

# **PAEDIATRIC CARDIOLOGY TRAINING PROGRAMME**

## **Paediatric Cardiology Subspecialty Development Group**

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## **1. Background**

Since the first paediatric open heart surgery performed in the 1960s in Hong Kong, the subspecialty of paediatric cardiology has continued to develop and evolve over the past 5 decades. In the past 3 decades in particular, we have witnessed remarkable success in the development and provision of a comprehensive paediatric cardiology service in Hong Kong. The efforts and dedication made by our predecessors in this field working at Queen Mary Hospital, Grantham Hospital, Queen Elizabeth Hospital, and Prince of Wales Hospital, and colleagues currently working at the public, private, and the academic sectors are duly acknowledged.

With the commencement in 2021 of the paediatric cardiology service at the Hong Kong Children's Hospital, the only tertiary paediatric cardiology centre in the territory, and the establishment of the hub-and-spoke model for delivery of territory-wide paediatric cardiology service, it is timely for development of a comprehensive and structured paediatric cardiology training programme to nurture future generations of paediatric cardiologists in Hong Kong to ensure continued provision of quality care to children with heart disease.

Members of the Paediatric Cardiology Subspecialty Development Group, who are currently serving the public, private and academic sectors, agreed on the timeliness of the application for accreditation of a structured paediatric cardiology training programme in Hong Kong. These members are Fellows of the Hong Kong of Paediatricians and are recognized locally, regionally, and/or internationally as experts in the field of the paediatric cardiology. The proposal as presented represents the outcomes based on rounds of discussion among all members of the group.

## 2. Objectives

Paediatric Cardiology is a branch of paediatric medicine that involves the diagnosis and management of children and adolescents with structural congenital heart disease, acquired heart disease, cardiomyopathies, and cardiac arrhythmias.

Upon completion of the training, the trainee is expected to have acquired the knowledge, skills, and attitude necessary for the delivery of quality care to children presenting with cardiac complaints and those diagnosed to have cardiac disorders.

The objective of the Paediatric Cardiology Training Programme is to provide a comprehensive and structured framework for trainees to acquire competence in the following aspects:

- i) Generic capabilities including skills in communication and teamwork, adoption of evidence-based practice, research, teaching, and improving the health care system
- ii) Core knowledge on the embryology, anatomy, genetics, pathophysiology, clinical manifestations, diagnosis, and management of paediatric cardiac conditions
- iii) Clinical skills in history taking, physical examination, and request of appropriate cardiac investigations
- iv) Ability to formulate differential diagnosis and to confirm the diagnosis
- v) Skills in performing cardiac procedures and interpretation of cardiac investigation findings
- vi) Ability to counsel patient and family with regard to the management plan, recommendation of treatment options and their indications and risks, and prognosis of the cardiac condition

### **3. Paediatric Cardiology Subspecialty Training Programme**

#### **3.1 Overview**

The Paediatric Cardiology subspecialty training programme is a 36-month curriculum designed to equip trainees with generic and subspecialty-specific capabilities and procedural skills required for quality clinical care of children with heart disease. The curriculum will be delivered through work-based experiential learning, postgraduate teaching, self-directed learning, and participation in relevant courses and paediatric cardiology meetings.

The trainees must have completed 3 years of basic training in general paediatrics and have passed the Joint MRCPCH (UK) / Hong Kong College of Paediatricians Intermediate Examination. One year of subspecialty training may overlap with the higher training in general paediatrics with prior approval by the Subspecialty Board of Paediatric Cardiology. At the discretion of the Paediatric Subspecialty Board, certain degree of flexibility can be allowed to recognize the cumulative nature of achievement of the total of 36 months of subspecialty training.

The training programme should in principle be continuous. Any one period of interruption should not be more than 12 weeks. Only one period of continuous or cumulative 12-week leave would be allowed (other than the entitled statutory leave, annual leave and casual leave) during the 3-year Subspecialty Training Programme. Trainees taking leave more than that would be required to extend his/her training period to make up for the interruption in excess of 12 weeks during the subspecialty training.

The training programme is offered in the paediatric cardiology centre (Hong Kong Children's Hospital in this locality) and training networking units (as defined in section 3.4). All trainees shall undergo at least 24 months of training in a paediatric cardiology centre (local and/or overseas) and 12 months (or less) in training networking units. Opportunities for further exposure to enhance the acquisition of procedural skills in the paediatric cardiology centre beyond 24 months are available. Trainees are strongly recommended to receive 6 months of overseas training, with approval from the Training Programme Director required, in a paediatric cardiology tertiary referral centre.

A trainee should receive supervised training in at least two but not more than four accredited centres or networking units and should be under supervision of at least two accredited subspecialty trainers during the 3-year subspecialty training programme. Within each training centre or training networking unit, the trainee-to-trainer ratio should be no more than 2:1. During the subspecialty training programme, the trainee should have at least 50% of the time with subspecialty exposure.

During the 3-year training period, all trainees are encouraged to participate in clinical and/or basic scientific studies. Supervision shall be provided by trainers with relevant experience in either of these areas. The attainment of a postgraduate degree (e.g. MSc, MPhil, PhD, or MD) related to paediatric cardiology during the period of training may be recognized as completion of training for up to a maximum of 6 months subject to approval by the Training Programme Director.

### 3.2 Curriculum content

#### PART I. GENERIC CAPABILITIES IN THE PRACTICE OF PAEDIATRIC CARDIOLOGY

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| <b>COMMUNICATION AND TEAMWORK</b>  |
| <b>Objective:</b> To ensure the trainee can communicate effectively and share decision making  |
| <b>Knowledge</b>   |
| <b>Shall know</b> <ul style="list-style-type: none"><li>• The types of communication and interpersonal skills</li><li>• The ways of dealing with complex and dynamic clinical situations</li></ul>   |
| <b>Skills</b>  |
| <b>Shall be able to</b> <ul style="list-style-type: none"><li>• Communicate clearly with patients and carers</li><li>• Communicate effectively with clinical and other professional colleagues</li><li>• Summarize clinical problems concisely to facilitate discussion and formulation of management plan</li><li>• Identify and manage barriers to communication</li><li>• Demonstrate effective verbal and nonverbal communication skills</li><li>• Share decision making by providing information to, prioritizing the wishes of, and respecting the beliefs, concerns and expectations of the patients and family</li></ul> |
| <b>Attitudes</b>   |
| <b>Shall</b> <ul style="list-style-type: none"><li>• Demonstrate an understanding of the importance of communication in clinical practice</li><li>• Demonstrate an understanding of the importance of share decision making in complex clinical situations</li></ul>   |
| <b>HEALTHCARE SYSTEM AND HEALTH ADVOCACY</b>   |
| <b>Objective:</b> To contribute to improve system of care to meet current and future health needs of children with congenital and acquired heart disease   |

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| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The provision of the healthcare system for children with heart disease</li> <li>• Barriers to effective and equitable care</li> <li>• The social, economic, cultural, and psychological determinants of clinical problems and how they affect management</li> </ul>  |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Provide leadership for the judicious use of health resources</li> <li>• Assist patients and families in negotiating barriers to safe, effective and equitable care</li> <li>• Navigate bureaucratic complexities associated with patient care</li> <li>• Advocate for patient-centred provision of paediatric cardiac care</li> <li>• Advocate for children with heart disease who have difficulty accessing care</li> </ul> |
| <b>Attitudes</b>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate a commitment to improve the healthcare to meet the needs of children with heart disease</li> <li>• Demonstrate an understanding of medical, ethical, and legal issues of healthcare delivery</li> <li>• Discuss the social, economic, cultural, and psychological determinants of healthcare delivery</li> </ul>  |
| <b>EVIDENCE-BASED PRACTICE</b>   |
| <p><b>Objective:</b> To demonstrate an understanding of the importance of and the ability to use evidence to guide clinical management</p>   |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The principles of evidence-based medicine</li> <li>• The type and level of evidence</li> <li>• How to search and appraise evidence from various sources</li> </ul>   |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Use internet, databases, and library resources to search for evidence</li> <li>• Appraise critically the available evidence</li> <li>• Identify gaps where important evidence is lacking</li> <li>• Apply an evidence-based approach to optimize patient care</li> <li>• Consolidate and present available evidence with recommendations on clinical management</li> </ul>   |

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| <b>Attitudes</b>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of uncertainties, heuristics and bias in clinical decision-making</li> <li>• Integrate evidence-based medicine to patient care</li> <li>• Change current clinical practice in the light of new evidence</li> <li>• Contribute to research to fill the evidence gaps</li> </ul>  |
| <b>RESEARCH</b>   |
| <p><b>Objective:</b> To demonstrate knowledge of research ethics, design a research study, and conduct a research project from planning to publication</p>  |
| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The principles of research ethics</li> <li>• How to design and conduct a research study</li> <li>• How to perform appropriate statistical analysis</li> <li>• How to write a scientific paper</li> </ul>  |
| <b>Skills</b>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Appraise critically the scientific literature</li> <li>• Frame questions into hypothesis testable by a research project</li> <li>• Manage and analyze clinical information and research data</li> <li>• Demonstrate satisfactory written and verbal presentation skills</li> <li>• Present research findings in the form of an abstract and a scientific paper</li> </ul> |
| <b>Attitudes</b>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Adopt an inquisitive thinking attitude</li> <li>• Demonstrate an understanding of the importance of research in the generation of evidence for the clinical practice of paediatric cardiology</li> <li>• Apply for ethical approval and seek patient consent to conduct clinical research</li> <li>• Ensure confidentiality of data of research subjects</li> </ul>                  |

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| <b>TEACHING AND SUPERVISION</b>  |
| <b>Objective:</b> To ensure the trainee can receive effective teaching, assessment, and appraisal  |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The varied teaching strategy and learning styles</li> <li>• How to structure effective teaching activities</li> <li>• The principles of competency-based training</li> <li>• The principles of formative and summative assessments</li> </ul>  |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Identify learning outcomes and set educational objectives</li> <li>• Design and deliver effective small and large group teaching activities</li> <li>• Select and use appropriate teaching resources</li> <li>• Use work place based assessment and provide feedback through mini-clinical evaluation exercise, direct observation of procedural skills, case-based discussion, and multi-source feedback</li> </ul> |
| <b>Attitudes</b>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate a professional attitude, an enthusiasm, and a commitment to teach</li> <li>• Show respect for the learner</li> </ul>  |

## PART II. CLINICAL CAPABILITIES IN THE PRACTICE OF PAEDIATRIC CARDIOLOGY

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| <b>CLINICAL PRESENTATION</b>  |
| <b>Objective:</b> To assess and manage neonates and infants with cyanosis   |
| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The cardiac and non-cardiac causes of cyanosis in the newborn period</li> <li>• How to distinguish cardiac and non-cardiac causes of cyanosis in the newborn period</li> <li>• The ECG, CXR, and echocardiographic findings in congenital heart disease that presents with cyanosis in the newborn period</li> <li>• The indications, limitations, and risks of invasive and non-invasive investigation in newborns with cyanotic congenital heart disease</li> </ul> |



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| <ul style="list-style-type: none"> <li>The indications and risks of medical therapy, catheter intervention, and surgery in congenital heart disease that presents with cyanosis in the newborn period</li> </ul>  |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>Take a relevant history and perform an appropriate examination</li> <li>Interpret differential oximetry, ECG, CXR, and blood results and appreciate their importance and limitations in reaching a diagnosis</li> <li>Make an accurate anatomical and physiological diagnosis by clinical information, echocardiogram, and other invasive and non-invasive investigations where necessary</li> <li>Initiate prostaglandin E where appropriate and know how to monitor the effect, manage side effects, and titrate the dosage</li> <li>Initiate pulmonary vasodilator therapy and know how to monitor the effect for the management of persistent pulmonary hypertension of the newborn</li> <li>Plan and coordinate urgent surgery or catheter intervention where necessary</li> <li>Coordinate and provide emergency transfer to the cardiac centre</li> <li>Advise referring paediatricians on emergency management before transfer to the cardiac centre</li> <li>Explain the condition of the baby, diagnosis, treatment plan, and prognosis in terms understood by the parents</li> </ul> |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>Demonstrate an understanding of the concerns and anxiety of parents and other family members</li> <li>Be able to break bad news</li> <li>Recognize and respond appropriately to the urgency of investigations and treatment</li> <li>Recognize the importance of cooperation between cardiologists and referring paediatricians</li> </ul>   |
| <p><b>CLINICAL PRESENTATION</b></p>   |
| <p><b>Objective:</b> To assess and manage infants and children with heart failure</p>   |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>The pathophysiology of heart failure related to pressure overload, volume overload, and impaired myocardial contractility</li> <li>The cardiac and extra-cardiac causes of heart failure in infants and children</li> <li>The clinical presentation of heart failure in different ages and identify the likely diagnosis on the basis of the timing of presentation</li> <li>The anatomy, physiology, clinical features, and natural history of conditions that cause heart failure in infants and children</li> <li>The ECG, CXR, and echocardiographic findings in cardiac disorders that present with heart failure in infants and children</li> <li>The indications, limitations, and risks of invasive and non-invasive investigations in infants and children presenting heart cardiac failure</li> </ul>   |

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| <ul style="list-style-type: none"> <li>• The angiographic and haemodynamic findings at cardiac catheterization in congenital heart disease that presents with heart failure</li> <li>• The indications, contraindications, action, and side-effects of drug treatment for cardiac failure</li> <li>• The indications and risks of catheter intervention and surgery in congenital heart disease that presents with cardiac failure</li> </ul>  |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Take a relevant history and perform an appropriate examination</li> <li>• Assess symptoms and signs of heart failure in all ages and differentiate heart failure from other causes of respiratory distress</li> <li>• Interpret ECG, CXR, and blood results and appreciate their importance and limitations in reaching a diagnosis</li> <li>• Make an accurate anatomical and physiological diagnosis by clinical information, echocardiogram, and other invasive and non-invasive investigations where necessary</li> <li>• Institute appropriate drug therapy for heart failure and monitor the effect and manage side effects</li> <li>• Optimize nutrition and manage failure to thrive caused by heart failure</li> <li>• Plan and coordinate surgery or catheter intervention where appropriate</li> <li>• Advise referring paediatricians on managing children with heart failure</li> <li>• Explain the condition of the baby, underlying diagnosis, treatment plan, and prognosis in terms understood by the parents</li> <li>• Advise on schooling and sporting activity</li> </ul> |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the concerns and anxiety of patients and family</li> <li>• Be able to break bad news</li> <li>• Recognize and respond appropriately to the urgency of investigations and treatment</li> <li>• Recognize the importance of cooperation between cardiologists and referring paediatricians</li> </ul>   |
| <p><b>CLINICAL PRESENTATION</b></p>  |
| <p><b>Objective:</b> To assess and manage infants and children with cardiac murmurs</p>  |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The causes of cardiac murmurs</li> <li>• The characteristic signs of various congenital heart defects</li> <li>• The characteristic features of an innocent murmur</li> <li>• How to interpret physical signs found on cardiovascular examination</li> </ul>   |
| <p><b>Skills</b></p>   |

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| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Obtain a relevant history and perform cardiovascular examination</li> <li>• Differentiate innocent murmur from pathological murmur on the basis of history and physical examination</li> <li>• Make a provisional diagnosis after history and physical examination</li> <li>• Refine the provisional diagnosis with additional findings from CXR and ECG</li> <li>• Perform echocardiogram to define cardiac structures and function</li> <li>• Diagnose normality with confidence and explain to parents the meaning of an innocent murmur</li> <li>• Diagnose structural heart defect and explain to parents the abnormality, plan of management, and the need for lifestyle modifications and antibiotic prophylaxis</li> </ul>  |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the concerns of parents and reassure with confidence when the findings are normal</li> <li>• Demonstrate an understanding of the need for accuracy in diagnosis</li> </ul>   |
| <p><b>CLINICAL PRESENTATION</b></p>   |
| <p><b>Objective:</b> To assess and manage children and adolescents with chest pain, palpitations, or syncope</p>  |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The cardiac and non-cardiac causes of chest pain, palpitations, and syncope in childhood</li> <li>• The clinical features that differentiate arrhythmias, vasovagal syncope, and seizures</li> <li>• The differentiating clinical features of cardiac and non-cardiac causes of chest pain in childhood</li> <li>• The indications of an echocardiogram, exercise test, Holter monitoring, cardiac-event recorder, and tilt-table test for the investigation of chest pain, palpitations, and syncope in childhood</li> </ul>   |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Make a logical provisional diagnosis on the basis of history and physical examination</li> <li>• Identify features on the 12-lead ECG that suggest a substrate for or the presence of cardiac arrhythmias, ischaemic heart disease, and ventricular hypertrophy</li> <li>• Use echocardiography to define cardiac structure and function</li> <li>• Interpret exercise test, Holter monitoring, cardiac event recorder, and tilt-table test results in the context of the history</li> <li>• Institute appropriate treatment for vasovagal syncope and arrhythmias</li> <li>• Explain the likely diagnosis and plan for further investigation</li> <li>• Refer appropriately to other specialties when a non-cardiac cause is likely</li> <li>• Provide reassurance where there is no organic cause for symptoms</li> </ul> |

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| <b>Attitudes</b>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the concerns of children, adolescents, and family members</li> <li>• Demonstrate an understanding of the importance of making an accurate diagnosis and providing an explanation of the diagnosis with confidence</li> </ul>  |
| <b>HEART DISEASE</b>   |
| <b>Objective:</b> To diagnose and manage structural congenital heart disease   |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The cardiovascular adaptation from fetal to postnatal life</li> <li>• The epidemiology, embryology, genetics, anatomy, pathophysiology, and natural history of various types of acyanotic and cyanotic congenital heart defects</li> <li>• The clinical presentation of various types of congenital heart defects</li> <li>• The sequential segmental approach to describe complex congenital heart defects</li> <li>• The different modalities of investigations including ECG, CXR, echocardiography, diagnostic cardiac catheterization, computed tomography scan, and cardiac magnetic resonance</li> <li>• The timing, indications, relative benefits, success rates, and risks of surgery and catheter intervention</li> <li>• The course of recovery after surgery and catheter intervention for different types of congenital heart defect</li> </ul>  |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Make a provisional diagnosis and discriminate between the various types of congenital heart defects on the basis of history, physical examination findings, ECG, and CXR</li> <li>• Perform echocardiogram and assist in diagnostic cardiac catheterization to define the anatomy and pathophysiology of congenital heart defects</li> <li>• Stabilize critically ill patients with severe heart failure or cyanosis</li> <li>• Plan and coordinate management and communicate when necessary with surgical, intensive care, anaesthetic, and other specialty teams</li> <li>• Explain and counsel patient and family regarding the diagnosis and immediate and long-term management plan</li> <li>• Advise patient and family on nutritional needs, appropriate levels of physical activity, participation in competitive sports, and antibiotic prophylaxis against infective endocarditis</li> <li>• Provide advice to other medical teams on the management of patients with congenital heart disease undergoing non-cardiac treatment</li> <li>• Counsel patient and family on futility of treatment and offer palliative care</li> </ul> |
| <b>Attitudes</b>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the concerns and anxiety of patients and parents</li> </ul>   |

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| <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the importance of close communication with multiple teams involved in complex patient care and the referring paediatrician who provides joint care</li> <li>• Demonstrate an understanding of that medical care of congenital heart disease is evolving and that new evidence should be integrated where appropriate when formulating the treatment plan</li> <li>• Demonstrate an understanding of our limitations and the importance of seeking assistance when needed from the team in the management of complex and emergency situations</li> </ul>  |
| <p><b>HEART DISEASE</b></p>   |
| <p><b>Objective:</b> To diagnose and manage acquired heart disease in children</p>  |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The epidemiology, pathology, pathophysiology, clinical manifestations, natural history, and prognosis of rheumatic fever, Kawasaki disease, collagen vascular disease affecting the cardiovascular system, and infective endocarditis</li> <li>• The cardiac and non-cardiac manifestations of these disorders</li> <li>• The echocardiographic features of these disorders</li> <li>• The current recommendations for investigation and treatment of acute rheumatic fever, acute and chronic Kawasaki disease, and infective endocarditis</li> <li>• The current guidelines and their rationale on endocarditis prophylaxis</li> </ul>  |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Assess the clinical features of these disorders</li> <li>• Identify cardiac and extracardiac manifestations of these disorders</li> <li>• Take a relevant history and perform an appropriate examination to make a provisional diagnosis</li> <li>• Perform echocardiogram to define coronary artery aneurysms in Kawasaki disease and characteristic echocardiographic manifestations in rheumatic heart disease and infective endocarditis</li> <li>• Arrange and interpret blood and other appropriate investigations and appreciate the importance and limitations of these investigations in reaching a diagnosis</li> <li>• Demonstrate an understanding of the indications to perform coronary angiography, computed tomography coronary angiography, cardiac magnetic imaging, and stress testing in Kawasaki disease</li> <li>• Advise on acute and long-term management of these disorders</li> <li>• Advise patient and family on the long-term sequelae and prognosis of these disorders and the need for long-term monitoring and treatment</li> </ul> |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the anxiety of parents whose child is affected by these disorders</li> <li>• Demonstrate an understanding of the importance of primary and secondary prevention in rheumatic fever</li> </ul>  |

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| <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the need to cooperate with other specialists, including rheumatologists, immunologists, and microbiologists, in the investigation and management of these disorders</li> </ul>  |
| <p><b>HEART DISEASE</b></p>  |
| <p><b>Objective:</b> To diagnose and manage cardiac tumours in children</p>  |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The pathology, presentation, natural history, and management of cardiac tumours</li> <li>• The syndromic associations of cardiac tumours</li> <li>• The potential complications of cardiac tumours including ventricular inflow and outflow obstruction, cardiac dysfunction, and arrhythmias</li> <li>• The indications and limitations of investigations in the assessment of cardiac tumours</li> </ul>   |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Obtain clues to the nature of the tumour on the basis of history and physical examination</li> <li>• Perform echocardiogram to diagnose cardiac tumours and assess their impact on haemodynamics, cardiac function, and surrounding structures</li> <li>• Plan further investigations where necessary</li> <li>• Plan and coordinate surgery where necessary</li> <li>• Explain the diagnosis, plan for further investigation, and management to patient and family</li> </ul> |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the anxiety and concerns of parents whose child is harbouring cardiac tumours</li> <li>• Demonstrate an understanding of the urgency of intervention for some cardiac tumours</li> </ul>  |
| <p><b>HEART DISEASE</b></p>  |
| <p><b>Objective:</b> To diagnose and manage myocardial disease in children</p>   |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The classifications of cardiomyopathies</li> <li>• The pathogenesis, natural history, and prognosis of cardiomyopathies, myocarditis, or inflammatory myocardial disease</li> <li>• The genetic basis of cardiomyopathies and the clinical utilities and limitations of genetic testing</li> <li>• The principles of family screening</li> </ul>   |

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| <ul style="list-style-type: none"> <li>• The role of medical therapy, implantable cardioverter defibrillators, and catheter- and surgical-based management of cardiomyopathies</li> <li>• The indications, benefits, and risks of extracorporeal membrane oxygenator support and ventricular assist device</li> <li>• The indications for heart transplantation</li> </ul>  |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Recognize the signs and symptoms of heart failure in children</li> <li>• Select, use, and interpret appropriate investigations including echocardiography, Holter study, exercise testing, cardiac magnetic resonance, computerized tomography, cardiac biomarkers, cardiac catheterization, and endomyocardial biopsy</li> <li>• Recognize acute cardiac decompensation and initiate appropriate management</li> <li>• Identify patients with cardiogenic shock and seek advice on the use of extracorporeal membrane oxygenator support or ventricular assist device</li> </ul> |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Act quickly and initiate appropriate treatment in high risk patients</li> <li>• Utilize genetic testing appropriately in patients with cardiomyopathies</li> <li>• Collaborate with heart transplant specialist and cardiac surgeon in the management of end-stage heart failure due to myocardial disease</li> </ul>  |
| <p><b>HEART DISEASE</b></p>   |
| <p><b>Objective:</b> To diagnose and manage pericardial disease in children</p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The pathogenesis, natural history, and prognosis of pericardial diseases</li> <li>• The modes of presentation of pericardial disease</li> <li>• The pathophysiology of tamponade and precautions associated with anaesthesia</li> </ul>   |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Select and interpret appropriate investigations including echocardiography and diagnostic catheterization to diagnose pericardial disease and to differentiate where necessary from restrictive cardiomyopathy</li> <li>• Diagnose and manage cardiac tamponade</li> <li>• Diagnose and manage pericardial constriction</li> <li>• Perform pericardiocentesis under supervision in selected patients</li> </ul>   |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p>   |

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| <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the urgency of impending tamponade and provide timely management</li> <li>• Collaborate with surgeons and other specialists in the management of patients with pericardial disease being infectious or chronic inflammatory in nature.</li> </ul>   |
| <p><b>PULMONARY HYPERTENSION</b></p>   |
| <p><b>Objective:</b> To recognize pulmonary hypertension in children</p>   |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The normal pulmonary vascular physiology and pulmonary vascular pathophysiology</li> <li>• The physiology and natural history of pulmonary hypertension</li> <li>• The congenital and acquired cardiac defects that can cause pulmonary hypertension</li> <li>• Indications and contraindication for repair of congenital cardiac lesions in the presence of pulmonary vascular disease</li> <li>• The indications, limitations, and risks of noninvasive and invasive investigations</li> </ul> |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Identify presenting clinical features of pulmonary hypertension</li> <li>• Interpret pertinent findings on echocardiography for patients with pulmonary hypertension</li> <li>• Initiate appropriate investigations to establish the cause of pulmonary hypertension</li> <li>• Interpret and interrogate data obtained from cardiac catheterization in patients with or suspected to have pulmonary hypertension</li> </ul>   |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Make an appropriate referral for consultation with a specialist in paediatric pulmonary hypertension</li> </ul>   |
| <p><b>CARDIAC ARRHYTHMIAS</b></p>  |
| <p><b>Objective:</b> To diagnose and manage cardiac arrhythmias in children</p>  |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The normal electrophysiology of the heart and the mechanisms of arrhythmogenesis</li> <li>• The various types of arrhythmias and the characteristic ECG findings</li> <li>• The types of structural heart defects and paediatric cardiac surgery associated with abnormal cardiac rhythm</li> <li>• The modes of presentation and clinical features of arrhythmias</li> </ul>  |



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| <ul style="list-style-type: none"> <li>• The appropriate investigations, including non-invasive and invasive cardiac event recorders, to determine the cause of symptoms of heart rhythm disease</li> <li>• The acute management of arrhythmias by pharmacologic agents, cardioversion, and temporary transvenous and transcutaneous pacing</li> <li>• The classification, mechanism of action, interactions, side effects, contraindications and clinical use of antiarrhythmic drugs in paediatric patients</li> <li>• The indications, risks, and benefits of DC cardioversion, invasive electrophysiology study, transcatheter ablation, pacemaker and implantable cardiac defibrillator placement</li> </ul>   |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Take a history in a patient with palpitations and assess whether an arrhythmia is likely</li> <li>• Investigate in children with suspected arrhythmias and in patients with arrhythmias following cardiac surgery</li> <li>• Identify the type of arrhythmia present from an event captured on ECG</li> <li>• Interpret the results from non-invasive ECG monitoring, including ambulatory monitor and cardiac event recorder, and during exercise test</li> <li>• Perform and interpret an ECG taken during an adenosine challenge and an ECG from atrial epicardial wires in the postoperative patient</li> <li>• Perform vagal manoeuvres, overdrive pacing, and DC cardioversion in the treatment of tachyarrhythmias</li> <li>• Prescribe rhythm control drugs safely</li> <li>• Manage temporary pacing, including the use of epicardial wires in the postoperative cardiac patient</li> <li>• Counsel patient and family on the diagnosis, prognosis, management plan, and exercise recommendation for common types of cardiac arrhythmia</li> </ul> |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the anxiety caused by arrhythmias to patients and their family</li> <li>• Demonstrate an understanding of the importance of patient education and that the most appropriate treatment may differ among patients</li> <li>• Involve the geneticists where there is a genetic component to the disorder</li> </ul>   |
| <p><b>CRITICAL CARE</b></p>   |
| <p><b>Objective:</b> To assess and manage critically ill children with haemodynamic compromise and children after cardiac surgery</p>   |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The physiological factors that affect cardiac output, oxygen supply, and oxygen consumption and the cardiovascular compensatory mechanisms</li> <li>• The important cardiac and non-cardiac causes of haemodynamic compromise in childhood</li> <li>• The comorbidities related to multiorgan dysfunction in children with haemodynamic compromise and children after cardiopulmonary bypass</li> </ul>   |

- The pathophysiology of cardiopulmonary bypass
- The postoperative problems associated with cardiac surgery for various types of congenital heart defect
- The pathophysiology, prevention, and management of problems after cardiac surgery including pulmonary hypertensive crisis, cardiac arrhythmias, and lymphatic disorders
- The physiology and management of superior cavopulmonary connection and Fontan circulation
- The pharmacology of inotropes, systemic vasoconstrictors and vasodilators, and pulmonary vasodilators
- The principles of extracorporeal life support

### Skills

#### Shall be able to

- Evaluate the clinical and biochemical evidence and assess the cause of low cardiac output syndrome
- Secure arterial access and peripheral and central venous access
- Interpret readings from intracardiac and intravascular pressure lines and other physiologic monitoring parameters
- Differentiate cardiogenic and non-cardiogenic causes of haemodynamic compromise
- Use transthoracic echocardiography to assess cardiac function, evaluate the results of cardiac surgery, identify pericardial and pleural effusions, and image intracardiac and intravascular thrombus
- Identify the need for evaluation by further imaging (transesophageal echocardiography, computed tomography) and cardiac catheterization to define residual lesions that require further surgical intervention
- Administer fluid and inotropes to optimize cardiac output and tissue oxygen delivery
- Manage fluid balance, electrolyte balance, and coagulation status
- Diagnose and manage rhythm abnormalities
- Prevent and manage pulmonary hypertensive crisis
- Manipulate pulmonary vascular resistance to optimize pulmonary and systemic flow in single ventricular physiology
- Manipulate systemic vascular resistance to optimize the vasomotor tone
- Assess chylothorax and arrange for appropriate investigations and treatment
- Assess multiorgan involvements and arrange for appropriate investigations and treatment
- Discuss with parents and relatives the problems and current status of the child, provide treatment plan, explain investigation results and surgical outcomes, and counsel on a realistic prognosis

### Attitudes

#### Shall

- Act quickly in response to sudden haemodynamic compromise
- Acknowledge the role and recognize the importance of communication and cooperation with intensivists, cardiac surgeons, specialists in other areas, nursing staff, palliative team members, and other allied health professionals
- Demonstrate an understanding of the need of good communication skills to discuss problems of critically ill children and postoperative issues with parents and relatives
- Empathize and deal with sympathy the concerns of parents and relatives
- Demonstrate an understanding of how to break bad news

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| <b>GENETICS AND HEART DISEASE</b>  |
| <b>Objective:</b> To diagnose and manage inherited cardiac conditions and cardiac disorders in children with genetic disorders and syndromes   |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The fundamentals of human inheritance</li> <li>• The principles of molecular genetics and genetic testing</li> <li>• The genetics of common inherited heart diseases including cardiomyopathies, inherited arrhythmia syndromes, and aortopathies</li> <li>• The molecular pathophysiology, natural history, clinical presentation of common inherited heart diseases</li> <li>• The cardiac abnormalities found in common genetic disorders</li> <li>• The prognosis of genetic syndromes and their associated cardiac disorders</li> <li>• Clinical utility and limitation of genetic testing and the principles of family screening</li> <li>• The implication of genetic findings of variants of unknown significance in the clinical setting</li> </ul> |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Take a detailed clinical and family history and develop a pedigree for disease</li> <li>• Perform a specific systemic physical examination, including the detection of non-cardiac features</li> <li>• Perform echocardiogram to diagnose associated abnormalities in cardiac structure and function</li> <li>• Interpret ECG abnormalities seen in genetic disorders with arrhythmic potential</li> <li>• Interpret and apply genetic testing results to inform diagnosis and management</li> <li>• Explain the recurrence risk in subsequent children to parents</li> <li>• Provide advice on patients with inherited cardiovascular condition undergoing non-cardiac treatments</li> </ul>  |
| <b>Attitudes</b>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the worries and concerns of the patient and family with inherited cardiac conditions and cardiac disorders in association with genetic disorders and syndromes</li> <li>• Apply genetic testing in a judicious manner when investigating inherited cardiovascular condition</li> <li>• Demonstrate an understanding of the importance of early identification of affected family members for the prevention of sudden cardiac death</li> </ul>  |

**PART III. SKILLS IN PERFORMING PROCEDURES, INTERPRETING INVESTIGATION FINDINGS AND LIFE SUPPORT**

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| <b>ELECTROCARDIOGRAPHY</b>   |
| <b>Objective:</b> To be able to perform and interpret an ECG   |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The standard lead placement for paediatric ECG recording and lead placement for dextrocardia</li> <li>• The changes in ECG waveforms with age</li> <li>• The different modalities of electrocardiographic monitoring including atrial electrogram</li> <li>• How to evaluate rhythm, hypertrophy or dilation of cardiac chambers, ischaemia, and infarction on ECG</li> <li>• How to interpret ECG on telemetry monitor and to verify the presence of arrhythmias</li> <li>• The ECG abnormalities in children with congenital and acquired heart disease</li> </ul> |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Obtain a 12-lead ECG in children and perform an atrial electrogram using epicardial pacing wires</li> <li>• Interpret ECG in relation to age-related changes</li> <li>• Diagnose cardiac arrhythmias</li> <li>• Assess and interpret pathological ECG changes associated with congenital and acquired heart disease</li> </ul>   |
| <b>AMBULATORY ELECTROCARDIOGRAM AND CARDIAC EVENT RECORDING</b>  |
| <b>Objective:</b> To be able to supervise ambulatory ECG and cardiac event recording   |
| <b>Knowledge</b>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The indications for ambulatory ECG and cardiac event recording</li> <li>• The normal range of findings on ambulatory ECG monitor</li> </ul>  |
| <b>Skills</b>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Interpret 24 hour ambulatory ECG recording</li> <li>• Interpret results of cardiac event recording</li> </ul>  |
| <b>ELECTROPHYSIOLOGY PROCEDURES AND PACEMAKERS</b>   |
| <b>Objective:</b> To be able to perform temporary pacing and acquire skills in pacemaker monitoring  |

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| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The principles of pacing and electrophysiology and cardiac anatomy relevant to pacing</li> <li>• The principles and practice of monitoring, interrogating, and programming pacemakers</li> <li>• The indications for invasive electrophysiology study</li> <li>• How to interpret information obtained from an invasive electrophysiology study</li> <li>• The indications, procedure, and complications of catheter ablation</li> <li>• The indications for pacing, anti-tachycardia device implantation, implantable loop recorder, and implantable cardioverter-defibrillator</li> </ul> |
| <b>Skills</b>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Establish vascular access for intracardiac rhythm evaluation and pacing</li> <li>• Perform temporary transvenous and transcutaneous pacing</li> <li>• Insert transesophageal pacing probe for pacing and recording</li> <li>• Perform basic pacemaker interrogation, reprogramming, and trouble-shooting for loss of capture, under or over sensing, and battery end of life</li> </ul>   |
| <b>TRANSTHORACIC ECHOCARDIOGRAPHY</b>   |
| <p><b>Objective:</b> To be able to perform echocardiography to diagnose and assess all forms of congenital heart disease and paediatric acquired heart disease</p>  |
| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The physics of echocardiography, colour Doppler, and spectral Doppler</li> <li>• The factors determining image quality and resolution</li> <li>• The function of the controls on machines used for echocardiography and Doppler</li> <li>• The echocardiographic features of various congenital heart defects</li> <li>• How to assess the physiology of shunting defects, valve stenosis and regurgitation, and ventricular function</li> <li>• The indications for contrast echocardiographic studies</li> </ul>  |
| <b>Skills</b>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Make appropriate adjustments to obtain an optimal image quality</li> <li>• Obtain appropriate echocardiographic views and report on relevant examination findings</li> <li>• Interpret the significance and reliability of the information obtained by echocardiography</li> <li>• Perform and interpret contrast echocardiographic studies</li> </ul>  |
| <b>TRANSOESOPHAGEAL ECHOCARDIOGRAPHY</b>  |

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| <p><b>Objective:</b> To be able to perform transoesophageal echocardiography to diagnose and assess congenital heart disease and paediatric acquired heart disease</p>  |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The indications for and risks of transoesophageal echocardiography</li> <li>• The echocardiographic planes to image various cardiac structures</li> <li>• The transoesophageal echocardiographic features of various congenital cardiac defects</li> </ul>  |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Perform transoesophageal echocardiography to assess congenital heart disease and acquired heart disease in children</li> <li>• Perform transoesophageal echocardiography to guide catheter interventions</li> <li>• Perform transoesophageal echocardiography to guide surgical repair</li> </ul>   |
| <p><b>CARDIAC CATHETERIZATION AND RADIATION SAFETY</b></p>  |
| <p><b>Objective:</b> To be able to understand the role of cardiac catheterization in the management of patients with congenital heart disease, use radiation equipment appropriately and safely, and interpret the results of diagnostic cardiac catheterization</p>  |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The indications, contraindications, potential complications, and limitations and risks and benefits of diagnostic and common interventional catheterization for congenital heart disease</li> <li>• The principles of more complex interventions and hybrid procedures</li> <li>• The equipment required for cardiac catheterization</li> <li>• The principles of radiation physics and angiogram acquisition and its applications in cardiac catheterization, including image intensifier angulation, radiation scattering, coning, and contrast delivery</li> <li>• The principles of radiation safety</li> </ul>   |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Obtain safe arterial and venous access</li> <li>• Assist in diagnostic catheterization and simple interventional procedures</li> <li>• Interpret clinical information and data from non-invasive investigations to decide on the necessity of catheterization and the information to be acquired from cardiac catheterization</li> <li>• Interpret the results of diagnostic cardiac catheterization including waveform, pressures, and pressure gradients, cardiac output, vascular resistance, and angiographic information</li> <li>• Provide post-catheterization care and monitoring and recognize and manage post-procedural complications</li> </ul> |

- Counsel patients and family on the indication, risk, and benefit of the catheterization procedure

## CARDIAC CT, MRI AND RADIONUCLIDE IMAGING

**Objective:** To be able to interpret the results of cardiac and thoracic CT, cardiac MRI, and radionuclide imaging to assist in the diagnosis and assessment of children with cardiac diseases and adult congenital heart disease patients

### Knowledge

#### Shall know

- The basic principles on the generation of MRI images
- The indications, contraindications, and limitations of cardiac and thoracic CT, cardiac MRI, and radionuclide imaging
- The indications and contraindications of stress cardiac MRI and stress radionuclide imaging
- The safety measures for patients and staff in the MRI suite

### Skills

#### Shall be able to

- Explain the basic principles on the generation of MRI images
- Interpret basic cardiac CT and cardiac MRI images
- Interpret the functional parameters obtained from cardiac MRI and radionuclide imaging
- Integrate the imaging information in clinical decision making

## EXERCISE STRESS TESTING

**Objective:** To be able to supervise and interpret exercise test in children

### Knowledge

#### Shall know

- The indications, contraindications, and limitations of exercise testing in children
- The physiology of the cardiovascular response to exercise
- The normal heart rate and blood pressure response to exercise
- The methodology of a treadmill and cycle ergometry test

### Skills

#### Shall be able to

- Supervise an exercise test and obtain exercise data
- Assess the quality of exercise data with an awareness of ECG artefacts
- Interpret changes in heart rate, blood pressure and oxygen saturation during an exercise test
- Interpret changes in the ECG during an exercise test
- Interpret cardiopulmonary exercise test parameters in patients with congenital heart disease
- Report an exercise test in the clinical context and make appropriate recommendations

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| <b>TILT TABLE TESTING</b>   |
| <b>Objective:</b> To be able to supervise and interpret tilt table tests in evaluating patients with syncope  |
| <b>Knowledge</b>  |
| <p><b>Shall know:</b></p> <ul style="list-style-type: none"> <li>• The physiological principles of tilt table testing</li> <li>• The indications and limitations of tilt table testing</li> <li>• The methodology of tilt table testing</li> <li>• The sensitivity and specificity of a tilt table test</li> <li>• The limitations of tilt-table testing</li> </ul> |
| <b>Skills</b>   |
| <p><b>Be able to:</b></p> <ul style="list-style-type: none"> <li>• Supervise a tilt table test</li> <li>• Resuscitate a child during a tilt table test</li> <li>• Interpret the results of a tilt table test</li> </ul>   |
| <b>BALLOON ATRIAL SEPTOSTOMY</b>  |
| <b>Objective:</b> To assist and to perform balloon atrial septostomy  |
| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The indications for balloon atrial septostomy</li> <li>• The techniques for performing balloon atrial septostomy</li> <li>• The risks and complications of balloon atrial septostomy</li> </ul>   |
| <b>Skills</b>   |
| <p><b>Be able to</b></p> <ul style="list-style-type: none"> <li>• Explain the benefits and risks of the procedure to parents</li> <li>• Perform transthoracic echocardiography to guide the procedure</li> <li>• Perform balloon septostomy via the femoral or umbilical vein</li> <li>• Supervise the care of an infant following the procedure</li> </ul>         |
| <b>PERICARDIOCENTESIS</b>   |
| <b>Objective:</b> To perform pericardiocentesis safely  |



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| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The indications and contraindications for pericardiocentesis</li> <li>• The techniques for performing pericardiocentesis safely and effectively</li> <li>• The risks and complications of pericardiocentesis</li> <li>• The choice of percutaneous versus surgical drainage of pericardial fluid</li> </ul>   |
| <b>Skills</b>   |
| <p><b>Be able to</b></p> <ul style="list-style-type: none"> <li>• Explain the benefits and risks of the procedure to patient and parents</li> <li>• Decide on the timing of and the approach to performing pericardiocentesis</li> <li>• Perform transthoracic echocardiography to guide the procedure</li> <li>• Perform pericardiocentesis safely with placement of a drain</li> </ul>  |
| <b>LIFE SUPPORT</b>   |
| <p><b>Objective:</b> To be able to provide advanced paediatric life support and supervise resuscitation of paediatric patients</p>  |
| <b>Knowledge</b>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The cardiac and non-cardiac causes of cardiac arrest</li> <li>• The principles and practice of paediatric advanced life support</li> <li>• The current guidelines on resuscitation</li> <li>• The role and responsibilities of the team leader and each team member during a resuscitation</li> <li>• The limits of cardiopulmonary resuscitation</li> <li>• The scenarios when cardiopulmonary resuscitation should not be initiated or needs to be discontinued</li> <li>• local guidelines on Do-Not-Attempt Cardiopulmonary Resuscitation (DNACPR)</li> </ul> |
| <b>Skills</b>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Assess critically ill patients</li> <li>• Call for assistance where necessary</li> <li>• Initiate, perform, and supervise basic and advanced life support with effective communication and delegation</li> <li>• Establish vascular access in an emergency</li> <li>• Diagnose cardiac arrhythmias</li> <li>• Perform endotracheal intubation, cardioversion, and cardiac defibrillation</li> <li>• Initiate post-resuscitation treatment</li> <li>• Explain the consequences of DNACPR orders to family with compassion</li> </ul>                         |

## PART IV. EXPOSURE TO SUBSPECIALIST AREAS IN PAEDIATRIC CARDIOLOGY

Parts I to III constitute the core curriculum for the training of specialists in paediatric cardiology. Some specialists in paediatric cardiology may wish to subspecialize in one of the following areas: advanced echocardiography, cardiac MRI and CT imaging, catheter interventions, cardiac pacing and electrophysiology, fetal cardiology, adult congenital heart disease, pulmonary hypertension, and advanced heart failure and heart transplantation. It is envisaged that an additional training period of 2 years will usually be necessary. Exposure to these subspecialist areas under supervision during the first 3 years of specialist training, while optional, is strongly recommended.

| <b>ADVANCED ECHOCARDIOGRAPHY</b>   |
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| <b>Objective:</b> To be able to use advanced echocardiographic techniques to assess cardiac morphology and function  |
| <b>Knowledge</b>   |
| <b>Shall know</b> <ul style="list-style-type: none"><li>• The use of advanced echocardiographic techniques in the imaging of the full spectrum of congenital heart disease and paediatric acquired heart disease</li><li>• The physics of ultrasound and principles of advanced echocardiographic techniques</li><li>• The application, strengths, limitations, and contraindications of the various advanced echocardiographic techniques</li><li>• Interpretation and reporting of findings using advanced echocardiographic techniques</li></ul>  |
| <b>Skills</b>  |
| <b>Shall be able to</b> <ul style="list-style-type: none"><li>• Perform advanced echo imaging including tissue Doppler, strain imaging, three-dimensional echocardiography, assessment of dyssynchrony</li><li>• Perform and report transthoracic and transoesophageal echocardiography independently across the full spectrum of congenital heart disease and paediatric acquired heart disease</li><li>• Perform transoesophageal echocardiography to guide catheter interventions and surgical repair</li><li>• Perform transoesophageal echocardiography and epicardial imaging to guide surgical repair</li><li>• Interpret, report and present imaging and quantification data in the context of the indications for further investigations or treatment</li></ul> |
| <b>FETAL CARDIOLOGY</b>  |
| <b>Objective:</b> To diagnose and manage heart disease and cardiac arrhythmias in fetal life   |
| <b>Knowledge</b>   |
| <b>Shall know</b> <ul style="list-style-type: none"><li>• The normal fetal cardiac anatomy and physiology</li><li>• The risk factors for congenital heart disease</li></ul>  |

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| <ul style="list-style-type: none"> <li>• The indications for referral to fetal cardiology and the appropriate timing of fetal echocardiography</li> <li>• The associations between fetal cardiac abnormalities and genetic disorders and syndromes</li> <li>• How the natural history of congenital heart defects may differ in the fetal compared with postnatal period</li> <li>• The risks and natural history of fetal arrhythmias</li> <li>• The drugs used to treat fetal arrhythmias and their safe use in pregnancy</li> <li>• The postnatal management and outcomes of various fetal cardiac conditions</li> <li>• The limitations of fetal echocardiography</li> <li>• The legal framework for termination of pregnancy</li> </ul>   |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Determine appropriate referral for fetal cardiac assessment</li> <li>• Advise parents of the timing and limitations of antenatal diagnosis</li> <li>• Perform echocardiographic assessment of fetal cardiac diseases and arrhythmias</li> <li>• Refer for genetic assessment where necessary</li> <li>• Interpret the significance of fetal karyotype results and genetic analysis</li> <li>• Provide evidence-based counselling with clear explanation of diagnosis, management, and pregnancy options for patients with prenatal diagnosis of cardiac diseases and arrhythmias</li> <li>• Formulate plans for delivery and immediate postnatal care of babies with prenatal diagnosis of congenital heart defects and other heart diseases and fetal arrhythmias in collaboration with obstetricians, maternal-fetal medicine specialists, and neonatologists</li> </ul> |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the anxiety and concerns and other psychological impact on parents and their difficulties in decision making when presented with a fetal diagnosis of cardiac abnormality</li> <li>• Demonstrate an understanding of the impact of fetal cardiac abnormality on the fetus and parents</li> <li>• Demonstrate an understanding of the autonomy of decision of parents on continuation of pregnancy</li> <li>• Demonstrate an understanding of the importance of ongoing support during the pregnancy and detailed discussions to explain the diagnosis and prognosis</li> <li>• Demonstrate an understanding of the need for close communication with the obstetric and neonatology teams</li> </ul>   |
| <p><b>ADULT CONGENITAL HEART DISEASE</b></p>   |
| <p><b>Objective:</b> To apply knowledge on congenital heart disease for the transitional care and care of adults with congenital heart disease</p>   |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The natural history of congenital heart disease</li> </ul>   |

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| <ul style="list-style-type: none"> <li>• The unnatural history of congenital heart disease after surgery and catheter intervention</li> <li>• The common cardiac and non-cardiac medical problems in adult congenital heart disease and their treatment</li> <li>• The implications of congenital heart disease on medical and other aspects including education, employment, physical activities, lifestyle modifications, and travel on the patients</li> <li>• The evidence-based and guideline-directed management of grown-up congenital heart diseases</li> <li>• The psychosocial issues of adults with congenital heart and the importance of transition care</li> </ul>  |
| <p><b>Skills</b></p>  |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Take a relevant history and perform an examination</li> <li>• Perform echocardiography to define cardiac structure and function and physiology of grown-up congenital heart disease</li> <li>• Arrange where necessary and interpret investigations including ECG, echocardiography, computerized tomography, cardiac magnetic resonance imaging, Holter study, Treadmill exercise test, and cardiopulmonary exercise test</li> <li>• Arrange transition care from paediatric to adult congenital heart service</li> <li>• Manage grown-up patients with congenital heart disease based on evidence and guidelines where available</li> <li>• Counsel patients on the diagnosis, treatment plan, prognosis, endocarditis prophylaxis, exercise, life-style issues, employment, contraception, and pregnancy</li> <li>• Explore and refer where appropriate for potential psycho-social issues</li> <li>• Identify grown-up congenital heart patients who would benefit from the cardiac transplantation service and supportive and palliative care</li> </ul> |
| <p><b>Attitudes</b></p>   |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate an understanding of the life-span perspective of congenital heart disease</li> <li>• Demonstrate an understanding of the role of various specialties in the comprehensive care of grown-up congenital heart disease</li> <li>• Demonstrate an understanding of the need to liaise with adult congenital heart disease specialists, adult cardiologists, and cardiothoracic surgeons to provide seamless follow-up care and management</li> <li>• Demonstrate an understanding of the need to cooperate with obstetricians and obstetric anaesthetists to provide care of pregnant patients with congenital heart disease</li> </ul>  |
| <p><b>ADVANCED MANAGEMENT OF PULMONARY HYPERTENSION</b></p>   |
| <p><b>Objective:</b> To diagnose and manage pulmonary hypertension in children</p>  |
| <p><b>Knowledge</b></p>   |
| <p><b>Shall know</b></p>  |

|  |
|--|
| <ul style="list-style-type: none"> <li>• The indications, limitations, and risks of noninvasive and invasive investigations including cardiac catheterization and vasodilator testing</li> <li>• The indications, mechanisms of action, administration, and adverse effects of the medications used to treat pulmonary arterial hypertension</li> <li>• The indications, risks, benefits, and outcomes of lung or heart lung transplantation</li> <li>• The clinical utility and limitations of genetic testing in patients with pulmonary hypertension and the principles of family screening</li> </ul>  |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>• Risk stratify patients with pulmonary hypertension</li> <li>• Interpret and interrogate data obtained from cardiac catheterization in patients with or suspected to have pulmonary hypertension</li> <li>• Initiate appropriate management of children with pulmonary hypertension during acute presentation</li> <li>• Prescribe medications for treatment of pulmonary arterial hypertension</li> <li>• Identify patients for referral to tertiary pulmonary hypertension centres and for lung or heart-lung transplant</li> <li>• Provide advice on patients with pulmonary hypertension undergoing non-cardiac procedures</li> </ul>   |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>• Demonstrate skills to counsel families regarding the care of the child with pulmonary hypertension</li> <li>• Demonstrate support of patients transiting from paediatric to adult pulmonary hypertension service</li> </ul>   |
| <p><b>ADVANCED HEART FAILURE</b></p>   |
| <p><b>Objective:</b> To manage children and adolescents with advanced heart failure</p>  |
| <p><b>Knowledge</b></p>  |
| <p><b>Shall know</b></p> <ul style="list-style-type: none"> <li>• The haemodynamics of systolic and diastolic heart failure of the left and right ventricles</li> <li>• The indications, risks, and benefits of cardiac catheterization and endomyocardial biopsy in the evaluation of children or adolescents with advanced heart failure</li> <li>• How to evaluate pulmonary vascular resistance in heart failure patients</li> <li>• The mechanisms, indications for use, and side effects of pharmacologic agents used to treat advanced heart failure</li> <li>• The role of extracorporeal membrane oxygenation, ventricular assist device, and transplantation in the treatment of advanced heart failure</li> <li>• The indications and contraindications for heart transplantation</li> <li>• The outcomes of heart transplantation, including mortality and major morbidities</li> <li>• The common adverse events and drug interactions associated with immunosuppressive medications used in heart transplant patients</li> </ul> |

|  |
|--|
| <ul style="list-style-type: none"> <li>The role of palliative care in the management of advanced heart failure</li> </ul>  |
| <p><b>Skills</b></p>   |
| <p><b>Shall be able to</b></p> <ul style="list-style-type: none"> <li>Evaluate and provide initial treatment for paediatric patients with heart failure of various etiologies</li> <li>Establish an accurate diagnosis for the child with advanced heart failure utilizing appropriate investigations, including imaging, genetic evaluation, metabolic assessment, cardiac catheterization and endomyocardial biopsy</li> <li>Interpret the results of arrhythmia testing, exercise testing, biomarker levels, non-invasive imaging, and cardiac catheterization to plan treatment</li> <li>Safely prescribe first-line medical therapy including diuretics, angiotensin-converting enzyme inhibitors and inotropic agents for patients with heart failure</li> <li>Institute medical treatment including but not limited to lusitropic agents, antiarrhythmics, anticoagulation, angiotensin receptor-neprilysin inhibitor and beta-blockers in children or adolescents with advanced heart failure</li> <li>Diagnose acute cardiac decompensation and initiate appropriate management</li> <li>Identify patients with and advise on the use of extracorporeal membrane oxygenator support and ventricular assist device in advanced heart failure</li> <li>Assess and initiate investigation and treatment for post-transplant rejection</li> <li>Provide evidence-based counselling with a clear explanation of diagnosis and management options to the patients and family</li> </ul> |
| <p><b>Attitudes</b></p>  |
| <p><b>Shall</b></p> <ul style="list-style-type: none"> <li>Demonstrate an understanding of the worries and concerns of the patient and family</li> <li>Demonstrate an understanding of the need to apply emerging evidence for patient management</li> </ul>   |

### 3.3 Teaching and Learning Methods

The curriculum will be delivered through work-based experiential learning, postgraduate teaching, self-directed learning, and participation in relevant courses and paediatric cardiology meetings.

| Work-based experiential learning                |  |
|---|--|
| <p>Outpatient paediatric cardiology clinics</p> | <ul style="list-style-type: none"> <li>To act on the letter of referral to the clinic</li> <li>To differentiate significant and insignificant cardiac presentations</li> <li>To assess and manage the underlying cardiac abnormality or reassure patients and parents in the presence of normal cardiac findings</li> <li>To understand the management of congenital and paediatric acquired heart disease and cardiac arrhythmias</li> <li>To propose investigations and management plan</li> </ul> |

|   |  |
|---|--|
|   | <ul style="list-style-type: none"> <li>• To communicate with the patient and family and other health care professionals</li> <li>• To review patients with consultants and to obtain immediate feedback</li> </ul>   |
| Ward round and consultations  | <ul style="list-style-type: none"> <li>• To learn from the evolution of problems of inpatients with daily review</li> <li>• To learn to liaise with colleagues from other specialties on patient management</li> <li>• To learn by seeing consultations referred from colleagues from other specialties</li> <li>• To learn clinical management, reasoning, and decision-making skills from senior doctors and to obtain immediate feedback</li> </ul> |
| Noninvasive cardiac laboratory and cardiac catheterization laboratory | <ul style="list-style-type: none"> <li>• To acquire procedural skills through observation and eventually assuming the role of an independent primary operator</li> <li>• To learn to interpret and report the findings of noninvasive cardiac investigations and cardiac catheterization</li> </ul>  |
| Multidisciplinary meeting   | <ul style="list-style-type: none"> <li>• To present and to participate in discussion</li> <li>• To learn to discuss clinical problems and the skills of clinical reasoning and decision making</li> </ul>  |
| <b>Postgraduate teaching</b>  |  |
| Clinical  | <ul style="list-style-type: none"> <li>• To participate in case presentations</li> <li>• To attend lectures, webinars, and clinical skills demonstrations</li> <li>• To present in grand rounds, journal club, and critical appraisal of literature</li> </ul>   |
| Research  | <ul style="list-style-type: none"> <li>• To participate in clinical research studies in paediatric cardiology</li> <li>• To perform audit and quality improvement projects</li> </ul>  |
| <b>Self-directed learning</b>   |  |
| Activities  | <ul style="list-style-type: none"> <li>• To study web-based materials</li> <li>• To establish a habit of regular reading of journal articles</li> <li>• To maintain a personal portfolio</li> </ul>  |
| <b>Participation in meetings and courses</b>                          |  |
| Activities  | <ul style="list-style-type: none"> <li>• To attend paediatric cardiology and other relevant conferences</li> <li>• To participate in management, leadership, communication courses</li> </ul>  |

### 3.4. Standards for the accreditation of Paediatric Cardiology Training Centre and Networking Units

The paediatric cardiology centre and training networking units shall be accredited based on the spectrum of paediatric cardiac training activities that can be offered, case load, case complexity support from related specialties, education research opportunities, and availability of trainers.

|                                      | Centre                 | Networking Unit   |
|--------------------------------------|------------------------|---|
| Type of training offered             |                        |   |
|                                      | Comprehensive training | Acute admission, inpatients, cardiac outpatient clinics, echocardiography, non-invasive cardiac testing |
| Case load                            |                        |   |
| Inpatient (including consultation)   | >500                   | >100  |
| Outpatient                           | >2500                  | >750  |
| Surgery                              | >150                   | –   |
| Catheterization                      | >150                   | –   |
| Echocardiography                     | >3000                  | >500  |
| Non-invasive testing:                |                        |   |
| Holter                               | >200                   | >20   |
| Treadmill test (including CPX)       | >100                   | >20   |
| Case complexity*                     |                        |   |
| Complex (%)                          | 20                     | 0-5   |
| Intermediate (%)                     | 30                     | 20-25   |
| Simple (%)                           | 50                     | 70-80   |
| Support from related specialties     |                        |   |
| Cardiothoracic surgery               | Y                      | N   |
| Cardiac anaesthesia                  | Y                      | N   |
| Radiology                            | Y                      | Y   |
| Intensive care                       | Y                      | Y   |
| Education and research opportunities |                        |   |
| Multidisciplinary meetings           | Y                      | N   |
| Education activities                 | Y                      | Y   |



|                        |   |     |
|------------------------|---|-----|
| Research opportunities | Y | Y   |
| Trainer                |   |     |
| Number                 | 2 | 1-2 |

**\*Definition of case complexity**

***i) Complex***

Paediatric structural cardiac malformations, acquired heart disease, cardiomyopathies, and arrhythmias that require extensive and special diagnostic workup, close monitoring, multidisciplinary management (including but not limited to advanced medical therapies, surgical and catheter interventions, device therapy), and possible cardiac intensive care support.

***Examples include***

*Congenital heart disease:* all forms of cyanotic congenital heart disease, acyanotic congenital heart disease requiring interventions

*Acquired heart disease:* Kawasaki disease with giant coronary aneurysms, Marfan syndrome with significant dilation of aortic root

*Myocarditis and cardiomyopathies:* fulminant myocarditis, all types of cardiomyopathies

*Heart rhythm disorders:* channelopathies: LQTS, CPVT, Brugada syndrome, complete heart block, post pacemaker implantation, post ICD implantation

*Advanced heart failure:* end-stage heart failure conditions requiring advanced medical therapies, mechanical circulatory support, and heart transplantation

***ii) Intermediate***

Paediatric structural cardiac malformations, acquired heart disease, and arrhythmias that require detailed cardiac workup, periodic review, and can be cared jointly between specialist in paediatric cardiology and general paediatricians with interests in paediatric cardiology.

***Examples include***

*Congenital heart disease:* moderate-sized left-to-right shunts, moderate degree of left or right ventricular outflow obstructive lesions, post surgical repair of simple congenital heart conditions.

*Acquired heart disease:* Kawasaki disease with small coronary artery aneurysm, Marfan syndrome with moderately dilated aortic root, cardiac dysfunction post chemotherapy and in association with neuromuscular and metabolic disorders, pericarditis

*Heart rhythm disorders:* frequent premature ventricular contractions, isolated Wenckebach 2<sup>nd</sup> degree AV block, WPW syndrome, supraventricular tachycardia, ventricular tachycardia (idiopathic)

***iii) Simple***

Paediatric structural cardiac malformations, acquired heart disease, arrhythmias, and common paediatric cardiac presenting complaints that require only standard diagnostic evaluation, straightforward in terms of management, infrequent follow-up, and no anticipated invasive interventions.

***Examples include***

*Congenital heart disease:* small left-to-right shunts, mild valvar pulmonary or aortic stenosis, mild mitral valve incompetence, repaired left-to-right shunts without residua

*Acquired heart disease:* Kawasaki disease with no coronary artery aneurysm, Marfan syndrome with normal or mildly dilated aortic root, mild mitral valve prolapse

*Heart rhythm disorders:* isolated premature atrial contraction, isolated infrequent premature ventricular contraction, isolated prolonged PR interval, isolated Wenckebach 2<sup>nd</sup> degree AV block

*Common paediatric cardiac complaints:* chest pain, palpitations

## **4. Paediatric Cardiology Subspecialty Board, Training Program Director, and Trainers**

### **4.1 Paediatric Cardiology Subspecialty Board**

The Subspecialty Board of Paediatric Cardiology is under the supervision of the Director of Subspecialty Board and its operations are subjected to the approval by Council of the Hong Kong College of Paediatricians.

The Subspecialty Board of Paediatric Cardiology shall include 6 Fellows of the College for the first 3 years, and 5 Fellows thereafter:

- 5 Fellows in Paediatric Cardiology will be elected from the University, Hospital Authority, and the private sector
- 1 Fellow will be appointed by Council in the first 3 years of its operation
- the Chairman of the Subspecialty Board of Paediatric Cardiology will be elected by the Subspecialty Board members and appointed by Council
- No more than 2 co-opted members may be appointed if necessary for specific purposes, with endorsement from the Committee for Subspecialty Boards and the Council

The Subspecialty Board of Paediatric Cardiology is responsible for:

- setting the accreditation guidelines for the training programme in Paediatric Cardiology
- accreditation of the subspecialty programme in Paediatric Cardiology
- setting the criteria for accreditation of training modules within the training programme
- accreditation of an institution for the duration and type of paediatric cardiology training allowed by the Subspecialty Board
- accreditation of Training Programme Director and Trainers of the subspecialty of Paediatric Cardiology
- ensuring a high standard of practice in paediatric cardiology comparable to that in centres overseas by arranging peer review of proposed Subspecialty Training Programme
- appointment of examiners and organization of subspecialty board examinations
- the administration, organization and validation of continuing medical education / continuing professional development (CME/CPD) that must be fulfilled by all Fellows in Paediatric Cardiology within the CME requirement for paediatrics of the Hong Kong College of Paediatricians

### **4.2 Paediatric Cardiology Training Program Director**

The Programme Director of Paediatric Cardiology should

- be a First or an accredited Fellow in Paediatric Cardiology of the Hong Kong College of Paediatricians
- have 10 years of experience of good practice excluding the training period in Paediatric Cardiology in an accredited institution
- be actively involved in teaching as evidenced by teaching of postgraduates in Paediatric Cardiology
- be actively participating in clinical audit and establishment of management guidelines
- be active in research with track record in scientific publications

- participate and fulfill the continuing medical education / continuing professional development requirement of Paediatric Cardiology
- have local, regional or international standing in Paediatric Cardiology as evidenced by membership of learned societies, invitations for lectures and participation in regional and international meetings/organizations
- be in full-time employment in an accredited institution and spend more than 50% of his / her activity in the practice of Paediatric Cardiology
- be re-accredited once every 5 years

#### **4.3 Paediatric Cardiology Trainer**

The Subspecialty Trainer should

- be a first or an accredited Fellow in Paediatric Cardiology of the Hong Kong College of Paediatricians
- have 3 years of experience of good practice excluding the training period in Paediatric Cardiology in an accredited institution (this rule being exempted in the first 3 years after the establishment of the subspecialty of Paediatric Cardiology)
- be actively involved in teaching, research and clinical service of Paediatric Cardiology
- participate and fulfill the continuing medical education / continuing professional development requirement of Paediatric Cardiology
- supervise no more than two trainees either in the Subspecialty Training Programme or in the Higher Training Programme in Paediatrics at any one time
- be in full-time employment in an accredited institution and spend more than 50% of his / her activity in the practice of Paediatric Cardiology
- be re-accredited once every 5 years

## 5. Assessment

### 5.1 Continuous assessment

The trainee shall keep a logbook of clinical activities, procedures performed, teaching experience, research activities, attendance of training course and/or conference, and problems encountered during the period of training. Appendix I provides the checklist of the procedures expected to have been acquired by the trainee before completion of training. The trainee should attend and provide evidence of attendance at local, regional and/or international paediatric cardiology meetings or training courses at least once per year. At least 2 oral or poster presentations at meetings are required during the 3-year training period.

The trainer shall conduct a regular 3-monthly review of the trainee to ensure satisfactory progress, identify issues, and provide feedback and counseling where necessary. The trainer shall complete, after each review, an assessment form and discuss the outcome of assessment with the trainee. Formative assessments shall be performed every half-yearly by the trainer using the following tools: i) directly observed procedural skills, ii) case-based discussion, and iii) mini clinical evaluation exercise. The Programme Director shall conduct a regular 6-monthly review of the progress of the trainee through review of the logbook of the trainee and assessment forms submitted by the trainer. A rating of less than satisfactory in any aspect of the assessment will necessitate a meeting with the trainee for identification of issues pertaining to training and suggestions for improvement. The overall performance of each subspecialty trainee shall be reviewed on an annual basis by the Subspecialty Board through assessment of the training logbook and feedback from subspecialty trainers and Programme Director.

### 5.2 Final Exit Assessment

The final exit assessment will take place once every year. The trainee must submit 2 dissertations on topics related to paediatric cardiology and attend a viva examination.

The 2 dissertations shall include at least 1 research study, and at least 1 should have been accepted for publication in a local or international journal upon completion of subspecialty training. The trainee shall be the first author of these 2 dissertations, which should not overlap with the dissertations submitted for the general paediatric exit assessment.

The trainee shall be invited to attend a viva examination conducted by an Assessment Panel. The Assessment Panel, which comprises 3 assessors (3 local or 2 local with 1 external assessors), shall be appointed by the Paediatric Cardiology Subspecialty Board. The viva examination is in the format of a structured oral examination that aims to assess the clinical competence in different aspects of paediatric cardiology. The trainee shall also be prepared to discuss the 2 dissertations in detail during the viva examination.

Trainees who pass the Exit Assessment will be invited to apply for College Subspecialty Fellowship. If the trainee fails the Exit Assessment, the Assessment Panel will recommend subsequent actions for consideration by the Paediatric Cardiology Subspecialty Board and the Committee for Subspecialty Board of the Hong Kong College of Paediatricians.

## Appendix I

Checklist on all special procedures required for paediatric cardiology

| Procedure   | Minimum Number   |
|---|--|
| <b>Imaging-related</b>  |  |
| Transthoracic echocardiogram  | 500 (at least 400 in neonates, infants, children, and adolescents with the full spectrum of cardiac pathologies) |
| Transesophageal echocardiogram  | 30   |
| Fetal echocardiogram (observation on echocardiographic evaluation and counselling)  | 5  |
| <b>Catheter-related</b>   |  |
| Cardiac catheterization (as assistant or supervised primary operator with supplementary training on interpretation of haemodynamics using paper cases and angiograms) | 50   |
| Balloon atrioseptostomy (with video demonstration where necessary)  | 2  |
| <b>Electrophysiology-related</b>  |  |
| Electrophysiologic studies and ablation procedure (observation)   | 5  |
| Implantation of pacemaker/ implantable cardioverter-defibrillator / implantable loop recorder (observation)   | 2  |
| Pacemaker interrogate and testing   | 5  |
| Holter monitor  | 50   |
| ECG-atrial/ventricular electrogram using temporary pacing wires   | 5  |
| <b>Exercise test</b>  |  |
| Treadmill   | 50 (including at least 20 cardiopulmonary exercise test)   |
| Cardiopulmonary exercise test   | 20   |
| <b>Others</b>   |  |
| Pericardial aspiration (as assistant or supervised primary operator, with simulation where necessary)   | 2  |