetings and work hard to publish their work in indexed journals.

Evaluation

- Attendance at designated courses/lectures was monitored and incorporated into the annual evaluation score.
- Panel scoring of the presentation of the research abstract will be conducted in the first or second year.

COMMUNICATOR

- Demonstrate skills in conveying and discussing scientific research to scientific communities through posters, abstracts, teaching slides, manuscripts, or other scientific communications
- Communicate and collaborate effectively with the research supervisor to conduct the research.

COLLABORATOR

- Identify, consult, and collaborate with the appropriate experts to conduct the research.

LEADER

- Demonstrate the ability to identify an area of research interest and a research supervisor to engage in the scholarship of scientific inquiry and dissemination.
- Demonstrate the ability to utilize the available resources and regularly meet with an identified research mentor.
- Demonstrate the ability to set realistic priorities and use time effectively to optimize professional performance.
- Demonstrate an understanding of the cost-effective use of health care resources.

HEALTH ADVOCATE

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

SCHOLAR

- To demonstrate the ability to pose an appropriate research question, recognize and identify gaps in knowledge and expertise around this question, and formulate an appropriate study design to answer it.
- Demonstrate the ability to carry out the research outlined in the proposal.
- Demonstrate the ability for data collection, data analysis, and preparation of the abstract and manuscript.
- Demonstrate the ability to identify the areas for further research.

PROFESSIONAL

- The ethical and professional research expectations are consistent with institutional review board guidelines, including the maintenance of meticulous data and conduct of ethical research.
- Demonstrate personal responsibility for setting research goals and working with supervisors to set and achieve research timeline objectives.
- Publish accurate and reliable research results, with attention to appropriate authorship attribution criteria.
- Disclose potential financial conflicts of interest (including speaker fees and consultative relationships) as appropriate when engaging in and disseminating research results.

Appendix-E

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