الهيئة السعودية للتخصصات الصحية
Saudi Commission for Health Specialties

# Pediatric cardiac critical care

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بسم الله الرحمن الرحيم

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# PREFACE

Pediatric cardiac critical care fellowship curriculum constitutes a vital part in learning. In addition to informing trainees, trainers, and training supervisors about the goals and objectives of training, the curriculum will have major impacts on programs planning and execution and quality assurance of the training outcomes. The Saudi Commission for Health Specialties (SCFHS) is the national regulatory body of postgraduate training programs across all health professions in Saudi Arabia. This manual is meant to serve as a guide for members of the "Curriculum Development Committee" in their journey writing the curriculum of their specialty. Curriculum Development Committee (CDC) members should adhere to the proposed curriculum structure in this manual. The subject-matter content needs to be built by CDC members. CDC members will be required to set a blueprint of the curriculum content and get that approved by the scientific council/committee of the program (whenever that is applicable). This manual will provide pre-written sections and materials that are universally applicable for SCFHS programs. CDC members are advised to follow PCCCF instructions to help in customizing the content based on program needs. For any further support, please do not hesitate to contact us at Curricula@scfhs.org.sa

- 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 on training. However, such regulations need to be sought from the "general bylaws" and "executive policies" on training published by the SCFHS, which can be accessed online through the official SCFHS website. In the event of discrepancy in regulation statements, the one stated in the most 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 version at :

www.scfhs.org.sa

# ACKNOWLEDGMENT

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# INTRODUCTION

## 1. Context of Practice

With an increase in both the prevalence and complexity of congenital cardiac diseases in the pediatric population, there is a growing awareness among stakeholders in many developed countries of the need for more pediatric cardiac intensivists to collaborate with subspecialty medical providers in the management process for patients who are admitted to the pediatric cardiac ICU before or after cardiac surgery. The lack of experts and formally trained physicians who are dedicated to taking care of critically ill pediatric cardiac patients results in many potential concerns. For example, it is not clear to which degree general pediatric intensivists, especially those who have recently graduated from their fellowship programs, are comfortable and prepared to manage such complex cases within the medical healthcare system. Therefore, establishing a pediatric cardiac critical care fellowship (PCCCF) as a distinct subspecialty is recognized as one of the most critical recent interventions to be applied in the medical education field.

Practitioners within this subspecialty possess specific cognitive and procedural skills garnered from focused multidisciplinary training and experience with children with congenital and acquired heart disease (1), adhering to the highest standards of care with high-quality services provided for this growing category of patients.

The presence of qualified pediatric cardiac intensivists in Saudi Arabia is crucial; indeed, the need for such a clinical service may be higher than that in developed countries for two main reasons:

a) An increase in the pediatric population in our community.

b) A lack of well-established community services in Saudi Arabia.

There are currently more than 10 centers in the Kingdom that provide pre-

and postoperative care for critically ill pediatric cardiac patients. In addition, to keep up with the increasing number of medical schools in Saudi Arabia, the SCFHS are obligated to raise the number of available training seats in most training programs, including pediatric subspecialties. Subsequently, a higher number of trainees will graduate once they successfully complete their training programs. Developing a local fellowship program in pediatric cardiac critical care will help in accommodating these graduates.

Additionally, providing our country with highly trained Saudi pediatric cardiac intensivists is in line with the national transformation plan of the Ministry of Health and the 2030 vision.

## 2. Goal and Responsibility of Curriculum Implementation

The establishment of a fellowship in pediatric cardiac critical care is an important step in the development of our fellows' knowledge, skills, professional development, and research experience to become competent in this subspecialty. The fellowship curriculum includes teaching skills necessary to become effective clinicians, creative scientists, and knowledgeable teachers, who will be capable of conducting research in this field.

Taking all of these into consideration, there is a great need to develop a pediatric cardiac critical care fellowship, which will graduate pediatric cardiac intensivists who are equipped with the skills and attributes to meet the pediatric healthcare needs in our country.

The pediatric cardiac critical care fellowship (PCCCF) is an advanced subspecialty training program that aims to train a qualified competent pediatric intensivist or pediatric cardiologist who will have more advanced training to manage children with congenital heart disease before and after cardiac surgeries in the pediatric cardiac intensive care unit that could be separated from the general ICU or sharing the same physical space. The scientific committee of this fellowship program will be composed of the program directors from different centers and the founders of this fellowship and will follow the regulations of the SCFHS. This committee will be linked and supervised directly by the Scientific Board of Pediatrics.

# ABBREVIATIONS USED IN THIS DOCUMENT

| Abbreviation | Description |
|---|---|
| SCFHS | Saudi Commission for Health Specialties |
| F(1) | (First) year of Fellowship |
| 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 |
| RTC | Residency Training Committee |
| PCCCF | Pediatric cardiac critical care fellowship |
| PICU | Pediatric critical care unit |
| ECHO | Echocardiography |
| ECG | Electrocardiogram |
| EP | Electrophysiology |

# PROGRAM ENTRY REQUIREMENTS

## I. Pre-entry qualifications:

In order to be admitted to the program, the candidate should either:

• Possess the certificate of fellowship in pediatric critical care from the SCFHS or equivalent qualifications recognized by the SCFHS.

OR

• Possess the certificate of fellowship in pediatric cardiology from the SCFHS or equivalent qualifications recognized by the SCFHS, including 6-month training in pediatric critical care in a training center recognized by the SCFHS. This 6-month training in general pediatric ICU can be completed either during pediatric cardiology fellowship training or before commencing the PCCC fellowship training program.

Both candidates have to pass the interview conducted by the selection committee.

# LEARNING AND COMPETENCIES

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

### Learning Outcomes and Goals:

Upon completing the fellowship training program in pediatric cardiac critical care within one year, the candidate will have acquired the knowledge, skills, and competency to function at a consultant level with a solid academic background in pediatric cardiac critical care and will be able to diagnose and manage critical pediatric cardiac cases.

### General Objectives:

• To train the physician to care for critically ill pediatric cardiac patients.

• To maintain a high-quality pediatric cardiac critical care service in an academic teaching environment.

Upon completion of training, the fellow should acquire the following CanMEDS competencies: (PCCCF learning outcomes are summarized in Appendix A)

### I. Core Rotations:

### I.I Cardiac Critical Care Rotation Objectives:

### Role #1: Medical Expert

• Assess, diagnose, and manage congenital and acquired heart disease in neonates and infants.

• Demonstrate an understanding of the management of patients in the preoperative period.

• Demonstrate an understanding of the management and stabilization of patients with different congenital heart diseases in the immediate postoperative period.

• Recognize the pathophysiology and treatment of cardiogenic and permeability pulmonary edema.

• Describe the pathophysiology of pleural effusion.

• Interpret the different modalities for hemodynamic monitoring.
• Interpret the different modalities for monitoring tissue oxygenation.
• Demonstrate an understanding of the response of the ventricle to volume and pressure loading.
• Describe how respiratory disease impacts cardiovascular function.
• Describe how cardiovascular dysfunction impacts respiratory function.
• Demonstrate an understanding of the pathophysiology and treatment of low cardiac output syndrome (LCOS).
• Describe the pharmacologic approach to treating LCOS and shock.
• Describe the pharmacologic approach to treating congestive heart failure.
• Demonstrate an understanding of the pathophysiology and treatment of cardiomyopathies.
• Describe the clinical determinants of proceeding to mechanical circulatory support.
• Demonstrate an understanding of how the ECMO functions.
• Describe the different modalities for ventricular assist devices and how they function.
• Explain the pathophysiology and treatment of pulmonary hypertension and RV dysfunction.
• Explain the pathophysiology of diastolic and systolic ventricular interdependence.
• Describe and identify types of arrhythmias.
• Describe the pharmacologic treatment of common postoperative arrhythmias.
• Demonstrate an understanding of the use of pericardial pacing in the postoperative patient.
• Describe the neurologic injury associated with cardiac surgery for congenital heart disease.
• Describe the conduction of CPB, the inflammatory response to CPB, and its treatment.
• Describe the role of neurohormonal activation in the development of heart failure.
• Describe the response of the ventricle to volume and pressure loading.
• Describe the impact of heart failure on pulmonary vascular and RV functions.
• Describe the pathophysiology of dilated, hypertrophic, and restrictive cardiomyopathies.

## I.II General Pediatric Critical Care Rotation

### Role #1: Medical Expert

- Explain pharmacology as they pertain to pediatric cardiac critical care patients.
- Recognize the physiology of the airway, gas exchange unit, and lung and chest wall mechanics, including control of breathing.

## Describe and demonstrate knowledge in the following:

- Physiology, pathophysiology, and pharmacology as they pertain to critically ill pediatric patients.
- Normal anatomy and maturational variation in the respiratory system and disease processes related to the different stages of development of the pediatric respiratory system.
- Physiology of the airway, gas exchange unit, and lung and chest wall mechanics, including control of breathing.
- Principles of respiratory monitoring and diagnostic imaging of the respiratory system.
- Pathophysiology and treatment of lung diseases, including, but not limited to, acute lung injury, obstructive lung diseases, and pneumonia.
- Principles and theory of assisted ventilation and other methods of respiratory support.
- Weaning from assisted ventilation.
- Physiology of cerebral circulation.
- Physiology of the central and peripheral nervous systems.
- Normal anatomy and maturational differences and physiology of the genitourinary system.
- Principles of renal function monitoring.
- Pathophysiology, prevention, and management of acute kidney injury, including, but not limited to, renal replacement therapies.
- Normal anatomy and maturational variation and physiology of the gastrointestinal and hepatobiliary systems.
- Pathophysiology and treatment of gastrointestinal dysfunction, including, but not limited to, acute abdomen arising from obstruction, ischemia, perforation, and dysmotility.
- Upper and lower gastrointestinal bleeding.
- Acute and chronic hepatobiliary dysfunction, including, but not limited to, fulminant hepatic failure.
- Complications of abdominal surgery.
- Physiology of the hormones and regulatory cytokines involved in shock.
- Principles of invasive and non-invasive monitoring of shock.
- Pathophysiology and treatment of shock.
- Pathophysiology and treatment of disorders of red cells, white cells, and platelets.
- Pathophysiology and treatment of coagulation disorders.

- Blood component therapy and alternatives and principles of massive transfusion.
- Physiology of thermoregulation and metabolic, endocrine, fluid, and electrolyte homeostasis.
- Normal and abnormal body temperature regulation and associated disorders.
- Pathogenesis and diagnostic criteria for sepsis, severe sepsis, septic shock, systemic inflammatory response syndrome, and multi-organ dysfunction syndrome.
- Techniques for diagnosis of sepsis and occult indicators of sepsis.
- Epidemiology of host specific infectious diseases.
- Pharmacology, indications, complications, interactions, monitoring, and efficacy of usual antimicrobial agents.
- Fluid/caloric requirements in critically ill patients.
- Indications, limitations, methods, and complications of enteral and parenteral nutritional therapy.
- Indications for and use of vasoactive agents.
- Safe administration of therapeutic agents including, but not limited to, modification in the setting of organ dysfunction.
- Physiology associated with air and ground transportation.
- Equipment and monitoring methods specific to air and ground transportation.
- Patient preparation, transportation modes, and communication to facilitate safe patient transport.
- Withholding and/or withdrawing life sustaining therapies.
- Diagnosing and treating fluid and/or electrolyte disturbances, acid-base disorders, endocrine emergencies, abnormal body temperature, including, but not limited to, hyperthermia, rewarming for hypothermia, and therapeutic hypothermia.
- Assessing, optimizing, and minimizing the perioperative risk.
- Managing pain and sedation in the perioperative period.
- Practicing infection control measures.

## I.III Cardiac Anesthesia/Cardiac Theatre Rotation Objectives:

### Role#1: Medical Expert

The fellow will demonstrate knowledge of the basic sciences as applied to the preoperative, intraoperative, and postoperative periods of a cardiac surgery.

- Demonstrate an understanding of the common physiological changes occurring in the postoperative period and the impact they have on end-organ function.
- Describe the different congenital cardiac anomalies and their surgical management.
- Describe the altered respiratory physiology of immediate postoperative cardiac cases.
- Compare common medications for cardiac surgical patients, including anesthetic agents, vasodilators, vasoconstrictors, and inotropic agents.
- Apply the basics of transesophageal echocardiography (TEE), including techniques of probe insertion and several basic views and implications and applications in critical care patients.
- Recognize the significance of temperature management in the intraoperative period, including hypothermic techniques.
- Describe the indicators of volume status.
- Manage metabolic and electrolyte disturbances in the intraoperative period.
- Illustrate the basic principles of cardiac support devices, including the bypass machine and extracorporeal membrane oxygenation (ECMO).

The fellow is expected to acquire an understanding of the anatomic, physiologic, pharmacologic, and psychological concepts in relation to anesthesia practice.

## The Respiratory System

- Anatomic differences in the neonate and pediatric airway.
- Age differences in control of respiration, compliance, lung volumes, and oxygen consumption.

## The Cardiovascular System

- Anatomy and physiology of transitional circulation.
- Maturation of the myocardium and autonomic nervous system.

## The Central Nervous System

- Age differences: intracranial pressure, cerebral blood flow, and auto regulation.

## The Genitourinary System

- Renal maturation.
- Fluids and electrolytes, maintenance requirements, and hydration assessment.

## The Gastrointestinal/Hepatic System

- Feeding, fasting guidelines, and glucose control.
- Maturation of hepatic function.

## The Hematological System

- Normal values in infants and children.
- Natural history of fetal hemoglobin.
- Blood component therapy.

## The Hematological System

- Body surface area and heat loss.
- Differences in methods and ability to thermoregulate.
- Heat loss and prevention.
- Malignant hyperthermia.

## Psychological Issues

- Anxiety/fear at different ages.
- Separation anxiety and parental anxiety.
- Use of premeditations.

## Pharmacology

- Pediatric anesthesia induction techniques using inhalation, intravenous anesthetic agents.

## Neuromuscular blockade

- Age differences in volume of distribution, pharmacokinetics, pharmacodynamics, and toxicity.
- Pain management.
- Use of muscle relaxants.

## Anesthesia Equipment

- Sizes of masks, endotracheal tubes, laryngeal mask airways, laryngoscopy blades, bronchoscopes, and glide scope.
- Vascular access and invasive monitoring.
- Warming devices.

## I.IV Echocardiography Rotation Objectives:

## Role#1: Medical Expert

- Identify the structures appreciated in the parasternal (long axis and short axis), subcostal, and apical views.
- Describe the assessment of LV systolic function using the modified Simpson rule method and its limitations.
- Describe the assessment of RV systolic function.
- Identify the pericardial effusion and the criteria for tamponed physiology.
- Identify normal chamber size for the right ventricle and left ventricle.
- Identify normal thickness for the RV free wall, IVS, and LV free wall.
- Describe the principles of Doppler in measuring the velocity of fluid and therefore pressure gradient (prograde and retrograde).
- Identify findings consistent with moderate and severe MR.
- Describe the assessment of aorta pulmonary shunt function.
- Describe the determination of RV systolic pressure based on TR jet.
- Describe the estimation of RV systolic pressure based on the position of IVS during systole.

- Describe the normal orientation and position of the IVS during diastole and systole.
- Describe the abnormal orientation and position of IVS during diastole and systole.

## I.V Cardiac Catheterization Rotation Objectives:

## Role#1: Medical Expert

- Differentiate between measured and calculated hemodynamic data.
- Demonstrate an understanding of normal hemodynamic data for the atria, ventricles, and pulmonary vasculature.
- Identify the methods available to determine CO and pulmonary and systemic vascular resistance.
- Describe the limitations of using an assumed VO2 for determining flow and resistance.
- Describe the assessment of valvular and septal defect pressure gradients.
- Describe the hemodynamic evaluation of congenital heart disease, including the evaluation of shunt percentages.
- Describe the catheter interventions utilizing balloon angioplasty and valvotomy.
- Describe the catheter intervention for defect closure, coil embolization, and stent placement.

## I.VI Electrophysiology Rotation Objectives:

## Role#1: Medical Expert

- Be able to read normal and abnormal pediatric electrocardiograms and demonstrate a solid understanding of age-related changes in ECG.
- Determine the value of normal conduction intervals and how they can be obtained.
- Describe the differential diagnosis of different types of arrhythmia.
- Illustrate the common anti-arrhythmic medications and their uses and contraindications; know the ECG changes happening with treatment.
- Order, apply, and perform Holter tests.
- Recognize and apply the indications for and appropriate doses of transthoracic pacing, cardioversion, and defibrillation.
- Manage temporary pacemakers and different modes of pacing.
- Recognize and apply the loss of capture and inappropriate sensing.
- Describe catheter ablation and its indications.
- Describe the pacemaker and ICD devices: Their indications and common complications of implantation in children or adults with congenital heart disease, basic device functions, and ICD implantation (primary vs. secondary indications).

## II. Elective Rotation

The objectives of the elective experience are to provide flexibility and opportunities to explore career possibilities, gain experience in critical care medicine beyond the core curriculum, and study certain areas in greater depth. Fellows are free to identify and choose specific electives in keeping with their individual training objectives, subject to approval by the program director.

## Role #1: Medical Expert

The fellow should acquire knowledge to:

- Provide optimal ethical and patient-centered medical care.
- Acquire clinical knowledge, skills, and attitudes appropriate to the rotation subject.
- Use preventive and therapeutic interventions effectively.
- Demonstrate proficient and appropriate use of procedural skills, both diagnostic and therapeutic.
- Seek appropriate consultation from other health professionals, recognizing the limits of their expertise.
- Elective rotation includes but is not limited to:
- Medical imaging and echocardiography.
- Pediatric cardiology.
- Cardiac anesthesia and operating room.

Competencies under the following roles are expected in all rotations:

## Role #2: Communicator

CanMEDS key competencies methods to achieve competencies

- Provide educational and supportive learning from a role model.
- Counsel patients and their families in simple terms.
- Show empathy through verbal and non-verbal communication.
- Identify barriers to effective communication and modify approaches to minimize those barriers.
- Provide succinct and clear explanation of life resuscitative measures for the patient's family.
- Demonstrate effective communication skills in dealing with terminally ill patients and breaking bad news.
- Resolve conflicts between the family and healthcare professionals.
- Document properly the patient's medical record.
- Respect the role of each member of the multidisciplinary PICU team in maintaining a good teamwork spirit in the unit.
- Demonstrate effective communication skills in other subspecialties.
- Counsel junior trainees about their performance in a constructive manner.
- Make simulation-based scenarios.
- Communicate with family under the supervision of senior fellows and consultants.
- Organize case conference meetings for complex cases.
- Make rounds under the supervision of consultants.
- Monitor the fellow's performance when consulted outside the unit.
- Review by the consultant of the fellow note in the medical record.
- Supervise junior residents and fellows.
- Present at national and international conferences.
- Present at journal clubs.

## Role #3: Collaborator

CanMEDS key competencies methods to achieve competencies

- Realize the importance of collaboration and assess the stages of team formation.
- Recognize the unique roles of members of the interdisciplinary PICU team.
- Demonstrate effective collaboration among members of the interdisciplinary team and other healthcare professionals.
- Discuss management plans with team members and ensure that they are well understood and carried out.
- Demonstrate integration and responsibility as a team member.
- Organize case conference meetings for complex cases.
- Facilitate simulation-based learning.
- Participate in morbidity discussions.
- Participate in mortality discussions.
- Collaborate as a team member for quality performance indicator web- based programs.

## Role #4: Health Advocate

CanMEDS key competencies methods to achieve competencies

- Demonstrate an understanding of the long-term consequences of disease in critically ill children.
- Demonstrate an understanding of the impact of disease on family dynamics.
- Apply severity-of-illness measurement scores.
- Discuss case scenarios with the members of the multidisciplinary team.
- Apply quality improvement measures.
- Discuss patterns of the disease in critically ill children in relation to the society
- Define the sociocultural and spiritual preferences in the society.
- Coordinate social and financial support for families.
- Implement various ethical and legal issues such as informed consent, end-of-life care, and beneficence.
- Consider appropriate utilization of resources to avoid futility of care, including nurses, respiratory therapists, dietitians, occupational therapists, social workers, clinical psychologists, home healthcare providers, and spiritual counselors.
- Collaborate in creating support groups for patients and their families.
- Obtain detailed informed consent under direct supervision.
- Conduct seminars on ethics.
- Conduct patient-centered discussions.

## Role #5: Leader

CanMEDS key competencies methods to achieve competencies

- Run the unit in an efficient and smooth manner.
- Demonstrate the ability to make independent decisions related to patients.
- Demonstrate skills in time management.
- Demonstrate the ability to function under stress.
- Acknowledge signs of burnout.
- Recognize signs of burnout of other members in the team.
- Demonstrate skills in triage, transfer, and bed allocations.
- Recognize the importance of resource allocations.
- Directly talk with the consultant after taking decisions related to patients.
- Directly supervise junior colleagues and give them feedback.
- Make rounds as a leader once per week or as requested.
- Conduct the monthly mortality and morbidity meeting of the unit.
- Collaborate as a team leader for quality performance indicators.
- Share administrative responsibilities.
- Write policies and procedures.
- Get involved in ordering and purchasing equipment.
- Get involved in planning the unit expansion.

## Role #6: Scholar

CanMEDS key competencies methods to achieve competencies

- Make evidence-based decisions.
- Review the literature on solving clinical problems.
- Apply critical appraisal skills to the literature.
- Provide clinical teaching and mentoring for juniors.
- Describe the unique challenges of intensive care research and strategies to overcome them.
- Apply the principles of qualitative and participate in all academic activities.
- Perform clinical research/quality projects supervised by senior staff.
- Publish papers.
- Understand and utilize biostatistics.

## Role #7: Professional

CanMEDS key competencies methods to achieve competencies

- Demonstrate integrity, honesty, and compassion in the care of patients.
- Demonstrate accountability and punctuality.
- Guarantee continuity of patient care.
- Practice the principles of bioethics on daily basis.
- Develop skills in resolving conflicts.
- Practice the legal and ethical aspects of informed consent.
- Adhere to hospital policies and procedures.
- Doing a comprehensive handover when transferring patients.
- Getting a comprehensive handover when receiving patients to the unit.
- Organizing case conference meetings for complex cases.
- Provide simulation-based teaching.

The PCCCF curriculum applies principles of competency-based medical education. CanMEDS/ACGME/OTHER represents a globally accepted framework outlining competency roles. "CanMEDS 2015/ACGME 2018 framework" has been adopted in this section. AGME reference and link: https://www.acgme.org/Portals/0/MilestonesGuidebook.pdf

This reference is an example of the general outline of the CanMEDS competency (Frank JR, Snell L, Sherbino J, editors. CanMEDS 2015 Physician Competency Framework. Ottawa: Royal College of Physicians and Surgeons of Canada, 2015).

## 2. Program Durations

The total length of the program will be 1 year of full-time teaching and training on the principles and practice of pediatric cardiac critical care.

## 3. Program Rotations

### Rotations (4 weeks for each block):

### Candidates with a PICU background will have rotations containing thirteen (13) blocks:

- 9 blocks of PCCC (including one block at the end of training as an acting consultant).
- 4-week vacation.
- 1 block of ECHO rotation.
- 1 block of pediatric cardiac catheterization/pediatric cardiac electrophysiology.
- 1 block of related electives (examples: cardiac anesthesia/cardiac theater).

### Candidates with a Pediatric Cardiology background will have rotations containing 13 blocks:

- 1 block of anesthesia.
- 9 blocks of PCCC (including one block at the end of training as an acting consultant).
- 4-week vacation.
- 2 blocks of general PICU.

| Training Year | Mandatory core rotations* | | Elective rotations** | |
|---|---|---|---|---|
| | Rotation name | Duration | Rotation name | Duration |
| F1 with PICU background | • PCCC<br>• ECHO<br>• Cath lab/EP<br>• Vacation | 9 Blocks<br>1 Block<br>1 Block<br>4 Weeks | • Cardiac anesthesia and Cardiac OR | 1 Block |
| F1 with cardiology background | • PCCC<br>• Cardiac anesthesia and cardiac OR<br>• PICU<br>• Vacation | | | |

*Mandatory core rotation: Set of rotations that represent program core components and are mandatory to do.
**Elective rotation: Set of rotations that are related to the specialty, as determined by the scientific council/ committee, and the trainee is required to do some of them.

## 4. Mapping of Learning Objectives and Competency Roles to Program Rotations:

This section aims to match the competencies and objectives related to each rotation. Trainees and trainers should work together to achieve these objectives during teaching and formative assessment. Expectations should evolve as the training level progresses (training stage; milestones).

## 5. Rotation Name:

| Rotation Sitting | Training stage | 1-year training | Duration of rotations (months/ weeks/ blocks) | Rotation specific objectives (SMART)* (To describe the purposed outcomes in the form of KSA) | Competency roles** |
|---|---|---|---|---|---|
| Pediatric cardiac critical care | Pediatric cardiac critical care fellows with both backgrounds | F1 | 9 Blocks | Please refer to Appendix A | CanMEDS (ME, COM, COL, L, HA, P, S) ACGME (PC, MK, COM, P, SBP, PBL) |
| Pediatric critical care | Pediatric cardiac critical care fellows with pediatric cardiology background | F1 | Blocks 2 | Please refer to Appendix A | CanMEDS (ME, COM, COL, L, HA, P, S) ACGME (PC, MK, COM, P, SBP, PBL) |
| Cardiac anesthesia and cardiac operation room | Pediatric cardiac critical care fellows with pediatric cardiology background (mandatory) or as elective for fellows with PICU background | F1 | Block 1 | Please refer to Appendix A | CanMEDS (ME, COM, COL, HA, S, S) ACGME (PC, MK, COM, P, PBL) |
| Echocardiography rotation | Pediatric cardiac critical care fellows with PICU background | F1 | Block 1 | Please refer to Appendix A | CanMEDS (ME, COL, HA, P, S) ACGME (PC, MK, COM, P, PBL) |
| Cardiac catheterization rotation | Pediatric cardiac critical care fellows with PICU background | F1 | Block 1 | Please refer to Appendix A | CanMEDS (ME, COM, COL, HA, S) ACGME (PC, MK, COM, P, SBP) |
| Electrophysiology rotation | Pediatric cardiac critical care fellows with PICU background | F1 | Block 1 | Please refer to Appendix A | CanMEDS (ME, COM, HA, S) ACGME (PC, MK, COM, P, SBP, PBL) |

# TEACHING METHODS

**The pediatric cardiac critical care fellowship training pogroms implement the adult learning concept in each feature of the activities where fellows are responsible for their own learning requirements. The formal training time should include the following three formal teaching activities:**

- Program-specific learning activities
- Universal topics
- General learning opportunities

## 1. Program-specific learning activities

The program-specific learning activities are educational activities specifically designed and intended for teaching trainees during their training time. Trainees are required to participate in these activities, and non-compliance can subject trainees to disciplinary actions. It is advisable to link attendance and participation in these activities to the continuous assessment tools (see the formative assessment section below). Program administration should support these activities by providing protected time for trainees to participate in such activities.

## 2. Program academic half-day

Every week, at least 2-4 hours of formal training time (commonly referred to as academic half day) should be reserved. Formal teaching time is an activity that is planned in advance with an assigned tutor, time slots, and venue. Formal teaching time excludes bedside teaching, clinic postings, and so on. The academic half day covers the core specialty topics that are determined and approved by the specialty's scientific council aligned with specialty-defined competencies and teaching methods. The core specialty topics will ensure that important clinical problems of the specialty are well taught. It is recommended that lectures are delivered in an interactive, case-based discussion format. The learning objectives of each core topic need to be clearly defined, and it is preferable to use pre-learning materials. Whenever applicable, core specialty topics should include workshops, team-based learning (TBL), and simulations to develop skills in core procedures. Regional supervisory committees should work in coordination with academic and training affairs, program directors, and chief fellows to ensure the planning and implementation of academic activities as indicated in the curriculum. The trainee should be actively involved in the development and delivery of topics under faculty supervision. Involvement might be in the form of delivery, content development, research, and so on. The supervisor's educator should make sure that the discussion of each topic is stratified into the three categories of the learning domain: knowledge, skills, and attitudes (see Appendix C for table of knowledge topic-list). The recommended number of half-days conducted annually is 40 sessions per training academic year, reserving time for other forms of teaching methods such as journal clubs and clinical/practical teaching. Through the fellowship training committee, program directors and chief fellows should work in coordination with academic and training affairs and regional supervisory committees to ensure the planning and implementation of academic activities as indicated in the curriculum. This should aim for the efficient use of available resources and the optimization of the exchange of expertise (see Appendix C).

## 3. Clinical/practical teaching

This includes attending courses and workshops (e.g., simulations, standardized patient programs, bedside teaching, research methodology courses, and evidence-based medicine courses). This will allow each program to describe the required courses or workshops in detail, including the objectives of the course or the workshop, the teaching methods, the expected time to complete the course/workshop during training, and the assessment methods applied for each activity. It is highly advisable to integrate these activities with relevant formative assessment tools (e.g., DOPS, mini-CES, logbook, etc.).

## 4. Practice-based learning

Training exposures during bedside, Lab, OR, and other work-related activities represent excellent targets for learning. Trainees are expected to build their capacity based on self-directed learning. On the other hand, practice-based learning allows the educator to supervise trainees to become competent in the required program practical skills that ensure fulfilling knowledge, psychomotor, and/or attitude learning domains. Each trainee needs to maintain a logbook documenting the procedures observed, performed either under supervision or independently (refer to Appendix C). It would be prudent to determine the minimum number of procedures to be performed before training completion and the minimum number needed to maintain competency after certification.

## 5. Universal Topics (UT)

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

- Are of high value
- Are interdisciplinary and integrated
- Require expertise that might be beyond the availability of the local clinical training sites

Universal topics have been developed by the SCFHS and are available, as e-learning via personalized access for each trainee (to access the online modules). Each universal topic will include a self-assessment at the end of the module. As indicated in the "executive policies of continuous assessment and final completion," universal topics are a mandatory component of the criteria for program completion. Universal topics will be distributed throughout the entire training period. Please refer to Table XX for the universal topics modules assigned to the training year/stage of your program.

### Module 1 – Introduction

1. Safe drug prescription
2. Hospital-acquired infections (HAIs)
3. Antibiotic stewardship
4. Blood transfusion

### 1. Safe drug prescription:

At the end of the learning unit, fellows should be able to:

- Recognize the importance of safe drug prescription in healthcare.
- Describe various adverse drug reactions with examples of commonly prescribed drugs that can cause such reactions.
- Apply the principles of drug–drug, drug–disease, and drug–food interactions in common situations.
- Apply the principles of prescribing drugs in special situations such as renal failure and liver failure.
- Apply the principles of prescribing drugs for the elderly, children, and pregnant or lactating women.
- Promote evidence-based, cost-effective prescription.
- Discuss the ethical and legal framework governing safe drug prescription in Saudi Arabia.

### 2. Hospital acquired infections (HAIs):

At the end of the learning unit, fellows should be able to:

- Discuss the epidemiology of HAIs with special reference to HAIs in Saudi Arabia.
- Recognize HAIs as one of the major emerging threats in healthcare.
- Identify the common sources and set-ups of HAIs.
- Describe the risk factors of common HAIs such as ventilator-associated pneumonia, methicillin-resistant Staphylococcus aureus, central line-associated bloodstream infections, and vancomycin-resistant enterococcus.
- Identify the role of HCWs in the prevention of HAIs.
- Determine appropriate pharmacological (e.g., selected antibiotic) and non-pharmacological (e.g., removal of indwelling catheter) measures in the treatment of HAIs.
- Propose a plan to prevent HAIs in the workplace.

### 3. Antibiotic stewardship:

At the end of the learning unit, fellows should be able to:

- Recognize antibiotic resistance as one of the most pressing public health threats globally.
- Describe the mechanism of antibiotic resistance.
- Determine what constitutes appropriate and inappropriate use of antibiotics.
- Develop a plan for safe and proper antibiotic usage, including indications, duration, types of antibiotics, and discontinuation.
- Appraise local guidelines on the prevention of antibiotic resistance.

### 4. Blood transfusion:

At the end of the learning unit, fellows should be able to:

- Demonstrate knowledge of the different components of blood products available for transfusion.
- Recognize the indications and contraindications of blood product transfusion.
- Discuss the benefits and risks of transfusion and alternatives.
- Obtain consent for specific blood product transfusion.
- Perform steps necessary for safe transfusion.
- Develop an understanding of special precautions and procedures necessary during massive transfusions.
- Recognize transfusion-associated reactions and provide immediate management.

## Module 4 – Medical and Surgical Emergencies

- Management of the altered level of sensorium.
- Management of hypotension and hypertension.
- Management of GI bleeding.
- Management of arrhythmia.
- Management of pulmonary hypertension.

For all the above, following learning outcomes apply.at the end of the learning unit, fellows should be able to:

- Triage and categorize patients.
- Identify patients who need prompt medical and surgical attention.
- Make preliminary diagnoses based on history and physical examination.
- Order and interpret urgent investigations.
- Provide appropriate immediate management to patients.
- Refer the patients to the next level of care, if needed.

## Module 5 – Acute Care

1. Postoperative care.
2. Acute pain management.
3. Chronic pain management.
4. Management of fluids in the hospitalized patient.
5. Management of electrolyte imbalances.

### 1. Postoperative care:

At the end of the learning unit, fellows should be able to:

- Devise a postoperative care plan including monitoring of vitals, pain management, fluid management, medications, and laboratory investigations.
- Hand patients over properly to appropriate facilities.
- Demonstrate knowledge of the process of postoperative recovery in a patient.
- Identify common postoperative complications.

- Monitor patients for possible postoperative complications.
- Institute immediate management of postoperative complications.

### 2. Acute pain management:

At the end of the learning unit, fellows should be able to:

- Demonstrate knowledge of the physiological basis of pain perception.
- Proactively identify patients who might be in acute pain.
- Assess patients with acute pain.
- Apply various pharmacological and non-pharmacological modalities available for acute pain management.
- Provide adequate pain relief for uncomplicated patients with acute pain.
- Identify and refer patients with acute pain who can benefit from specialized pain services.
- Identify and refer patients with chronic pain who can benefit from specialized pain services.

### 3. Chronic pain management:

At the end of the learning unit, fellows should be able to:

- Demonstrate knowledge of the bio-psychosocial and physiological basis of chronic pain perception.
- Discuss various pharmacological and non-pharmacological options available for chronic pain management.
- Provide adequate pain relief for uncomplicated patients with chronic pain.

### 4. Management of fluids in hospitalized patients:

At the end of the learning unit, fellows should be able to:

- Review the physiological basis of water balance in the body.
- Assess a patient's hydration status.
- Recognize a patient with over- and under-hydration.
- Order fluid therapy (oral as well as intravenous) for a hospitalized patient.
- Monitor fluid status and response to therapy through history, physical examination, and selected laboratory investigations.

### 5. Management of acid-base and electrolyte imbalances:

At the end of the learning unit, fellows should be able to:

- Review the physiological basis of electrolyte and acid-base balance in the body.
- Identify diseases and conditions that are likely to cause or are associated with acid-base and electrolyte imbalances.
- Correct electrolyte and acid-base imbalances.
- Perform careful calculations, checks, and other safety measures while correcting acid-base and electrolyte imbalances.
- Monitor response to therapy through history, physical examination, and selected laboratory investigations.

## Module 7 – Ethics and Healthcare

1. Occupational hazards among healthcare workers.
2. Patient advocacy.
3. Ethical issues: transplantation/organ harvesting and withdrawal of care.
4. Ethical issues: treatment refusal and patient autonomy.
5. Role of doctors in death and dying.

### 1. Occupational hazards among healthcare workers (HCWs):

At the end of the learning unit, fellows should be able to:

- Recognize the common sources and risk factors of occupational hazards among HCWs.
- Describe common occupational hazards in the workplace.
- Develop familiarity with the legal and regulatory frameworks governing occupational hazards among HCWs.
- Develop a proactive attitude toward promoting workplace safety.
- Protect themselves and colleagues against potential occupational hazards in the workplace.

### 2. Patient advocacy:

At the end of the learning unit, fellows should be able to:

- Define patient advocacy.
- Recognize patient advocacy as a core value governing medical practice.
- Describe the role of patient advocates in the care of patients.
- Demonstrate a positive attitude toward patient advocacy.
- Be a patient advocate in conflicting situations.
- Demonstrate knowledge of local and national patient advocacy groups.

### 3. Ethical issues: transplantation/organ harvesting and withdrawal of care:

At the end of the learning unit, fellows should be able to:

- Apply key ethical and religious principles governing organ transplantation and withdrawal of care.
- Be familiar with the legal and regulatory guidelines about organ transplantation and withdrawal of care.
- Counsel patients and families in the light of applicable ethical and religious principles.
- Guide patients and families to make informed decisions.

### 4. Ethical issues: treatment refusal and patient autonomy:

At the end of the learning unit, fellows should be able to:

- Predict situations where a patient or family is likely to decline the prescribed treatment.
- Describe the concept of a "rational adult" in the context of patient autonomy and treatment refusal.
- Analyze key ethical, moral, and regulatory dilemmas in case of treatment refusal.
- Recognize the importance of patient autonomy in the decision-making process.
- Counsel patients and families who decline medical treatment in light of the patient's best interests.

### 5. Role of doctors in death and dying:

At the end of the learning unit, fellows should be able to:

- Recognize the importance of doctors' roles in the dying process.
- Provide emotional and physical care to a dying patient and his/her family.
- Provide appropriate pain management to a dying patient.
- Identify and refer suitable patients to palliative care services.

# UNIVERSAL TOPICS MODULES

Topics to be completed by the end of the fellowship program if not completed prior to joining the program:

## Universal Topics
## Module 1 – Introduction

Safe drug prescription

Hospital-acquired infections (HAIs)

Antibiotic stewardship

Blood transfusion

## Module 4 – Medical and Surgical Emergencies

Management of the altered level of sensorium

Management of hypotension and hypertension

Management of upper GI bleeding

## Module 5 – Acute Care

Postoperative care

Acute pain management

Chronic pain management

Management of fluids in the hospitalized patient

Management of electrolyte imbalances

## Module 6 – Ethics and Healthcare

Occupational hazards among healthcare workers

Patient advocacy

Ethical issues: transplantation/organ harvesting and withdrawal of care

Ethical issues: treatment refusal and patient autonomy

Role of doctors in death and dying

### General Learning Opportunities:

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

- Journal clubs
- Grand rounds
- Involvement in quality improvement committees and meetings
- Continuous professional activities (CPD) relevant to specialty
- Morbidity and Mortality (M&M)

The M&M conference offers trainees an opportunity to discuss patient cases where adverse effects had occurred due to errors or complications. The goal of this resource is to refocus the content of morbidity and mortality and transform it into a platform for teaching patient safety principles and emphasizing error reduction strategies.

# ASSESSMENT AND EVALUATION

**Topics to be completed by the end of the fellowship program if not completed prior to joining the program:**

## 1. Purpose of Assessment

Assessment plays a vital role in the success of postgraduate training. Assessment will guide trainees and trainers to achieve defined standards, learning outcomes, and competencies. On the other hand, 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 to assess the curriculum alignments between the objectives, learning methods, and assessment methods. Finally, assessment assures patients and the public that health professionals are safe and competent to practice their profession.

Assessment can serve the following purposes:

a. Assessment for learning: Trainers will use information about trainees' performance to inform their learning for improvement. It enables educators to use information about trainees' knowledge, understanding, and skills to provide feedback to trainees about learning and how to improve.

b. Assessment as learning: It involves trainees in the learning process, which enables them to monitor their own progress. Trainees use self-assessment and educators' feedback to reflect on their progression. It develops and supports trainees' metacognitive skills. Assessment as learning is crucial for helping fellows become lifelong learners.

c. Assessment of learning: It is used to demonstrate achievement of your learning. This is a graded assessment, and it usually counts toward the trainee's end-of-training degree.

d. Feedback and evaluation: Assessment outcomes will represent quality metrics that can improve learning experience.

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

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

# 2. Formative Assessment

## 2.1 General Principles

Trainees, as adult learners, 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. Every two weeks, trainees should allocate at least 1 hour to meet with their mentors, in order to review performance reports (e.g., ITER, e-portfolio, etc.). Input from the overall formative assessment tools will be utilized at the end of the year to make a decision on promoting each individual trainee from current-to-subsequent training level. Formative assessment will be defined based on the scientific (council/committee) recommendations (usually updated and announced for each individual program at the start of the academic year). According to the executive policies on continuous assessment (available online: www.scfhs.org), formative assessment will have the following features that will be used based on Miller's pyramid (Appendix D):

- Multisource: a minimum of four tools.
- Comprehensive: covering all learning domains (knowledge, skills, and attitudes).
- Relevant: focusing on workplace-based observations.
- Competency-milestone oriented: reflecting trainees' expected competencies that match their developmental level.

Trainees should play an active role in seeking feedback during their training. On the other hand, trainers are expected to provide timely and formative assessments. The SCFHS will introduce an e-portfolio system to enhance communication and analysis of data arising from formative assessment.

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 evaluation forms.

## 2.2 Formative Assessment Tools

| Learning Domain | Formative Assessment Tools | Important details (e.g., frequency, specifications related to the tool) |
|---|---|---|
| Knowledge | Structured Oral Exam (SOE) | Midyear assessment |
| | Final Written Exam | At the End of the F1 year<br>The number of exam items, eligibility, and passing scores will be the responsibility of the PCCCF scientific committee |
| Skills | • OSCE: Objective structured clinical examination | Fellows are required to pass the final written exam in order to be eligible to sit for the final clinical/practical exam. |
| | • DOPS: Direct Observation for Procedural Skills | Every 3 months |
| | • Logbook | Once every 3 months and at the end of a given rotation. |
| Attitude | • ITER: In-Training Evaluation Report | For PCCC rotation every 3 months and for other rotations at the end of rotation |

### 1. In-Training Evaluation Rotation (ITER)

To achieve the CanMEDS competencies based on the end of the rotation evaluation, the fellow's performance (F1) will be evaluated by PCCC consultants for the following competencies:

- Performance of the trainee during daily work.
- Performance and participation in academic activities.
- Trainers should provide timely and specific feedback to the trainee after each assessment of a trainee-patient encounter.
- Performance of diagnostic and therapeutic procedural skills by the trainee. Timely and specific feedback for the trainee after each procedure is mandatory.
- The CanMEDS-based competencies end-of-rotation evaluation form must be completed within two weeks following the end of each rotation (preferably in an electronic format) by at least two consultants.
- The fellow's in-training evaluation should be signed by the program director who will discuss it with the fellow.
- The fellow should sign the evaluation form.
- The evaluation form will be submitted to the PCCC fellowship committee at the SCFHS within four weeks following the end of the rotation.

### 2. Structured Oral Examination (SOE)

- A performance assessment method using case scenarios with PCCC consultants questioning a candidate in a structured and standardized manner.
- This exam format assesses the "know how" of clinical decision-making and the application or use of medical knowledge using realistic patient scenarios.
- It will be considered as a midyear assessment.

### 3. Logbook

- The logbook will be electronically filled and monitored to assess the performance of the procedures for F1.
- Trainees and faculty must meet to review the portfolio and logbook once every three months and at the end of a given rotation.
- The purposes of the logbook are as follows:
- Monitor trainees' performance on a continual basis
- Maintain a record of procedures and technical interventions performed
- Enable the trainee and supervisor to determine the learning gaps
- Provide a basis for feedback to the trainee

### 4. Final Written Exam

- To be eligible for this exam, trainees are required to have "Certification of Training-Completion."
- The number of exam items, eligibility, and passing scores are the responsibility of the PCICU scientific committee.

**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:
• In case the candidate scored "borderline failure" in a maximum of one or two components, and these scores should not belong to the same area of assessment (for example, both borderline failures should not belong to skills).
• The candidate must have passed all other components and scored a minimum of clear pass in at least two components.

# 3. Summative Assessment

## 3.1 General Principles

Summative assessment is the component of assessment that aims primarily to make informed decisions on trainees' competency. In comparison to the formative one, summative assessment does not aim to provide constructive feedback. For further details on this section, please refer to general bylaws and executive policies of assessment (available online: www.scfhs.org). To be eligible for the final exams, a trainee should be granted "Certification of Training-Completion".

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

**Blueprint of the final exam is shown in the following table:**

**Example of a Written Exam Blueprint**

| Sections Acute Subsection: | MCQs percentage for each subsection | Domain 1: Pathophysiology & Etiology | Domain 2: Investigation & Diagnosis | Domain 3: Management | Domain 4: Outcome |
|---|---|---|---|---|---|
| Cardiovascular (Preoperative and postoperative care) | 17 | 5 | 4 | 5 | 3 |
| Respiratory | 10 | 3 | 2 | 3 | 2 |
| Neurology | 5 | 1 | 1 | 2 | 1 |
| Infectious Diseases inflammation | 5 | 1 | 1 | 2 | 1 |
| Renal and Electrolyte | 6 | 1 | 1 | 3 | 1 |
| Endocrinology | 3 | 1 | | 2 | |
| Hematology | 7 | 1 | 1 | 5 | |
| Gastroenterology/ Nutrition | 5 | 1 | 1 | 2 | 1 |
| Pharmacology | 10 | 1 | 2 | 7 | |
| Anesthesia Cardiac surgery | 14 | 3 | 3 | 5 | 3 |
| Procedures Monitoring and other cardiac ICU issues | 7 | 2 | 3 | 2 | |
| Research and ethics | 5 | 1 | 1 | 2 | 1 |
| Mechanical Cardiovascular support and heart transplantation | 6 | 1 | 1 | 2 | 2 |
| TOTAL | 100 | 22 | 21 | 42 | 15 |

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

## 3.3 Certification of Training-Completion

In order to be eligible for the final specialty examinations, each trainee should be granted "Certification of Training-Completion." Based on the training bylaws and executive policies (please refer to www.scfhs.org), trainees will be granted "Certification of Training-Completion" once the following criteria are fulfilled:

- Successful completion of all training rotations.
- Completion of training requirements (e.g., logbook, others) as outlined in FITER that is approved by the scientific council/committee of the specialty.
- Clearance from the SCFHS training affairs that ensures compliance with tuitions payment and completion of universal topics.

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

## 3.4 Final Specialty Examinations

• Final specialty examination is the summative assessment component that grants trainees the specialty's certification. It is composed of two elements:
• Final written exam: to be eligible for this exam, trainees are required to have "Certification of Training-Completion."
• Final clinical/practical exam: Trainees will be required to pass the final written exam to be eligible for the final clinical/practical exam.
• Blueprint Outlines: The content of the following table is for demonstration only; please refer to the most updated version published on the SCFHS website.
• The blueprint of the final written and clinical/practical exams is shown in the following table:

Example of a Final Clinical Exam Blueprint

| Domain for integrated clinical encounter | Patient management | Procedure and technical skills | Communication and professional behavior | #station |
|---|---|---|---|---|
| Central nervous system | 1 | | | 1 |
| Respiratory system | 1 | 1 | | 2 |
| Cardiovascular system | 3 | 2 | | 5 |
| Infectious and hematology system | 1 | | | 1 |
| Psychosocial aspects | | | 1 | 1 |
| Total station | 6 | 3 | 1 | 10 |

# PROGRAM AND COURSES EVALUATION

The SCFHS will take 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. Trainees' assessment (both formative and summative) results will be analyzed and mapped on to the curriculum content. Other indicators that will be incorporated are:

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

Goal Based Evaluation: The intended milestones achievement 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 subject-matter opinion, best practices from benchmarked international programs, the SCFHS will adopt a robust method to ensure that this curriculum will utilize all the data that will be available when revising this curriculum in the future.

# POLICIES AND PROCEDURES

This curriculum represents the means and materials outlining learning objectives with which trainees and trainers will interact for the purpose of achieving 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 processes related to training. General bylaws regarding training, assessment, and accreditation as well as executive policies on admission, registration, continuous assessment and promotion, examination, trainees’ representation and support, duty hours, and leaves are examples of regulations that need to be enforced. Trainees, trainers, and supervisors need to apply this curriculum in compliance with the most updated bylaws and policies accessible online via the official SCFHS website.

# APPENDICES



## Appendix A

Fellow Competency: Competency, Learning Domain, and Milestones
Upon completing the fellowship training program in pediatric cardiac critical care within one year, the candidate will have acquired the knowledge, skills, and competency to function at a consultant level with a solid academic background in pediatric cardiac critical care and will be able to diagnose and manage pediatric cardiac critical cases.

| Training year level: first year PCICU fello | Competency-Roles with annotation of learning domains involved: K: knowledge, S: skills, A: attitude) | Professional Activities Related to Specialty | | | | | |
|---|---|---|---|---|---|---|---|
| | | Conducting full patient clinical assessment | Managing high risk pediatric cardiac patients with medical problems or | Managing patients before and after cardiac surgery | Managing pediatric cardiac patients with other medical problems | Managing unstable children with known cardiac conditions | Compliance with documentation and proper reporting standards |
| | Professional Expert | Mastering history taking and physical examination K, S | High risk children with cardiac conditions, medical or surgical K, S, A | Clinical and laboratory evaluation relevant to critical children with cardiac conditions K, S | Assessing and managing heart failure K, S | Evaluating and managing unstable children with cardiac diseases K, S | Relevant documentation of daily patient care, prescriptions, discharge summaries K, S, A |
| | Communicator | Effectively communicating with the patient and guardian K, S, A | Effectively communicating with parents and team members K, S, A | Obtaining informed consent. Developing a trusting and ethical therapeutic relationship with patients and families. K, S | Accurately eliciting and synthesizing relevant information and perspectives of patients and families, colleagues, and other professionals. K, S, A | Accurately conveying relevant information and explanations to patients and families, colleagues, and other professionals. K, S, A | Writing, dictation, and presentation skills K, S |
| | Collaborator | | Multidisciplinary, teamwork S, A | Participating effectively and appropriately in an inter-professional healthcare team. S, A | Seeking support from senior physicians when needed. K, S, A | Effectively working with other health professionals to prevent, negotiate, and resolve inter-professional conflicts. K, S, A | Inter-professional communication. A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Advocate** | Applying a holistic approach and preventive medicine. K, S, A | Responding to individual patient health needs and issues as part of patient care. | Responding to the health needs of the communities that they serve. K, S, A | Maintaining patient safety. K, S, A | Identifying the determinants of health within the populations that they serve. K, S, A | Quality improvement and promoting the health of individual patients, communities, and populations. K, S, A |
| | **Leader** | Manage time efficiently. | Lead the team. S, A | | Lead the situation for the patient's best interests. S, A | Lead the situation for the patient's best interests S, A. | Quality assurance. K, S, A |
| | **Scholar** | Maintaining and enhancing professional activities through ongoing learning | Critically evaluating information and its sources and applying this appropriately to practice decisions. | Applying evidence- based practices. K, S | Facilitating the learning of patients, families, students, residents, other health professionals, the public, and others as appropriate. K, S | Applying evidence- based practices. K, S | Contributing to the creation, dissemination, application, and translation of new medical knowledge and practices. |
| | **Professional** | Demonstrating a commitment to their patients, profession, and society through ethical practices. A | Maintain confidentiality and good inter-professional relations. A | Demonstrating commitment to physicians' health and sustainable practices. A | | | |

# Appendix B

| Procedures | Minimum number required |
|---|---|
| 1. Intubation | 20 |
| 2. Central Venous Access<br>a. Femoral<br>b. Internal Jugular<br>c. Subclavian | 20 |
| 3. Arterial Line Insertion<br>a. Radial<br>b. Femoral<br>c. Axillary<br>d. Brachial | 10 |
| 4. Chest tube insertion/pleural drain | 5 |
| 5. Percutaneous peritoneal drainage | 2 |
| 6. Critical ultrasound for intensivists | 20 |

# Appendix C

Top topics and simulations

| Examples of Core Specialty Topics: Case Discussions; Interactive Lectures | |
|---|---|
| **Topics** | **Comments** |
| **1. Cardiopulmonary physiology:**<br>a) Determinants of, and means of influencing, oxygen delivery, cardiac output, and vascular resistance.<br>b) The physiology of the patient with a single ventricle, including determinants of, and means of influencing, systemic arterial oxygen saturation, systemic perfusion, and myocardial work.<br>c) The physiology of the patient with a ductal-dependent left-sided obstructive lesion, including determinants of, and means of influencing, systemic arterial oxygen saturation, systemic perfusion, and myocardial work.<br>d) The physiology of the patient with a fixed restriction of pulmonary blood flow, including determinants of, and means of influencing, systemic arterial oxygen saturation, systemic perfusion, and myocardial work.<br>e) The physiology associated with d-transposition of the great arteries.<br>f) The physiology of cardiopulmonary interaction, including how mechanical ventilation affects cardiac output. | Case discussion & interactive lectures |

| | |
|---|---|
| **2. Cardiovascular pharmacology:**<br><br>The trainee should learn the actions, mechanisms of action, side effects, and clinical use of:<br>a) Inotropic agents (e.g., digoxin, adrenergic agonists, and phosphodiesterase inhibitors).<br>b) Vasodilators/antihypertensive agents (e.g., alpha adrenergic antagonists, angiotensin-converting enzyme inhibitors, calcium channel antagonists, and beta-adrenergic antagonists).<br>c) Commonly used antiarrhythmic drugs (e.g., digoxin, procainamide, lidocaine, and amiodarone).<br>d) Inhaled nitric oxide.<br>e) Prostaglandin E1.<br>f) Neuromuscular blocking agents (e.g., pancuronium, succinylcholine).<br>g) Analgesics and sedatives (e.g., morphine, fentanyl, ketamine, and benzodiazepines).<br>h) Anticoagulants (unfractionated and low molecular weight heparin, warfarin).<br>i) Diuretics (e.g., furosemide, chlorothiazide).<br>j) Prostacyclin and other pulmonary vasodilators. | Case discussion & interactive lectures |
| **3. The relationship between cardiac structure, function, and clinical state:**<br><br>The trainee should learn:<br>a) How cardiac structural abnormalities (e.g., obstruction of the atrial septum in hypoplastic left heart syndrome) affect the cardiopulmonary function, physiology, and hence clinical state of the patient.<br>b) Methods (e.g., echocardiography, invasive pressure measurements, arterial blood gas analysis, and magnetic resonance imaging) to determine and measure cardiac structure, function, and physiology in the ICU patient and the limitations of these techniques.<br>c) Indications for remedy of structural lesions (in both unoperated and operated patients) and appropriate means of therapy (surgical, catheter-based intervention). | Case discussion & interactive lectures |
| **4. Diagnosis and therapy of arrhythmias:**<br><br>Especially those occurring in ICU patients. In particular, the trainee should be familiar with the use of atrial and ventricular pacing leads or transesophageal electrocardiography for diagnosing and treating arrhythmias and the diagnosis and therapy of junctional ectopic tachycardia. | Case discussion & interactive lectures |

| | |
|---|---|
| 5. Airway management skills.<br>6. Provision of analgesia and sedation.<br>7. Conducting cardiopulmonary resuscitation.<br>8. Commonly used modes of mechanical ventilation and their application in patients with heart disease.<br>9. Common complications that occur in cardiac patients in the ICU and how they may be prevented and treated. The trainee should be familiar with factors that predispose to common postoperative complications (e.g., catheter-related sepsis, pathological thrombosis, and surgically induced heart block), appropriate diagnostic techniques, and therapy for these complications.<br>10. Familiarity with extracorporeal membrane oxygenation and other cardiac support systems.<br>11. Indications for and general principles of providing "end-of-life" or "palliative" care. | Case discussion & interactive lectures |
| Acute Kidney Injury in the Postoperative Care | Case discussion & interactive lectures |
| Coagulation Disorders and Anticoagulation in the Postoperative Care | Case discussion & interactive lectures |
| Sepsis and Multiorgan Dysfunction in the Cardiac Intensive Care Unit | Case discussion & interactive lectures |
| Heart Transplantation | Case discussion & interactive lectures |

| Examples of Core Specialty Topics: Workshops/Simulation | |
|---|---|
| **Topics** | **Comments** |
| Pediatric Advanced Life Support Course | Mandatory |
| ECMO Course (Local or International) | Mandatory |
| Neonatal and Pediatric Critical Care Ultrasound Course | Optional |
| Difficult Airway Management Course | Optional |
| Pediatric Fundamental Cardiac Critical Care Support Course | Optional |

# Half-day activities

The following is a table with example topics that illustrate the half-day activities as it spans over the course of one year (date is variable in every upcoming year).

| Professional Activities Related to Specialty | | | | | |
|---|---|---|---|---|---|
| Academic week | Section | Date | Time | Sessions | Presenters |
| 1 | Fundamentals in Pediatric Cardiac Critical Care I | January 5 | 13:00-14:00 | Introduction to the program | Program director |
| | | | 14:00-15:00 | Case-based study** | A |
| | | | 15:00-16:00 | Cardiopulmonary Physiology | B |
| 2 | Fundamentals | January 12 | 13:00-14:00 | Principles of Cardiopulmonary Bypass | C |
| | | | in Cardiac Surgery | Case-based study | D |
| | | | 15:00-16:00 | Intraoperative Myocardial Protection | E |
| 3 | Fundamentals in Pediatric Cardiology | January 19 | 13:00-14:00 | Physiology of Fetal and Neonatal Circulation | F |
| | | | 14:00-15:00 | Case-based study | B |
| | | | 15:00-16:00 | Congenital Heart Disease | C |
| 4 | Fundamentals in Pediatric Cardiac Critical Care II | January 26 | 13:00-14:00 | Journal club* | K |
| | | | 14:00-15:00 | Case-based study | B |
| | | | | Cardiovascular Pharmacology | A |

* Journal clubs could be conducted at the evening time or during the half day.
** Case-based studies could be made at the evening time or during the half day.

# Appendix D

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

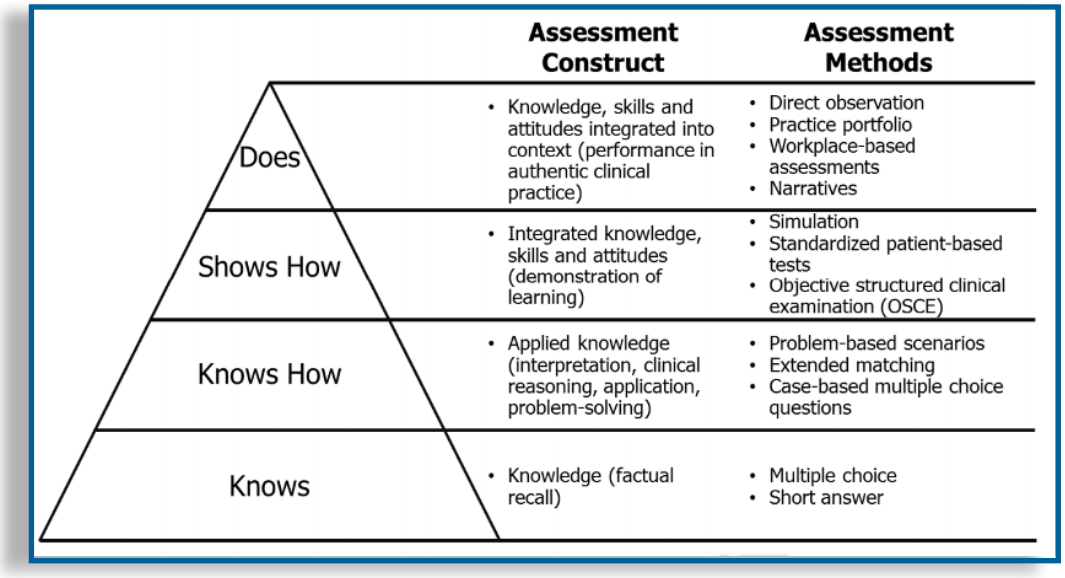


Figure1: Miller's Pyramid

• Adapted from: Walsh CM. In-training gastrointestinal endoscopy competency assessment tools: types of tools, validation and impact. Best Practice & Research Clinical Gastroenterology. 2016 Jun 1;30(3):357-74.
• Miller GE. The assessment of clinical skills/competence/performance. Acad Med. 1990;65(9 Suppl): S63–7.

# Appendix E

| Glossary | |
|---|---|
| Blueprint | Description correlating educational objectives with assessment contents. For example, 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 entrustment of a trainee by completing the program with the required knowledge, skills, and attitudes needed to practice the profession unsupervised. |
| Specialty Core Content (skills, knowledge, and professional attitudes) | Specific knowledge, skills, or professional attitudes that are 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 primarily intended for making judgments or decisions (though they can be a secondary gain). |
| Mastery | Exceeding the minimum level of competency to reach the proficient level of performance, indicating rich experience in addition to great knowledge, skills, and attitudes. |
| Portfolio | A collection of lines of evidence of progression toward competency. It may include both constructed components (defined by mandatory continuous assessment tools in the 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 judgments and decisions about the level of learning and certification. |
| Universal Topic | Knowledge, skills, or professional behaviors that are not specific to the given specialty but are universal for the general practice of a given healthcare profession. |

# Appendix F

## REFERENCES

Stromberg, D. (2004). Pediatric cardiac intensivists: Are enough being trained? Pediatric Critical Care Medicine, 5(4), 391-392.

• Gillette, P. C. (1999). Pediatric cardiac intensive care Edited by Anthony C. Chang, Frank L. Hanley, Gil Wernovsky, and David L. Wessel Williams & Wilkins, Baltimore (1998) 587 pages, illustrated, ISBN: 0–683–01508–7. Clinical Cardiology, 22(6), 437.

• Kulik, T., Giglia, T. M., Kocis, K. C., Mahoney, L. T., Schwartz, S. M., Wernovsky, G., & Wessel, D. L. (2005). Task Force 5: requirements for pediatric cardiac critical care. Journal of the American College of Cardiology, 46(7), 1396-1399.

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